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INECO

Institutional and Economic Instruments for Sustainable Water Management in the Mediterranean Region

Coordination Action

DELIVERABLE NO 11

STAKEHOLDER ASSEMBLY WORKSHOP PROCEEDINGS

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Contents

Preface

Deliverable 11 of the INECO Project ("Institutional and Economic Instruments for Sustainable Water Management in the Mediterranean Region" – Contract No: INCO-CT-2006-517673) comprises the Proceedings of the Project's Stakeholder Assembly Workshop, which was organized within the framework of WP 8 of the project.

The Workpackage involved the organization of a Joint Event, with the participation of stakeholders from all the INECO Case Studies. The event was oriented towards the presentation of outcomes from the Regional Analyses undertaken within the framework of WP 7 of INECO, on the "Analysis of economic and institutional instruments with emphasis on effectiveness and equity". In this regard, work undertaken within the framework of WP 8 was aimed at:

- Presenting the results from the analysis of cost recovery mechanisms
- Evaluating the social aspect of the cost recovery principle, including gender
- Discussing transparency mechanisms regarding cost allocation and estimation
- Establishing a participatory process for the exchange of views on the already analysed arrangements and proposed economic instruments

In the above context, the Stakeholder Assembly Workshop which was held in Tunis on July 15th-16th 2008, was aimed at addressing the following specific objectives:

- Presentation and evaluation of the outcomes of the INECO Regional Analyses on the applicability of institutional and economic instruments;
- Sharing, exchange and integration of experience associated with the application of solutions across the Mediterranean Basin;
- Assessment the corresponding economic, environmental and social trade-offs; and
- Development of recommendations for enabling the effective implementation of proposed instruments.

The event was attended by a total of 35 participants, 16 of which were stakeholders from the INECO Case Study regions.

This document, which was compiled by the International Office for Water (IOW), is based on the individual contributions (presentations) of workshop participants and on the transcript of workshop discussions. It is structured in three Chapters:

- Chapter 1 includes a description of the context, background and objectives of the Assembly event.
- Chapter 2 describes the implementation of the INECO Stakeholder Assembly Workshop, providing the overview and the minutes of the event.
- Chapter 3 is the Proceedings of the Workshop, including all presentations made by workshop participants.

1 Introduction

The INECO Stakeholder Assembly Workshop was organized in Tunis, Tunisia on July 15th-16th 2008, within the framework of WP 8 of the INECO Project. The event was primarily aimed at fostering the discussion on innovative approaches among stakeholders from all the INECO Regions for the mitigation of water management problems encountered in the Mediterranean Basin.

In accordance with the overall scope of INECO, during the Stakeholder Assembly Workshop discussions evolved on potential soft-path approaches that need to complement other (mostly technical) initiatives and options for problem mitigation. Emphasis was given on economic instruments, to provide incentives towards environmentally responsible behaviour, but also to the institutional prerequisites and administrative procedures that would enable their effective implementation.

Towards this end, during the event all INECO Regional Partners presented the progress of their individual Case Studies, also outlining the current institutional framework for water management, the barriers and inefficiencies that this framework imposes, as well as the current efforts undertaken at national, regional and local level for improving the efficiency of the water sector. In an effort to allow the sharing of experience, special attention was given to the analysis of economic instruments already in place and to the barriers that inhibit their effective implementation. Additionally, and within the overall Case Study development process, which is based on stakeholder participation, Regional Partners also presented the outcomes of the participation initiatives undertaken thus far, and the results of the second year, concerning the definition of objectives and the preliminary screening of alternative approaches in terms of individual preference, present and future applicability, and relevance to the analysed focal problem.

This document is the Proceedings of the INECO Stakeholder Assembly Workshop and is structured in the following way:

- Section 1.1 provides a brief overview of the INECO Regional Stakeholder Workshops, which preceded the Stakeholder Assembly Workshop, in terms of consolidating the collaboration between the INECO team and local stakeholders and initiating the discussion on alternative responses for addressing water management issues considered significant in the local (Case Study) context;
- Section 1.2 presents the context and background of the INECO Stakeholder Assembly Workshop.
- Chapter 2 describes the implementation of the INECO Stakeholder Assembly Workshop. More specifically, Section 2.1 provides the overview of the event, whereas Section 2.2 includes the workshop minutes.
- Chapter 3 is the Proceedings of the Workshop, including all presentations made by workshop participants.

Finally, the Annexes to this document include: (a) the workshop participants (Annex 1), and the workshop flier and poster (Annex 2).

1.1 The INECO Regional Stakeholder Workshops

As mentioned above, the INECO Stakeholder Assembly Workshop followed from a series of individual Regional Workshops held in each Case Study Region from July 2007 and up to March 2008. These events constituted an important milestone in the overall effort promoted by INECO to foster constructive stakeholder engagement, to develop joint action and reach consensus for the mitigation of water management issues considered important at local level.

The theme of each event was directly related to the scope of each INECO Case Study, as follows:

- Water pollution in the Seybouse River Basin (Algeria);
- Increasing vulnerability of groundwater bodies (Cyprus);
- Water quality deterioration in the region of Bahr Basandeila Canal (Egypt);
- Water stress in the Damour River Basin (Lebanon)
- Inefficient irrigation water use in the Oum Er Rbia River Basin (Morocco)
- Water pollution in the Barada River Basin (Greater Damascus Area) (Syria)
- Groundwater degradation (Tunisia)

In a broader context, the workshops aimed to strengthen the alliance between the INECO Research Team and Local Stakeholders by:

- Discussing on the focal water management problem experienced in each region;
- Promoting the development of a process where each contributor gains both a better understanding of the problem and insight on how other participants see the problem;
- Initiating the participatory involvement of stakeholders in determining, defining and evaluating alternative institutional and economic instruments towards problem mitigation.

Furthermore, the workshops served as a discussion forum on the problems and challenges faced by stakeholders, and offered the opportunity for participants to share their experiences, knowledge, ideas, preferences, hopes, fears, opinions, and values.

The INECO Regional Stakeholder Workshops

1.2 Background and context of the INECO Stakeholder Assembly Workshop

Following from these individual regional events, the participatory approach was fostered through individual consultation meetings, local events, conference sessions and workshops. All these subsequent events were aimed at exploring perceptions and sharing views on instruments that can be effective in mitigating the focal problem of each Case Study.

Additionally, potential policy approaches were discussed and evaluated in terms of:

- Individual stakeholder preference with regard to the suggested options;
- Relevance for addressing immediate water management challenges and opportunities;
- Relevance and feasibility to address the water management issue at hand;
- Need for immediate (or more effective) implementation;
- Relevance to future water management policies and operations;
- Broader applicability of the suggested approach.

Furthermore during these events and individual consultations, currently applied economic and institutional options were discussed within an effort to assess their effectiveness, barriers that inhibit their effective implementation, and wider social and environmental considerations.

The INECO Stakeholder Assembly Workshop Participants

In the above context, the INECO Tunisia Stakeholder Assembly Workshop was an important milestone in the overall effort of INECO to promote constructive engagement of stakeholders while at the same time allow the exchange of view and experience between important stakeholders and experts.

The event brought together stakeholders from all the INECO Case Studies, with the aim to achieve following specific objectives:

- Present and evaluate the outcomes of the analyses undertaken during the 2nd year of INECO on the applicability of institutional and economic instruments in each Case Study;
- Share, exchange and integrate experience associated with the application of solutions across the Mediterranean Basin and assess the corresponding economic, environmental and social trade-offs;

- Derive recommendations for enabling the effective implementation of proposed instruments at both regional and national levels.

In this regard, the INECO Stakeholder Assembly Workshop constituted a significant step towards the definition and formalization of the final output of INECO, which comprises the formulation of adaptive sets of guidelines on institutional and economic instruments for improved water management in the Mediterranean Basin.

2 The implementation of the INECO Stakeholder Assembly Workshop

2.1 Event overview

The INECO Stakeholder Assembly Workshop was structured along four sessions:

- Session 1, Introduction, was aimed at presenting the overall approach of INECO, and the context for the development of the project's Case Studies.
- Sessions 2a, 2b and 3 were devoted to the presentation and discussion of the project's Case Studies. In more detail, Session 2a focused on the Case Studies on River Basin Management (Damour River Basin, Lebanon and Oum Er Rbia Basin, Morocco), Session 2b included Case Studies on Groundwater management (Pegeia, Cyprus and Tunisia), whilst Session 3 included case studies dealing with water quality and urban water management problems (Barada River Basin, Syria, Seybouse River, Algeria and Bahr Basandeila area, Egypt.

Each Case Study session was followed by a discussion panel, which focused primarily on the options suggested by the INECO Research team and local stakeholders for problem mitigation. The overall framework of the workshop is illustrated in Figure 1.

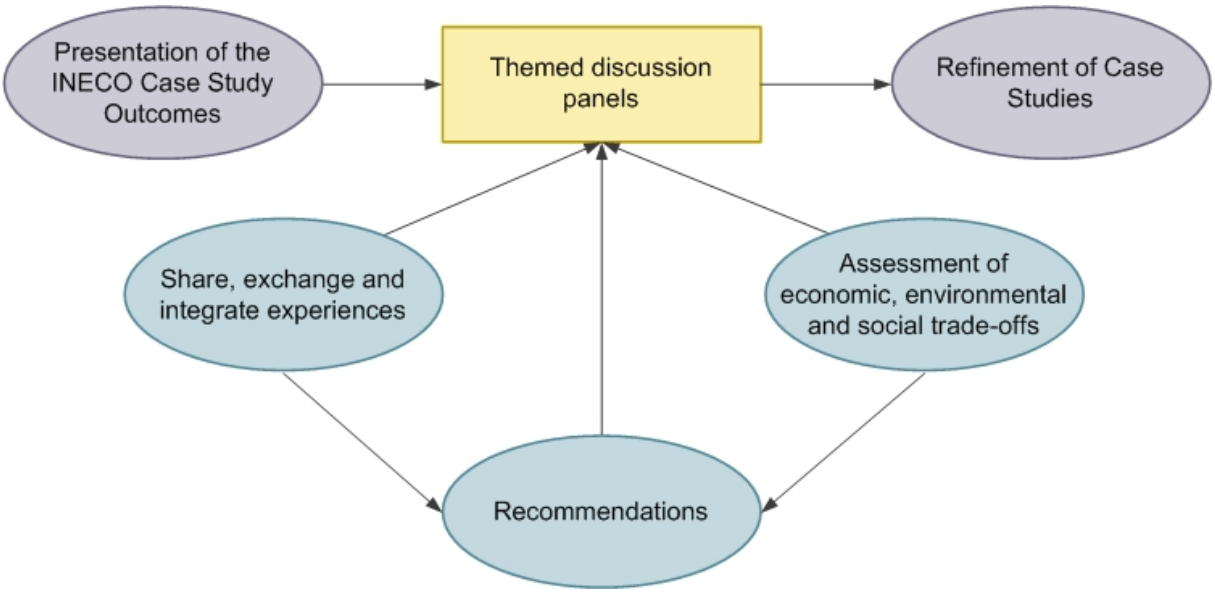


Figure 1: The INECO Stakeholder Assembly Workshop framework

2.1.1 The Introductory Session

The Introductory Session of the workshop was aimed at providing an overview of INECO, focusing particularly on the adopted methodological approach and the outcomes achieved thus far. It further introduced the event and its objectives, as well as the expected main outcomes.

The session included three presentations:

- Prof. Dionysis Assimacopoulos (INECO Project Coordinator), explained the overall framework of INECO, the main milestones and outputs thus far achieved by the project, as well as its expected final 3rd year outputs.

- Mr. Daniel Valensuela (Deputy Director of IOW and INBO representative), focused on public participation and networking as means to achieve capacity building for IWRM.
- Prof. Antonio Massarutto (IEFE), elaborated on the overall concepts governing INECO, and on the methodological approach followed for the analysis of alternative institutional and economic instruments at the Project's Case Studies.

2.1.2 The Case Study Sessions

Sessions 2a, 2b and 3 were devoted to the presentation and discussion of the outcomes of the INECO Case Studies.

To facilitate the three discussion sessions that followed the Case Study presentations, the corresponding inputs were structured in three parts. The first part of the Regional Presentations was aimed at providing a comprehensive overview of the selected (focal) water management issue. This overview included the description of the problem, using also illustrative photos and indicators, the outcomes of the Stakeholder Analysis stage, through the description of the different user groups and their interests, as well as the authorities and institutions involved in the corresponding decision-making process and the relevant institutional issues that are linked to the problem, focusing primarily on problems related to legislation and enforcement, the governance setting and the relevant deficiencies etc. The second part of the Case Study presentations was aimed at disseminating the regional experience with regard to problem mitigation, describing the current efforts and responses to the problem and their pitfalls and successes. Emphasis is given to the currently (or already) applied options and on institutional and economic responses and their inefficiencies. Finally, the last part of each presentation focused on the key elements of the INECO participatory process for the development of the Case Study, describing the outputs from the corresponding regional analyses and workshops, i.e.:

- The problem tree analysis;
- The policy objectives that were defined in collaboration with local stakeholders;
- Suggested options as elaborated during the 2nd year of the project;
- The outcomes of the option screening process, including comments and additional suggestions, as formulated by stakeholders.

These outputs were further synthesized by the INECO Regional Partners into proposals for the mitigation of the problem.

As mentioned above, each Case Study Session was followed by a Discussion Panel on currently applied and proposed options, where stakeholders and experts participating in the workshop were asked to give their opinion and share experiences on practices and instruments adopted in other areas for addressing similar issues. Each discussion panel was introduced with a summary presentation, which:

- Portrayed the commonalities and the differences between the commonly themed Case Studies,
- Presented common policy approaches for dealing with the issues at hand, and
- Summarized themes for the discussion that would follow.

The proposed discussion themes for each panel are summarized in Table 1.

Table 1: Workshop discussion themes

Session Theme	Discussion Themes
River Basin Management	➢ Supply enhancement ~ 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 mechanisms - Conflict resolution - Allocation of water between competitive uses/users - Public information organizations on local WM issues
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
Water quality and urban water management	➢ Competitiveness vs. environmental protection - Incentives towards cleaner production in the industrial sector - 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

2.1.3 Workshop conclusions

The main conclusions, as derived from the discussions held during the event were the following:

- The main objective of INECO, i.e. to build a network of stakeholders in the Mediterranean Basin has been achieved to a significant degree.
- INECO does not aim at providing solutions to local problems, which have to be addressed by the local societies. Instead, the project is about sharing knowledge and experience on IWRM issues and particularly with regard to sustainability and means to enable the effective and sustainable implementation of proposed solutions.
- The guidelines that will be developed during the third year of the project will principally aim at assisting stakeholders to properly develop and implement such solutions, taking into account the corresponding environmental, social and economic criteria and assess the trade-offs of their decisions.
- Although coping with climate change has emerged as a dominant policy question in the last few years, one of the main issues that Mediterranean countries have to address is the lack of capacity to address current water management problems, while at the same time foster the development of adaptive and more flexible and sustainable solutions. Questions related to cost sharing, public participation and institutional transformation are still valid, in spite of considerable research undertaken in these fields.

- In this regard, in several countries and regions, institutional reforms and efforts to build capacity through knowledge and experience sharing are just beginning to yield results. Efforts need to be strengthened, taking into account immediate and future challenges and opportunities.
- The multiplicity of projects undertaken in the same Mediterranean regions, within the overall effort of providing tools to developing countries for addressing water management issues inhibits their visibility and wide dissemination of their outcomes to policy and decision makers. Often, this raises the question of whether action will follow the analysis and the lessons learned from a project, i.e. the "appropriation" of its results. This is not only a problem of the projects, but it can also be attributed to the public administration of the countries concerned. On the other hand, and as pointed out by the stakeholders that participated in the event, a perfectly developed network of people can be setup, who can try empower stakeholders and build policies based on public participation and not only on government decisions.
- Economic instruments are linked to the overall institutional framework and cannot be successfully applied unless there is a certain degree of decentralization and democratic management. This is contrast to the traditional vision, promoted by many international organizations, which is based on the concept that since new forms of management cannot be imposed, the suggested simplified solutions for sustainable water management would be the introduction of economic tools (pricing) and privatization.
- One of the most important outcomes of INECO as a project lies in the lessons that each Case Study can tell the others, not about the solution to the selected water management issue but about the methodology that has been used for framing the problems, for gathering stakeholders around the table and for understanding the constraints around economic instruments. As stated during the workshop, the economic approach has increasing limits. In this regard, there is no point in issuing guidelines about how to tailor instruments, but instead there is need for proceeding the discussion on what is useful in this approach and what is useless. In this regard, the guidelines to be developed by the project should focus more on the methodological aspect of how to perform participative analysis of such approaches in the Case Studies. The solution for the Case Studies themselves is something that is to be expected from the local society.
- All Mediterranean countries have very different institutional situations. In this context, the most positive outcome of a project like INECO is that it allows people from different countries to gather around the table to exchange national or even local experiences and experiments; this in turn helps them to build capacity and ability to pass messages relevant to their own national situation,

2.2 Workshop minutes

2.2.1 Session 1: Introduction

The INECO Workshop scope and expected outcomes

Prof. Dionysis Assimacopoulos, INECO Project Coordinator, introduced the workshop, which is the 3rd Assembly Meeting of INECO, following the Athens Kick-Off Meeting in July 2006 and the 1st

Annual Meeting, which was held in Cyprus in October 2007, in combination with the local WP 5 Workshop. He pointed out that during these first two years, the project organized a series of workshops, one in each participating country. The introduction to the INECO Tunisia Workshop is aimed at presenting (a) the overall progress and achievements of the project, and (b) to discuss the third year of project implementation.

Prof. Assimacopoulos pointed out that the aim of the INECO event is to gather key stakeholders and discuss the outcomes of the INECO approach in its 7 case studies in a cross-regional way, aimed at facilitating integration, exchange of experience and views and mutual learning. INECO is a Coordination Action project, that builds on previous research while at the same time facilitate dissemination and approaches for constructively engaged Integrated Water Resources Management. Additionally, the project aims to facilitate the uptake of research efforts, and it is a project that builds on the active participation of local communities.

Currently, the main water management challenges (in addition to the broader challenge of climate change) faced in the Mediterranean basin include inefficient land use, poor infrastructure maintenance, overuse of water resources, need for sustaining economic growth without compromising water ecosystems and future water availability etc. The main issue however is that the solutions to all these problems are more or less known, as they have often been researched and applied to other parts of the world, but still they have not been implemented. As often advocated in the pertinent literature, the basic elements for effective water management are: (a) the sustaining of a vital economy and healthy environment, (b) the assurance of high standards of living. For achieving such aims, IWRM has emerged as the solution; it means that we need to integrate across sectors and environment, improve the river basin management system, use water efficiently, preserve water quality and support environmental stewardship. Within the framework of INECO, the discussions on sustainability are pursued on three dimensions: (a) valuing water, (b) transparent, efficient and equitable governance, and (c) effective, inclusive and participative management of shared resources, taking into account the interests of all users. Another key premise of the project is the establishment of Multi-Stakeholder Fora, through which the project seeks to promote constructive engagement of different stakeholders. The overall process aims at developing consensus on the social, environmental and economic dimensions of the water management problems experienced in the different regions.

In this regard, one of the big questions of INECO is the involvement of citizens, the involvement of people, because the implementation of a project concerns a community; communities are instigators of policies, and it is their needs that must be addressed when projects are designed (and not after they have been implemented).

INECO is not a project on Decision Support Systems; it does not concern data collection. On the contrary, it focuses on interaction with stakeholders. The first step of the project was to undertake stakeholder analysis, and try to establish communities of INECO in each of the participating regions. For framing the discussions on the problems experienced in each case study, Regional Partners also tried to collect relevant data, to depict its importance, and the relative weight of its causes. Following from problem definition and analysis, the next discussions were on the definition of policy objectives and on the formulation of alternative options to be discussed with local stakeholders. For example, in Cyprus, Prof. Massarutto proposed many different policy approaches and options for addressing groundwater overexploitation. The final step of the project comprises the evaluation of these options and the development of guidelines, which will be discussed during the third day of this workshop. In

this context, the first year of the project concerned situation analysis (water supply, demand, data, data for problem analysis), stakeholder analysis and consultation with stakeholders and citizens. From this process, the Project identified the focal, critical problems for each region, and we further defined the INECO Case Studies. Then a problem tree was developed for each case study, and an indicator list relevant to the problem. Overall, in INECO there are 7 Case Studies, four of which focus on River Basin and Groundwater Management, and three of which focus (more) on Urban Water Management. In this regard, the INECO Stakeholder Assembly Workshop was structured in three main sessions:

- Session 1 focuses on water stress and sectoral water allocation, incorporating the Case Studies of Lebanon and Morocco.
- Session 2 regards groundwater management and problems relating to groundwater overexploitation (Case Studies of Cyprus and Tunisia);
- Session 3 deals with Urban Water Management and Pollution, comprising the case studies of Algeria, Syria and Egypt.

Within the framework of INECO, the developed problem trees have facilitated the identification of common causes behind the focal problem selected for each region. The individual regional workshops which have helped INECO consolidate this analysis and facilitated the discussion with stakeholders required a very big effort, undertaken by the Regional Partners, but also from IOW and from the experts collaborating with the project (Prof. Barraque and Prof. Vlachos). This effort, through the workshops, was aimed at engaging people in a constructive dialogue, and establish a shared frame of reference, goals, and foster an initiative to design with local stakeholders an efficient process to achieve the goals of IWRM.

The second year of INECO was devoted to developing the discussion on a proposal of instruments that can be considered efficient and effective for addressing the issues at hand, taking also into account the social dimension, contribution to the objectives set and economic efficiency. Furthermore, the Project, through dedicated questionnaires asked the preference of stakeholders and citizens on different instruments. The chart of Figure 2 presents results from the Lebanon Case Study.

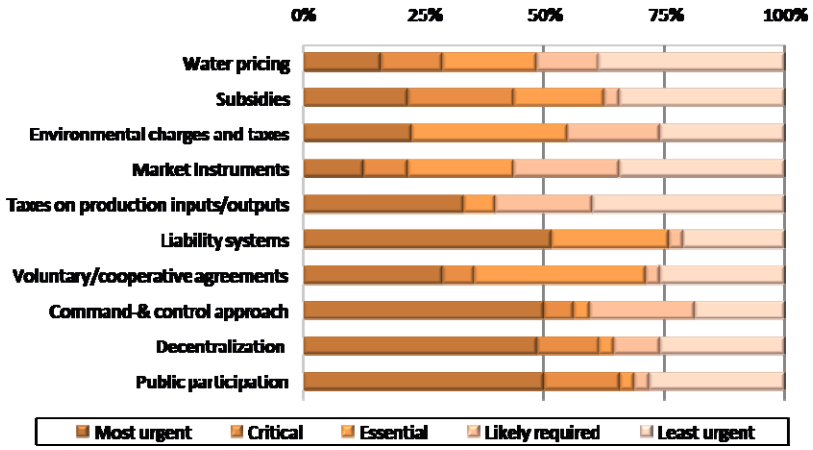


Figure 2: Outcomes of the option screening option (Lebanon Case Study), concerning the need for immediate implementation of different instrument approaches

In this regard, the objectives of this event is to present and evaluate the outcomes of the 2nd year analyses of INECO on the applicability of the different institutional and economic instruments. After each session there is discussion aimed at exchanging views and integrating experience, and at

assessing, if possible, the corresponding social, economic and environmental trade-offs. The third year of the project will be aimed at further elaborating on the analysis of the different options and at synthesizing all information to develop guidelines, as depicted in Figure 3.

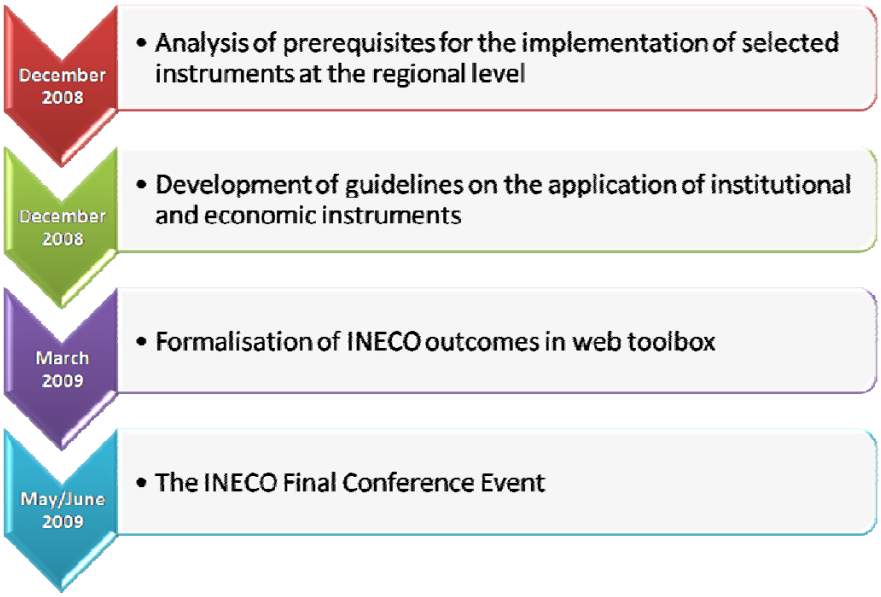


Figure 3: Outline of the third year of INECO

These guidelines will be integrated in a web toolbox to facilitate discussions on alternative instruments. All of these will be discussed and presented in the INECO Final Conference Event, which will be held in June 2009.

Information exchange, participation and networking for sustainable water management

Mr. Daniel Valensuela, Deputy Director of IOW, provided an overview of current, global, efforts for information exchange, participation and networking aimed at increasing knowledge transfer on different aspects related to the ongoing effort to achieve Integrated Water Resources Management in different countries. He pointed out that presently, technical solutions to solve water management challenges (both present and future) more or less exist. However, still and despite ongoing efforts, institutional problems still exist in many countries, whereas efforts to reach agreements and consensus in the management of transboundary waters need close cooperation among the different countries involved.

The prevailing top-down approach to the development and implementation of water management options hinders the participation of societies and of affected user groups in the decision-making process. Actors should emphasize on improving water governance. According to the speaker, there is increasing need for:

- National strategies at country level, or international strategies in the case of transboundary waters management;
- National policies and regulations;
- Institutional framework enhancement and adaptation;
- Decentralization of water management operations;
- Working at the basin and/or local level, as appropriate;

- Development of master plans and long-term planning instead of short-term, fragmented mitigation responses;
- Mechanisms for transboundary water management;
- **Knowledge** and **participation**, which can be considered the key pillars in developing an integrated approach to the management of water resources.

The importance of knowledge, data and transfer of know-how are increasingly being perceived as important elements in the development of the "right" water policies, application of appropriate regulations, the analysis of "baseline" conditions, the monitoring of progress made, and for the comprehensive assessment of the impacts of projects (e.g. infrastructure development in a river basin). With regard to information sharing and dissemination, it is important to acknowledge and ensure that the right people (stakeholders) are informed. However, it is critical also to ensure that relevant information on water issues, problems etc. is also diffused to the civil society. Required information and data on water resources, use, land use, land management, rural development needs to be addressed in perspective, in a way that enables forecasting not only at the national level, but also at the local and/or sub-basin level. Data is usually collected, managed and owned by several institutions, such as the local and central administration, basin organizations, NGOs, water service operators and research institutes. It is often heterogeneous; there are different definitions for the same type of information, depending on discipline, and collected data are seldom harmonized and complete. In addition, knowledge is often badly adapted to suit the needs of decision-makers and the administration. In some cases, there is information available, because a research institute is involved in a project; however, research outcomes are often not useful to meet the needs of practitioners. On the other hand, in several cases the "owners" of data decide to work separately, and make use of their own information. In this context, the main challenge is to collect data and information in a normalized way and allow everyone to have access to it. This would be the aim of an **Integrated Water Information and Monitoring System**. A water information system should respond to the needs of stakeholders; in this regard, key stakeholders should be involved in the process of developing the system, so as to ensure that the system meets the needs of all parties involved. Further to that, a comprehensive system should be useful in controlling activities, particularly in relation to water management, monitoring water resources, assessing relevant policies and plans etc.

Such considerations apply to all activities relating to data collection at all levels. Summarizing, data collection should not only refer to the national level, but also at local level. How to enable the collection of appropriate information at local level is the first important question. The second is its dissemination to all users and stakeholders. And the third issue is to make information available to everyone in the affected area (country, basin, transboundary basin).

It is also important to address the theme of participation of stakeholders and the civil society. There are many stakeholders, and many groups of stakeholders with different interests. According to the literature, five levels can be distinguished (Figure 4): information sharing, consultation with affected groups, involvement in the planning process but not in the decision-making process, collaborative planning and citizen empowerment. Usually, in most cases we are only able to reach the "information stage", depending of course on the case. For achieving participation, there is need for enabling the appropriate policies and this requires political will. There are many types of participation.

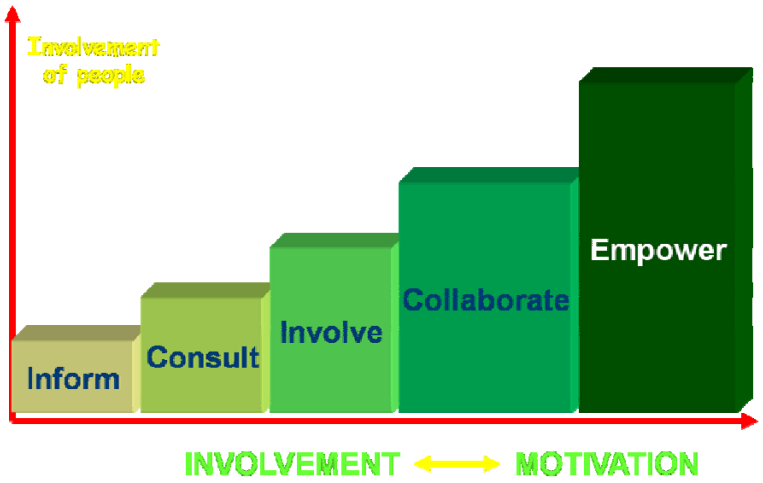


Figure 4: Levels of stakeholder involvement and participation

An example is legal participation, which is the case of river basin agencies, where representatives are elected. For specific cases or projects, the civil society and citizens are also often consulted. Finally, there is also the issue of deciding on broader national (e.g. legislative or institutional reforms) where there are public debates among all actors concerned.

Evaluating current and potential institutional and economic options at the INECO Case Studies: Context and Methodology

Prof. Antonio Massarutto then elaborated on the context and methodology for the evaluation of current and potential institutional and economic instruments in the INECO Case Studies. The typical water policy dilemma originates from the increased demand for water services, not only with regard to water supply but also concerning water pollution abatement. Water ecosystems cannot respond to the increasing demands; in this context, the capacity of nature to provide water services at low cost is becoming more and more limited. Therefore, as the demand increases at levels that exceed the natural capacity of water systems, policy makers face the dilemma of expanding supply capacity through artificial means (which is normally very costly and in most of the cases exceeds what water users are willing or ready to pay for water services). On the other hand, the demand is strong enough to exert significant pressure on the environment and over the natural capital. This implies that if no solution is found, the pressure over natural capital will result in its unsustainable use.

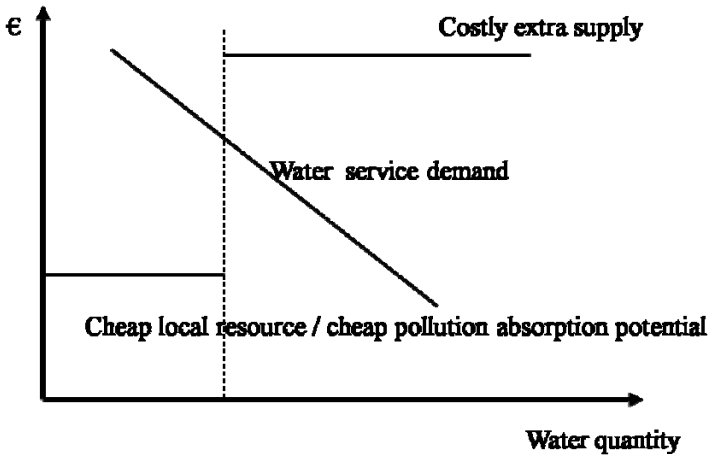


Figure 5: The water policy dilemma

This dilemma, portrayed in Figure 5, can be solved in three ways. First, the supply capacity can be expanded. Secondly, the productivity of the natural capital can be increased, probably by using water in a more efficient way. Finally, the third option is to reduce demand by phasing out certain uses, especially those with the lowest added value. It should be noted however that the value added is not the only criterion; many demands are not ready to pay, but this does not necessarily mean that they are less socially valuable.

There are many ways to implement the above policy options. The traditional approach to water policy is however facing increasing difficulty in providing solutions to this type of dilemma. As expanding supply infrastructure through the public budget is becoming increasingly costly, the State does not have the capacity to finance supply expansions. Access to capital markets is also possible, but is also very costly. Capital markets normally require a high interest rate unless the State provides the appropriate guaranties, which is not possible in all cases.

Increasing productivity in water use implies professional management. Professional water management does not necessarily imply the involvement of the private sector, but certainly requires commercial attitude towards the provision of water services. This is something that is not easy to perform within the framework of the traditional approach to water policy development. Furthermore, reducing demand perhaps also implies a command-and-control approach or a strong legal power of the State. This again is not easy to develop, because of constraints faced by the State regarding the legitimacy of decisions, political consensus and institutional empowerment.

The traditional model usually implies that demand from individual economic sectors and individual water users conveyed to politicians. Politicians then assign to the administration and technocrats to find a solution to the problem. This usually means development of technical systems, which entail increasing economic costs, increasing environmental cost, and decreasing capacity of the natural capital to meet all needs. Along this line, a vicious circle develops, that impairs the capacity of the whole system to deliver solutions in the long-run. In this perspective, alternative coordination models are required. Presently, there is an increasing demand from stakeholders to be directly involved in the definition and the implementation of solutions, and there is also an increasing need to directly involve the users in the recovery of costs for the implementation of these solutions. The traditional way of sectoral water policy development, where each user uses and discharges its own water, where integration is left to the environment or probably to the public budget and where each user survives alone without considering the others needs to be replaced by alternative models where users cooperate among themselves.

Prof. Massarutto pointed out that Europe, especially through the Water Framework Directive, experiences this shift of water policy conventions. Traditional water policy conventions are based on the consideration that water services are social rights and public goods that should be provided through the general taxation and not charged to users. In this regard, the role of the Government is to ensure that this social right is guaranteed. Traditional conventions regard water management as a supply-side problem. Water scarcity is basically considered as an issue that can be solved through new infrastructure development. On the other hand, emerging policy considerations recognize water as a scarce resource that has a social and economic value that has to be allocated efficiently, taking into account the illustration of Prof. Bernard Barraque that “what is scarce is not water but money”. Money is scarce; since it is scarce, it has to be allocated efficiently. Therefore, the solution is not to continuously fund the expansion of the water system, so as to eventually solve all problems. An

additional convention that is becoming increasingly important in Europe is the consideration of water services as public utilities. This does not mean that water services should be provided by the Government for free. Instead, the role of the Government is to ensure that every citizen has access to water services, especially the poorer ones. This implies that the corresponding costs should be shared more equitably, and not that the service should be provided for free. To that end, there is also the concept is that water management is no longer only a supply-side problem; options should be compared to demand-side management, which means reducing the demand or diverting users to different water supply alternatives and also improving the capacity to cooperate.

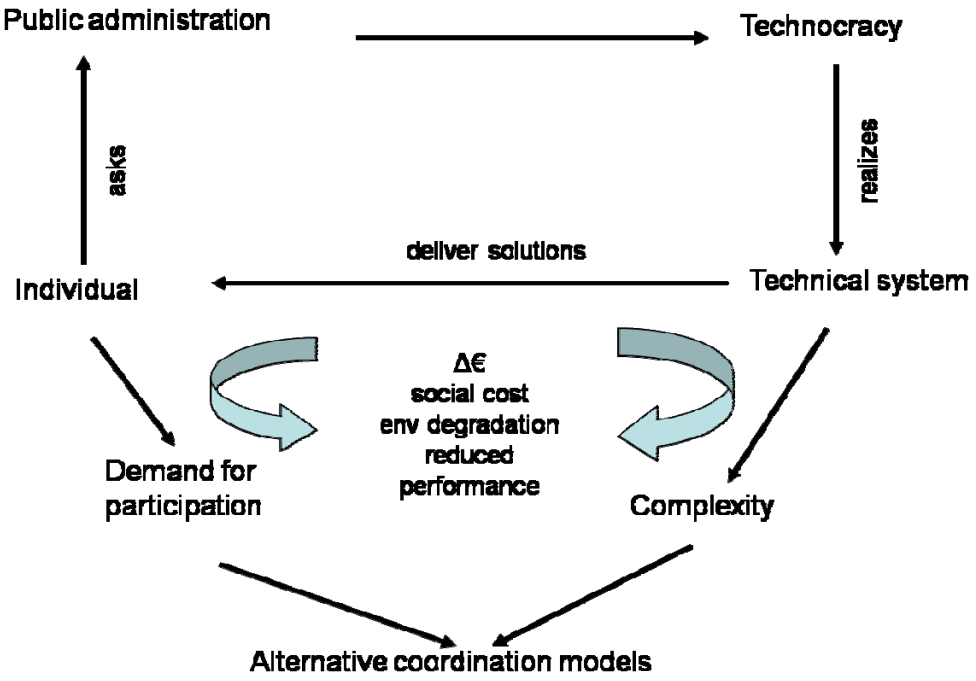


Figure 6: The vicious circle of traditional solutions to water problems

In this framework, economic instruments and approaches have been rather mythisized by the pertinent literature but also by a narrow vision of economics that has been sometimes put forward in the policy debate. This narrow idea says that the water scarcity problem is not in fact a problem of water being scarce. It is a pricing problem and scarcity occurs because prices are too low. If prices are increased, scarcity will be eliminated. Another myth is that inefficient allocation is due to the lack of economic analysis of decisions. In this regard, if Cost-Benefit Analysis would be applied instead of political decisions, then all solutions would be efficient and sustainable. Furthermore, there is the concept that inefficient management derives from the public sector. Therefore, privatization, commercialization and liberalization and increased competition would be ways of solving these inefficiencies. More generally, there is the concept that every time the State becomes involved it is to serve private interests and that users distort will to their favour; on the other hand, economists argue that all market-based mechanisms allow users to play with the right cards on the table.

Summarizing, the economic myth entails a kit of solutions that comprise pricing, cost-benefit analysis, more market, more privatization and more capitalization. However, we should take into account that water management issues are not only about economics; therefore we cannot expect that economics alone can provide the solution. Ten years ago, the OECD, the World Bank and many other international institutions regarded pricing as an instrument that should foster optimal water

management, and that could address all relevant objectives. Presently, we are all aware that different pricing structures are adapted to different policy aims. In this regard, if we try to address all these aims under the same objectives we might create confusion, because optimal strategies towards some of these objectives completely contradict the goals of others.

For example, in the past, Increasing Block Tariffs (IBTs) have been recommended as an appropriate policy option for water pricing. The option had been suggested by environmental economists, having in mind the incentives provided towards water saving; furthermore, IBTs were supposed to correspond to the marginal cost pricing approach. On the other hand, once it had been acknowledged that one of the main problems of the water sector, especially with regard to sanitation and wastewater treatment, was the recovery of the financial cost for infrastructure, IBTs were considered as a very weak tariff structure, because it hampers the capacity of the system to recover costs in the long-run. Another shortcoming of IBT is that it is highly regressive, i.e. in proportion, the poor pay much more than the rich. There is a very interesting study by the World Bank that shows very clearly that IBT tariff schemes impact dramatically on the poor because the elasticity of water demand to income is very low. In order to avoid this type of regressive effect, it is recommended to introduce a fixed charge, which should be further parameterized according to the capacity-to-pay and not according to the willingness-to-pay. This was an example to illustrate the kind of trade-offs and complications that may arise once we go further into the discussions. Further examples of debates concern local metering. Economic instruments and approaches require metering of quantities abstracted and used. On the other hand, metering introduces new costs, which need to be recovered, etc.

We continue to believe that an economic approach could be useful for facilitating the search of an alternative approach to the water policy dilemma. However, we cannot expect that the economic approach could work automatically. Economic instruments are useful because they can provide incentives to users and allow more efficient use and allocation of resources. They are further useful because they provide a true representation of the users' willingness-to-pay; therefore claims that the stakes of certain user groups are more important than the interests of others cannot be supported in the political arena, and the scope of regulatory capture is reduced. Furthermore, economic instruments allow recovering the cost of water services when the public sector does not have the capacity to fund the water sector and last but not least they allow sharing the costs in a more equitable way.

Such instruments, including compensation for ecosystem services, bargaining between users, implementation of dedicated taxation systems so as to foster financial flows between users and between water use sectors, are becoming increasingly important in the reduction of distributive effects and maintaining the affordability of technical solutions.

It should be noted that economic instruments do not operate in a "vacuum"; they require the appropriate institutional context, in which they can operate adequately. This institutional setting is not to be taken for granted, but should be implemented. It does not only mean legislation and rules; the appropriate political and cultural setting is required, and also ways through which stakeholders can interact. It further concerns property rights, institutional arrangements that enable users to cooperate, etc.

There are instruments that aim at resource allocation or re-allocation, instruments that target efficient water use and reduction of pollution, instruments that enable foreseeing the long-run effects of today's decisions (e.g. liability systems or property rights systems). There are also instruments aimed at

promoting integrated solutions, e.g. those that engage stakeholders in bargaining, through cooperative or voluntary agreements between users' associations, which aim at redistributing the costs among water users and not just at providing incentives. There are also instruments that do not target the actual use of water, but instead address the macro-drivers, such as instruments that concern the agricultural policy or urban development. These instruments are often neglected in the policy debate, but are more important, since we have recognized through the analysis of water demand and water service demand that most of these demands are very inelastic and rigid, unless we are able to address the drivers that operate behind them. Finally, there are instruments that have financial rather than economic aims. This means that they aim at fostering the self-sufficiency and cost recovery of water supply and sanitation services. This does not necessarily mean privatization or commercialization of water services; the self-sufficiency of the water system means that the system will rely on self-generated financial resources, not claiming funding from the public budget.

In this framework, INECO started with a common way of defining the diagnosis of the situation in the Case Studies. The main aim of this exercise was to understand the problem behind the data. Further, actors have tried to discuss in the different workshops, what are the policy objectives and to categorize different instruments, deciding what type of economic approach could be more helpful in each particular situation. However, economic approaches and instruments cannot be just put on the table and used as a toolbox that fits everywhere. Economic approaches and instruments should be tailored to each specific situation and should be mixed together in order to be helpful to the specific policy aims and policy needs that each Case Study has put forward. In this regard, a questionnaire has been sent to each Regional Partner responsible for the implementation of each Case Study, in order to map:

- Which economic instruments and approaches have already been implemented;
- What kind of improvements could be made to each of them;
- What could we expect from an alternative way of using these instruments in the different Case Studies;
- How do stakeholders react about them, what is their feeling and what they perceive as the most interesting and helpful way of using them.

This checklist questionnaire will be used as the basis of the tailored analysis performed in each Case Study. It can also allow identifying what are the institutional and other constraints that presently hamper the adoption of certain responses.

2.2.2 Session 2: Presentation and discussion on the INECO Case Study outcomes: Focus on River Basin Management

Water stress in the Damour River Basin, Lebanon

Mr. C. Tabbal, General Director of Conseil et Developpement s.r.l., presented the outcomes of the Lebanon Case Study, which focuses on the increasing water stress experienced in the Damour River Basin.

The main reason for the selection of the Damour area as a promising Case Study for INECO was that it is a case representative of the water management problems experienced throughout the country today. In general, these problems include pollution of waterways and aquifers and increasing water shortage, also due to the deterioration of the quality of water available for industrial, domestic and agricultural purposes.

The Damour River Basin has an area of approximately 333 km^2, and is characterized by relative freshwater abundance, when compared to other basins of Lebanon. The Basin includes the Damour perennial river, with a total length of about 40 km, two major springs, Es Safa and Barouk, which contribute to water discharge during the winter, and three minor rivers, Es Safa, Zeble, and El Hamam. The area is predominantly agricultural.

The main water management issue experienced in the Damour River Basin is the decrease in the total amount of surface and groundwater of appropriate quality to meet the needs of the different water uses in the basin. The major reasons for this decrease are both natural and man-made, and can be summarized in the following:

- Drop in precipitation levels,
- Overexploitation of surface and groundwater sources,
- Uncontrolled discharge of waste from domestic and industrial sources,
- Limited capacity of authorities,
- Limited financial resources,
- Interbasin transfer of groundwater,
- Sea water intrusion, due to overexploitation.

Overall the recovery of water service costs is poor; municipal authorities, which are in charge of water supply provision, are facing difficulties in covering operational and maintenance costs. Most municipalities in the river basin do not charge local users with the official tariff, because of socio-economic reasons. Instead, they charge an annual lump sum per household. Furthermore, environmental supervision from the corresponding institutions is not exercised. Although there are relevant provisions in the legislation, these are still not enforced, due to various institutional and political barriers and constraints.

The vulnerability of the region in terms of water availability and exploitation of freshwater resources is increased by the large quantity of water that is committed for interbasin transfer. Today, interbasin transfer is in the range of 340 to 400 l/cap/d, while the allocated volumes should be around 150 l/cap/d. Currently, 80% of the water abstracted from a total of 16 wells is delivered to Beirut and Ain Delbeh.

Detected COD levels confirm possible release of industrial wastewater. The main activities are olive farming and olive oil production, stone cutting and asphalt production. Most of these activities developed when it was decided to build the South National Highway, which connects Beirut to the South of Lebanon. This resulted in the development of highway asphalt production units in the area, which are still operating and have significant environmental impact. More important however are the results concerning river water quality, which indicate pollution from domestic sewage. Two samples from the river revealed concentrations of fecal coliforms that exceeded normal standards. Additionally, since 2001 there has been reduction in the total discharge at the river mouth, which reaches 55% of the total annual yield and reveals problems regarding water allocation and use upstream.

In the River Basin, water charges are collected by the municipalities, while in other areas of Lebanon this task is entrusted to water authorities. The water sector is still very centralized. However, efforts towards decentralization, which is also advocated in the Constitution, are currently being initiated and, if pursued, are expected to have positive effect on many issues and problems. Currently, municipalities

are also in charge of collecting water tariffs; water charges are collected separately, but the current base for metering water consumption is still under calibration. Volumetric consumption is identified through water gauges that calibrate outflow. The tariff is unique in Lebanon and this has to be changed in order to develop a logical system. In the region of Damour, the tariff used to be 100,000 LBP/yr (i.e. 45 €) instead of 240,000 LBP/yr. This lump sum is exceptionally applied in the area due to socio-economic issues.

Zones of the area, especially upstream the Damour River, are declared protected. In these areas, well and borehole drilling is restricted, according to the Decree 129 of 1998. The Decree restriction limits the uncontrolled extraction of groundwater but has economic consequences, one being the high cost of expropriation, which results in significant costs for acquiring land for projects of public welfare. Extraction permits are subject to strict conditions and require public order or decree with the exception of boreholes that do not exceed 150 m depth and 100 m^3/d. However, the practice is not to obey the relevant legislation; users obtain permits for drilling a borehole with a capacity of 90 m^3/d or of 120 m depth and instead they drill at 400 or 500 m. Abstraction charges are fixed by a Ministerial Decree that takes into consideration depths and flow. Again, at this level, the recovery of costs can be considered inadequate, mainly because users are charged on what they are supposed to have abstracted and not the actually abstracted quantities.

In the above context, Conseil et Developpement, through INECO, is fostering a participatory process to motivate citizens and authorities and to develop a more holistic view of the problems at hand. In this context, the INECO WP 5 Workshop, which was realized on September 12th 2007, gathered a representative panel of stakeholders, who participated in the debate on water stress-related issues and alternative solutions.

The tentative analysis of the focal water management problem revealed the main causes, which were further used to draw the problem tree. Through this exercise, INECO tried to map the different levels of causes and their impacts that contribute to the exacerbation of the problem. During the debates that took place during the workshop, stakeholders focused mainly on the following issues:

- The overexploitation of water resources by the Beirut Water Authority is perceived by the local population as the main cause of the problem;
- The overexploitation of water resources by upstream users (farmers, etc.);
- The contamination of the river by upstream users;
- The increasing salinity of groundwater because of excessive pumping;
- The lack of irrigation and domestic water supply during the dry summer periods;
- The insufficient discharge standards to ensure proper treatment of domestic & industrial waste water prior to disposal in the river.

Further to the above there are problems associated with limited enforcement of the pertinent legislation and the lack of a sewerage network, as currently the entire region is served by septic tanks.

Following from problem analysis, Conseil et Développement proposed policy objectives which were discussed with stakeholders in the next sessions of the workshop. Stakeholders' suggestions were articulated around four main elements. Their main request is to secure the necessary quantity and quality of surface and groundwater, especially during the summer period. Another key objective is to rehabilitate infrastructure and reinforce monitoring and control over water metering.

Box 1: Institutions involved in water management in the Damour River Basin

The institutional framework of Lebanon regarding water management is very centralized. The Ministries involved in water management are (a) the Ministry of Energy and Water, which is the main body that is responsible for water management issues and for setting the framework for sustainable management; (b) the Ministry of the Environment, which is responsible for pollution abatement and prevention policies (c) the Ministry of Public Health, which is responsible for monitoring the quality (and safety) of drinking water (d) the Ministry of Agriculture, (e) the Ministry of Public Works, and (f) the Ministry of Industry.

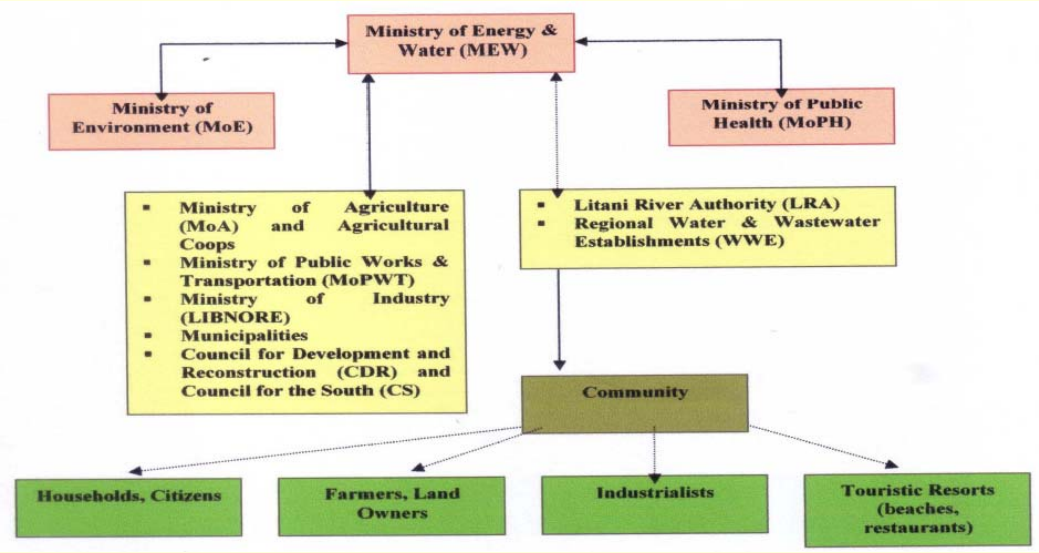


Figure 7: Authorities involved in water management in Lebanon

In addition to the above, there is also an institution responsible for setting Lebanese standards, taking into account the relevant European and International Standards. The Council for Development and Reconstruction, which is also involved in water management, was created after the end of the Lebanese Civil War, with the aim of raising and providing the relevant funds for public sector project.

The Litani Water Authority is responsible for the management of the Litani Dam (the main dam of Lebanon), and there are also the regional water and wastewater authorities, responsible for water management and water service provision at local level. In the Damour River Basin, these responsibilities are undertaken by the Beirut and Mount Lebanon Water Authority, which was originally responsible only for providing water supply to its subscribed customers. Later, following various reforms, the Beirut and Mount Lebanon authority also undertook responsibilities regarding water management in the Damour River Basin and in Mount Lebanon, of which Damour is part. In Damour, municipalities which are the authorities responsible for drinking water supply, have started to enforce subscriptions to the distribution network, including an annual fixed fee per m^3/d. Before this, there was an agreement between authorities and citizens, because of the socio-economic problems encountered in the area. This agreement involved the payment of a fixed annual lump sum, which was less than half the annual fixed price. After 2008 however, authorities started to enforce the official water pricing policy.

With regard to groundwater extraction, the political, social and economic instability has dramatically impeded all policies to stop illegal wells and boreholes. Even nowadays, it is considered that the situation is uncontrollable. Legislation and permit conditions are not respected, and the many wells and boreholes already drilled have depleted groundwater bodies. Further to that, in the Damour River Basin, the increasing interbasin transfer poses an additional threat to groundwater supplies.

The Lebanese legislation concerning water dates back to the Ottoman and French regimes. After the civil war, the increasing importance to achieve sustainability in water management urged policy makers to reform water-related legislation. This reform was mainly effected through two main laws:

- Law # 221/2000 on the management of the water sector, which was however controversial and resulted in the modification of several other laws, decrees and decisions.
- The Law on environmental protection, sustainable use of natural resources and pollution prevention.

Decree 129, which designates Damour as a protected area is also of relevance to the INECO Case Study.

With regard to water metering, a contradiction can be identified: stakeholders request the strong "presence" of institutions that undertake enforcement of environmental legislation, but on the other hand, several users seldom comply with the relevant provisions. Stakeholders further stressed the need to prevent water pollution, and for allocating water according to a comprehensive socio-economic survey and analysis.

Along the same lines, alternative solutions/options for problem mitigation as suggested by stakeholders include:

- Construction of the already promised dam on the Damour River, in order to secure water supply. Dam construction remains controversial, mainly for economic and environmental reasons, but is still strongly supported by stakeholders.
- Limitations in interbasin transfer and exploitation of groundwater.
- Elimination of pollution through the construction of wastewater treatment plants.
- Prevention of the misuse of water and limitations of violation in use;
- Rehabilitation of infrastructure and introduction of canalization instead of open-air canals;
- Installation of water meters, a project that is currently under study.
- Implementation of liability systems and of the "polluter-pays principle".
- Enhancement of citizen awareness through targeted campaigns concerning water use and pollution prevention.

During the 2nd year of INECO, 80 adapted screening questionnaires for the different options were distributed to the same stakeholder categories. Because of the relative political instability of the region, only 32 answered surveys were collected, but these were representative of the different user categories. Prior to the distribution of the surveys, several consultation meetings were held and continuous contact was pursued. A key element of the survey 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 decentralization, public participation and increased liability of polluters. Instead of indirect taxes, there is preference for incentives, including voluntary agreements. There are also strong contradictions between the vision (what stakeholders hope for their region), and the actual practice concerning water use.

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 the installation of water meters will be accepted. Tariff structures could be revised, introducing different elements, provided that the increase on charges borne by the users does not exceed logical limits.
- A possible differentiation among customers could be envisaged by setting a low fixed charge and a volumetric charge. All professional categories, e.g. industries, beach 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 reach sustainability if water meters are installed and if the proposed differentiation of charges is also taken into consideration.

A command-and-control which would imply establishment of a discharge permit system, technology standards and enforcement of the relevant penalties and sanctions, where applicable, would be easy to adopt. Market-based instruments are neither a preferred nor appreciated option. They are generally

ignored by stakeholders, and are not presently considered applicable for different socio-economic reasons. Voluntary agreements have not been yet applied, except for a case in West Bekaa. However, a clear preference is set for such initiatives. It is however noted that their implementation would certainly have economic impacts, and would therefore necessitate compensation and alternative financing policies, which is a request always addressed to the central Government.

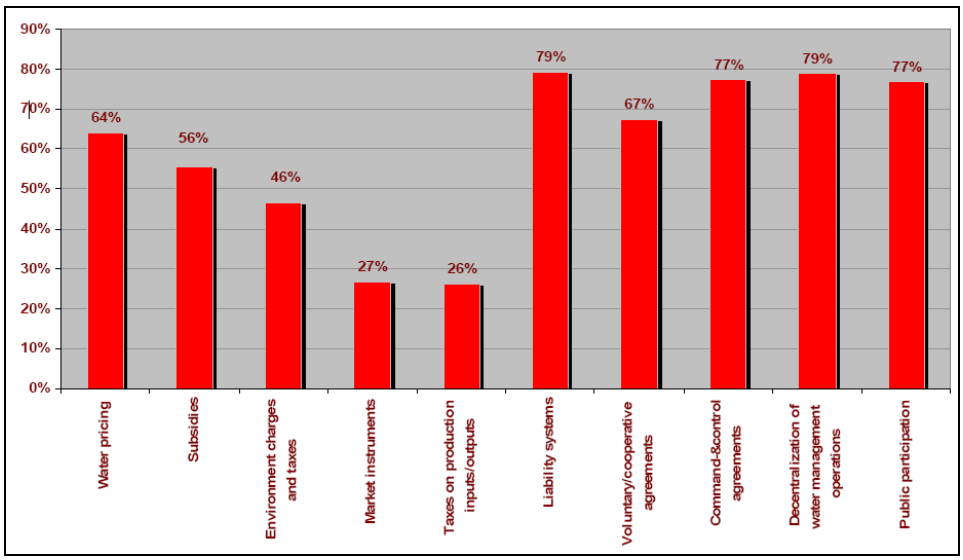


Figure 8: Individual preference of stakeholders on different instruments (Damour River Basin, Lebanon)

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 process of decision-making. This was also manifested by their willingness to cooperate and respond to our invitations.

The synthesis of all the above into a proposal, accepted by all stakeholders involved can be summarized in the following:

- Dam construction: All stakeholders request infrastructure development, taking also into account the successful example of the Shabrugh dam (capacity of 80 million m³), which was inaugurated in October 2007 and is already full.
- Limitation of extraction from groundwater wells.
- Installation of water meters.
- Pollution prevention.
- Community respect to laws and the environment.

Enhancing efficiency in irrigation water use in the Oum Er Rbia Basin, Morocco

Mr. Mohamed Marzouk, representative of the Basin Agency of the Oum Er Rbia, provided an overview of the INECO Case Study in Morocco, which focuses on the need to rationalize irrigation water use in the Hydraulic Basin.

Firstly, Mr. Marzouk provided an overview of the current situation regarding water availability and use at national level. Currently, water availability per capita shows decreasing trends, below 1000 m³/cap/yr. According to the relevant projections, it can even reach 500 m³/cap/yr, a value that

represents the water scarcity threshold. In the past, the adopted governmental policy focused primarily on large hydraulic infrastructure (dams and interbasin transfer projects).

As a result of this supply-oriented policy, today Morocco mobilizes approximately 65% of the available water resources. However, this policy was not oriented towards demand regulation; as a result, presently there is significant wastage of water, a fact that is not always recognized by decision-makers. In this regard, one of the main points discussed in the Morocco Stakeholder Workshop was related to Integrated Water Resources Management, and the overall effort of developing new policies focused on demand management.

The Oum Er Rbia Basin is located in the centre of Morocco; it is a predominantly rural area with approximately 5 million inhabitants. The industrial sector is also significant, comprising mainly phosphates. The total irrigated area is approximately equal to 500,000 ha; water availability is significant when compared to other regions of Morocco, but water supply cannot meet local requirements and there are discrepancies between water supply and demand. The total volume of surface water is about 3 km³/yr. Groundwater is not as significant, as only 300 Mm³ are mobilizable, and there is no significant potential for further exploitation. There are 50 dams in the region, 20 of which are large dams, and the total storage capacity is about 5,100 Mm³. Domestic water demand is only 337 Mm³/yr, whereas irrigation demand is about 10-fold of domestic water needs. Additionally, most dams are also used for hydroelectricity production, and contribute significantly to the electricity supply of the country.

The Basin has a typical Mediterranean climate. However, according to precipitation records, the last 27 years precipitation average is 20% of the average of the last 40 years. Therefore, it can be concluded that there is a distinctive decline of precipitation, coupled with increased variability of rainfall patterns. Given the decline in water availability, users resort to the use of groundwater, and presently water extraction is twice more than the sustainable yield. In this context, the total deficit is presently equal to about 300 million m³/yr. This also means that there is continuous decline of water tables (2 m/yr for shallow aquifers and 1 m/yr for deep aquifers). There are springs that have dried up, which were used to sustain small-scale agriculture.

Box 2: The River Basin Agencies in Morocco

One of the main outcomes relating to the recent institutional reform that took place in Morocco, is that it is not sufficient to have only a National Water Planning System; there is need to develop procedures for water resources planning and management at the scale of the river basin, and to also empower provincial and regional authorities for the issue of water abstraction permits.

Currently in Morocco the water sector follows the institutional model of France (Agences de l'Eau). Within the Agency, 45% of members are government representatives, 43% are water users, while the rest are important water users (e.g. representatives of the electricity company or public officials responsible for the management of irrigation perimeters). The system implements the "polluter-pays" principle, which allows the Agencies to fund programmes relating to water and environmental management. There is clear movement towards the implementation of the cost recovery principle (i.e. "water should pay for water"). However, there are still government subsidies, used for specific purposes. An example is the Agricultural Development Fund which can be used to finance irrigation improvements and investments for water conservation (up to 60% of Government Funding).

Irrigation is by far the most significant water use sector (90% of total demand). Most parcels are irrigated by gravity systems, which are inefficient. This is mainly the case in the large irrigation perimeters that were developed by the Government. Additionally, water from the Basin is transferred to meet water needs in other regions. Water is transferred to supply the metropolitan areas of

Casablanca and Marrakech and significant quantities are also used by the phosphate industry, and for an irrigation perimeter that is located outside the River Basin.

Due to the increasing deficit, hydroelectricity production is much less than the installed capacity (only 60% of the nominal power). However, the electricity company was the first user that accepted to pay the corresponding levies for water abstraction to the Oum Er Rbia Basin Agency. Pollution problems are becoming significant, and result in increasing the costs related to the production of drinking water. Authorities decided to use carps to clean waterways, a practice which has thus far proved successful.

With regard to envisaged solutions, the main idea is to artificially increase available supply, through the use of non-conventional water, especially with regard to the irrigation of golf courses in Marrakesh and in the phosphate industry. However, this is not expected to have significant impact, as today the total mobilization of water is equal to 94%, and almost no water reaches the sea. Additional infrastructure projects will be extremely costly to develop.

In addition, the State has considered interbasin transfer from the Northern River Basins, as means of alleviating water scarcity. As this was not considered a long-term solution, it has been decided to "invest" in the institutional system, and develop a levy system, firstly charging electricity production, and then extending charges to other uses. Since revenue has been generated at the River Basin Agency, the Agency would start implementing programmes for improving efficiency in water use, especially in irrigated agriculture. For example, and in order to promote the application of more efficient irrigation methods, a financing plan has been set up, where the River Basin Agency finances the cost of preliminary studies and also provides a 20% subsidy for system installation. An additional 60% of the cost is covered by the State Rural Development Fund. In this framework, farmers bear only 20% of the cost for the installation of modernized irrigation systems. This scheme is applied in two of the largest irrigation perimeters of the Oum Er Rbia, including also two smaller ones.

During the INECO March Stakeholder workshop, stakeholders pointed out that the main prerequisite is to improve knowledge on the actually available water supply, in order to have a real picture on exploitable water resources or resort to non-conventional water resources for certain uses. The main decision however is associated with implementing additional programmes for water conservation; for example the improvement of irrigation systems would reduce water demand by 20%. The main idea is to improve the institutional and legal framework, by developing and reinforcing the role of water user associations, which could then express their needs and interests in a collective way. All stakeholders strongly support this idea, in addition to the rationalization of tariff systems by introducing a uniform system which would replace the geographically diversified ones that exist today.

During the INECO Stakeholder Workshop, stakeholders also recommended additional socio-economic assessments, which are presently lacking. The scope of these assessments would be to identify user savings resulting from the shift towards modern irrigation systems. The replacement of gravity systems with drip irrigation requires significant investment; however farmers could save a significant amount of money, simply by not using water. A second issue concerns the fact that many hydraulic systems supply multiple uses (domestic demand, irrigation and industry, particularly the phosphate industry). In this case, it is not clear how the costs related to the financing and maintenance of this infrastructure is allocated among the different user groups. Therefore, additional studies are required in order to better allocate financial costs, especially between small-scale irrigation projects and large (public) irrigation perimeters. Finally, stakeholders recommended the development of a more global

and integrated vision, and the development of a strategic plan, involving not only water managers and decision-makers, but also politicians, researchers and academics, the private sector (commerce and industry), and water users.

Currently, Morocco is moving towards a new paradigm for water management; the policy of the 1970s, which involved construction of large hydraulic projects, needs to be replaced by demand management and water conservation policies.

Discussion panel on proposed options for the Lebanon and Morocco Case Studies

Following from the presentations on the Lebanon and Morocco Case Studies, Prof. Dionysis Assimacopoulos summarized the key points raised in both presentations, highlighting common elements, as presented in Table 2.

Table 2: Summary of the INECO Lebanon and Morocco Case Studies

	Damour River Basin, Lebanon	Oum Er Rbia Basin, Morocco
Focal Problem	Water stress, especially in the downstream part of the Basin, due to: ➢ Low quality & insufficient quantity due to upstream pollution & abstractions ➢ Overexploitation of groundwater, due also to interbasin transfer	Water stress, due to: ➢ Significant losses in irrigation distribution networks ➢ Low efficiency in irrigation methods ➢ Water-intensive cropping patterns
Policy orientation	➢ Supply enhancement and/or demand management (efficiency improvements in water use) ➢ Enabling of processes for reaching consensus on water allocation & protection at the River Basin level ➢ Enhanced collaboration between central authorities & local authorities	➢ Supporting demand management ➢ Enabling of processes for collective management at the users' level ➢ Enhanced collaboration between local authorities & user associations
Suggested options	➢ Stricter standards on water use & discharge – Enforcement mechanisms ➢ Grants/subsidies for improving efficiency in irrigated agriculture and domestic uses ➢ Metering & water pricing for agricultural & urban water use (incentives and sustainability of water services) ➢ Abstraction charges & effluent charges ➢ River Basin Association – Cooperation and Agreement protocols ➢ Citizen/user awareness and participation	➢ Higher grants & subsidies to farmers for modernizing irrigation methods ➢ Abstraction charges ➢ Tradable water quotas ➢ Increase of irrigation charges for abstractions greater than theoretical crop requirements ➢ Voluntary agreements supported by training for: (a) Irrigation scheduling, improvement in irrigation methods; (b) Shift to less water-intensive crops ➢ Institutional mobilization of users & local authorities

Initiating the discussion, *Prof. Bernard Barraqué* observed that the two cases are to his opinion complementary, because the two regions are very different in terms of size and significance to water management at national level. On the one hand, Damour is a small catchment (area of 333 km² and population of approximately 80,000 people). On the other hand, the Oum Er Rbia is a large River Basin District, with a total population of approximately 5,000,000 inhabitants. Typically, the two Case Studies do not discuss the same issues. It is obvious that the Lebanon Case Study can have on a more direct reaction from the farmers, while in the Oum Er Rbia Case, consulted stakeholders are more distant from the users, and can more freely discuss the overall policy and water pricing reforms in irrigated agriculture, aimed at balancing supply and demand.

In response to this comment, *Mr. Claude Tabbal* noted that the bottom-up approach adopted in the Damour River Basin Case Study allowed stakeholders to directly express their concerns and provide their opinion. On the other hand, in Morocco mostly secondary stakeholders have been brought around the table. This is in fact the difference between the two case studies. He further pointed out that the participatory approach was one of the main elements of INECO and that there is also need to have broader perspectives and expand beyond consultation with technicians, decision-makers and experts.

Prof. Bernard Barraqué replied, noting however that consultation with experts allows identifying what type of new assessments/studies need to be undertaken in order to reach decisions on new economic incentives and mechanisms. In this regard, that approach is likely to improve the public acceptability of these instruments, taking also into consideration the redistributive effects on the different water uses. He further asked whether the stakeholders involved in the Damour Case Study suggested additional assessments for water availability, distributive effects, etc.

Mr. Claude Tabbal replied that during the first Lebanon workshop, stakeholders were asked to express their views, the problems they experience and the policy objectives that need to be pursued. Many stakeholders also underlined the need for additional in-depth assessments, and also brought the relevant documentation to the table.

Subsequently, Prof. Evan Vlachos took the floor and commented that there is increasing apprehension that “water equation” (i.e. the balance between water supply and demand is changing dramatically in many parts of the world. He further noted that the legal system, which is mostly based on the Ottoman and French traditions, does not pose the difficulties faced by western countries with the riparian and the appropriation doctrine. Additionally, the vocabulary of public participation has been included not only in the Water Framework Directive, but also in international relations and in other national laws, and public participation is also part of our own way of thinking. In this regard, it is essential to know how much representative was the sample of stakeholders that were gathered around the table. Prof. Vlachos further pointed that it is critical to move away from the old way of giving presentations and distributing documents. Scientists may have models and data, but it is essential to ask people whether there are actually visible results. Traditional solutions (e.g. qanats) are also becoming important and receive increasing attention by stakeholders and decision-makers.

Ms. Sarra Touri (INAT) noted that surprisingly, stakeholders in Lebanon requested the reduction of the number of wells and the control of groundwater overexploitation. This is in contrast to the usual position of farmers, who prefer to exploit groundwater, as even if there is surface water available, groundwater is far less expensive to use. She further noted that according to their experience in certain areas of Tunisia, dams have been built to reduce the exploitation of water tables. The result was

disappointing, as in the end, farmers did not shift from groundwater to surface water, but instead preferred to use both.

Mr. Claude Tabbal replied that in Lebanon the Civil War resulted in limited presence of the State in all matters. In this regard, all citizens, farmers included, want a stronger presence of the State, especially with regard to environmental issues. Furthermore, during the civil water period, many illegal wells were drilled, in an effort to secure water, as there was no infrastructure. Therefore, there is public will to return to the pre-war state, when there were institutions, infrastructure and control.

Groundwater exploitation in Pegeia

Dr. Ioannis Glekas (Aeoliki Ltd.) presented the progress of the INECO Cyprus Case Study, on groundwater exploitation in Pegeia, Cyprus.

Pegeia is located in the north-western part of Cyprus; the municipality covers an area of approximately 54 km². The aquifer of Pegeia is the main source of water supply for domestic use. The aquifer covers an area of approximately 20 km²; however the main water body covers an area of less than 9 km². Thickness varies between 50 and 300 m and the annual abstraction is about 1,000,000 m³/yr, most of which is used to meet drinking water requirements. The remaining amount is used for irrigation purposes. It should be noted that the main source of irrigation water supply is the Asprokremmos storage reservoir, as the State decided to allocate surface water to local irrigation in an effort to protect the aquifer from overexploitation. However, farmers continue to pump groundwater through illegal boreholes.

In the area there were four municipal boreholes in 2004, and three more were drilled in 2007. The most important feature is that presently the region experiences rapid tourist and real-estate development. Farmers, who bought land at very low prices, abandon traditional agricultural activities and sell to developers, who develop big tourist villages and houses for foreigners. Presently, half of the population of the region are foreigners, of British nationality mainly, whereas the other half are Cypriots. In some cases this causes conflict as there are different perceptions on who is responsible and what should be the main course of action for mitigating water management problems.

Groundwater monitoring operations are undertaken by the Water Development Department of the Ministry of Agriculture, Natural Resources and the Environment. There are regular measurements of abstractions and groundwater quality; however the Department thinks that the network should be further optimized. Following from discussions held with local stakeholders, the main issue of concern is that there is sea water intrusion. At some locations, the WDD has monitored relevant small-scale problems, which however could be further exacerbated if no action is implemented. The problems are more acute during the summer period, where abstracted volumes are most significant. As mentioned above, a first measure taken by the Water Development Department was to allocate surface water from the Asprokremmos dam for crop irrigation, in an effort to eliminate groundwater abstractions by farmers.

Overall, the Pegeia aquifer is of major local importance; water quality is very good and meets drinking water quality standards. Therefore, the protection of the aquifer from sea intrusion, water quality degradation and overexploitation is of major significance. Measures that have been taken thus far focus more on the engineering side of the problem. With regard to water quality, it has been proposed to install small sewage treatment units at house or neighborhood level, in order to subsequently use treated water for garden irrigation. Furthermore, stakeholders stress the need for controlling the use of

agrochemicals and reduce losses in the distribution network, a task which falls under the responsibility of the Municipality of Pegeia. Additional suggestions comprise the need for regulating water use, especially during the summer period, when the population and water demand is dramatically increased.

Box 3: Institutional framework for water management in Cyprus

In Cyprus, all water is of public ownership; in some cases however, water rights have been assigned to individuals. The Water Development Department, which is the authority that manages the Government Water Works, recovers the costs of the system by selling water in bulk to Municipalities or Water Boards (domestic use) and to Irrigation Divisions, Associations and individual farmers (irrigation water). In the domestic sector, the Municipalities and Water Boards are responsible for distributing water to end-users, and recover the corresponding costs through water tariffs.

Several Departments and Ministries are involved in water management issues and there is an ongoing discussion for the establishment of a Water Entity (one institution) that will be responsible for all water management operations at national level. However, this remains a plan for the future. With regard to the water sector as a whole, the main problem encountered is related to the fragmentation of responsibilities. Fourteen (14) ministries and departments are involved in water management issues, and there is need for an "umbrella-law" to better define the entire framework. Furthermore, the slack supervision and control in environmental legislation, the lack of effective water pricing and the limited information disclosure to the interested parties are issues that are noted by stakeholders in all meetings.

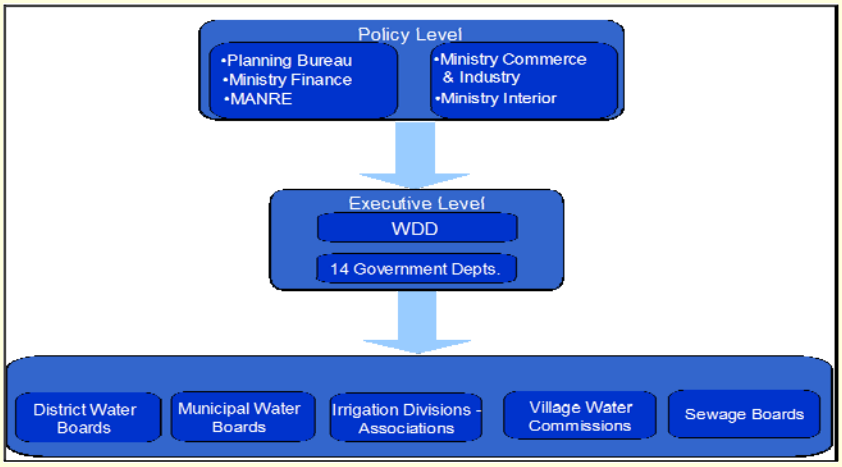


Figure 9: Institutional framework for water management in Cyprus

As far as vulnerability is concerned, in 2005 the aquifer was nearly in equilibrium. However, the low rate of replenishment, due to the substantial reduction of rainfall, agricultural activities, high extraction rates to meet domestic water needs and the rapid tourist and real-estate development increase the vulnerability of the aquifer to sea intrusion, and to pollution from agrochemicals. Until 2005 there has been an increase in water levels; however, however in the last three years at some locations of the aquifer and especially in the vicinity of boreholes from where water is abstracted for domestic use purposes, water levels are dropping. Until now, the quality of water is very good and there is no need for additional treatment. On average, groundwater abstractions exceed groundwater recharge by 5%.

As mentioned above, currently water from the aquifer is used for meeting mainly domestic water needs. According to a recent survey undertaken by the WDD, 0.8% of consumers in the area (mostly large hotels and tourist villages) account for 24% of the total water consumption during the summer period. This fact is always noted by locals, who are against the further development of the area. Box 4

summarizes the main stakeholder groups that have been consulted and their main interests/concerns over the management of the Pegeia aquifer.

With regard to efforts for water conservation, both in Pegeia and at national level, the improvement of irrigation methods is a policy objective that had been adopted by the Government several years ago. The application of advanced irrigation technologies was fostered through subsidies and long-term low interest loans for shifting from furrow to drip irrigation. The overall effort was very successful. Losses in distribution networks range between 15 and 20% in some municipalities (e.g. Limassol); however, this is not often the case, as in several other areas, losses are significant. There is significant State funding available for network rehabilitation. Furthermore, the Water Development Department is implementing a strategic plan for the promotion of technological advances aimed at water conservation, through subsidies and grants. In drought periods there are water supply restrictions imposed on all sectors in order to minimize water consumption. These measures raise significant objections from different social groups, and especially from agricultural organizations. For example, in 2008 the pronounced lack of water supply resulted in significant losses in agricultural production. There are also objections fro hotel owners, who however are rarely experiencing supply restrictions. In this context, several hotels are now requesting to install their individual desalination units.

In the specific case of Pegeia, and as mentioned above, the Government tried to promote the use of surface instead of groundwater for crop irrigation, a measure which contributed to the significant reduction of groundwater abstractions in the past years. Additional plans for the protection of water bodies in the area concern the initiation of the procedure for the construction of sewerage networks and a wastewater treatment plant, which will also allow the use of treated wastewater for irrigation purposes. The Water Development Department is also planning the construction of a large desalination plant (44,000 m^3/d) to meet domestic water needs in the entire Paphos area. It is expected that the plant will start operating in about four (4) years, adding to the existing desalination capacity which comprises two plants in Larnaka, and the future plant that will be constructed in Limassol.

Until now three meetings were held with stakeholders in Pegeia. Aeoliki Ltd. also had individual meetings with stakeholders last May, focusing on the screening of institutional and economic responses. Aeoliki considers that they have managed to establish close cooperation with local stakeholders, which will continue after the end of the project. The first two meetings with stakeholders focused on the problem of Pegeia and on the mapping of the corresponding causal interrelations in a problem tree form. Furthermore, during these first two meetings, and through a dedicated survey, stakeholder views and perceptions were mapped with regard to the issue at hand. Stakeholders generally believe that the aquifer is a locally important resource that needs to be protected from overexploitation and contamination. They also expressed the view that the authorized building permits presently exceed the carrying capacity of the area and exert significant pressure on water bodies and the water system in general. They also perceive that agricultural practices further contribute to the problem and note that there is lack of water conservation culture among the Pegeia residents. A lot of people raise also the issue of lack of information regarding water management issues; this lack of information is also often translated as lack of transparency. It also becomes clear that there is need for improving the management of the aquifer and the condition of the distribution network.

Box 4: Stakeholder groups and their interests with regard to water management in Pegeia

The **Municipality of Pegeia** is responsible for domestic water supply. With regard to the particular water management issue, they believe that they have to meet domestic demand; however there is lack of alternative water resources. Overall, the Municipality argues that it has limited capability to influence water policies, and is particularly favourable towards the construction of a large desalination plant. Furthermore, municipal authorities strongly support the further development of the area, and do not think that there should be restrictions towards the issue of building permits, as these constitute a significant source of income. Their desired main course of action is infrastructure improvement, raising awareness on water use and water conservation among the Pegeia citizens, and close cooperation with the policy makers of the central government.

The **Water Development Department** executes the governmental policy concerning water management. The Department is aware of the scarcity problems experienced in Pegeia, which are similar to those encountered throughout the country. According to their belief, there is need for improving water management practices; however, there is limited feedback from end-users with regard to the water deficit faced in the region. Overall, the Water Development Department has the capacity to influence decisions; within the framework of the WFD implementation, they have initiated public information campaigns towards raising awareness.

Farmers of the area were consulted on an individual basis, and were not represented by an association. They believe that the problem of the region is the lack of additional water supply sources, the cost of water and the climate conditions (currently Cyprus is facing an extensive drought period). It is worth noting that banana plantations are one of the prevailing cultivations in the area; however bananas are not considered a priority of the policy makers. Overall, farmers have limited capability to influence the decision-making process, and are eager to cooperate with other stakeholder groups since they face a lot of problems with the quantity made available for crop irrigation, and the sustainment of their production.

Developers are a different stakeholder group, which is gaining power with regard to decision-making in the area. Currently, Pegeia experiences rapid development in terms of real-estate and tourism. Developers believe that the main issue is the lack of additional water supply, which will ultimately result in water scarcity that can influence future developments. They expect that they will face problems in that respect in the near future, which will also have negative consequences on tourism. Developers can exert some influence over decision-making processes for serving their own interest (proceed with projects, secure water supply). As expected, they oppose restrictions on building permits; they are willing to cooperate with other stakeholder groups and can also mobilize political groups for solving the problem.

The **hotel industry and tourist apartment owners** also share the view that Pegeia is facing water scarcity. This problem affects the operation of hotels; two major hotel resorts have prepared tenders for installing small desalination units in order to meet their water needs, as they consider that due to the ongoing drought they may not be able to secure reliable water supply now or in the near future.

Finally, it should be noted that the **local population** can be divided in two different groups: those of **Cypriot nationality**, and **foreigners**, who have bought houses and land in the area. In majority, the population of foreign nationality are English-speaking who bought land from local farmers, and have contributed to the economic growth of the area. This group opposes the further development of the area (i.e. the building of new houses), and considers that water resources are managed inefficiently. Additionally, they recognize that there is pressure for the rapid development of the area and that water problems are accentuated by climate conditions, and consider that there is lack of information and transparency on water-related issues. On the other hand, the "local" group is positive for the development of desalination and believe that there is also significant water waste (which is attributed to the "foreigners'" group. They have a negative attitude towards water restrictions and water tariff reforms.

Following from problem analysis, the definition of objectives was further discussed with stakeholders. Their suggestions (both in terms of objectives and potential options) were the following:

- Development of additional water supply sources (e.g. desalination units), but also investment in other options, such as rainwater harvesting, loss reduction, use of unexploited resources (e.g. small rivers and streams, on which small interception dams could be developed), etc. It should be noted that such options had not been examined in the past; it was only this year the Municipality of Pegeia decided to exploit water from a stream that passes through the city.

- Development of small-scale sewage treatment units, which would allow for reusing water for garden irrigation;
- Transfer of water from neighbouring areas;
- Fostering of efficiency improvements in water use, through regular water audits for large consumers, and introduction of seasonal water tariffs.
- Enhancement of efficiency in water distribution;
- Subsidies for the installation of water saving equipment, which are already available, but of which local residents were not aware of;
- Economic incentives for the change of cropping patterns, especially with regard to banana plantations, which consume large amounts of water;
- Regulation of abstractions, strict monitoring and enforcement of penalties and fines for users that "waste" water;
- Introduction of small-scale desalination to meet the needs of the tourist sector (large hotels and tourist villages);
- Enhancement of awareness, through regular campaigns on water saving, and disclosure of information on water-related issues, through regular open meetings and public hearings.

With regard to the survey for the evaluation and screening of alternative instruments, Aeoliki Ltd. collected 25 answers. As far as individual preference of stakeholders is concerned, the most highly ranked instruments were water pricing, subsidies, liability systems and enhanced public participation. These instrument approaches were also considered the most relevant for improving groundwater management in Pegeia. Additionally, voluntary schemes and agreements were favoured by the consulted stakeholders. It is worth noting that a voluntary scheme is currently being implemented in Cyprus concerning the application of agrochemicals. However, this scheme, which has been adopted by approximately 800 farmers, has not been yet applied in Pegeia.

As far as domestic water pricing is concerned (tourism included), water for municipal use is priced at full cost. However, the introduction of desalination plants in the last 7 years was subsidized, and the tariff no longer reflects the full financial cost. In 2004, the Government of Cyprus proceeded to a major reform of rates charged for bulk domestic water supply to Municipalities and Water Boards, which were increased to 0.56 €/m³. The tariff structure imposed by Water Boards in all major urban areas comprises a fixed charge and a volumetric charge, which depends on consumption. Investments in rural water supply schemes are subsidised, depending on the size of population served. Tariffs are also differentiated according to the type of use (tourism vs. households), with tourism tariffs being considerably higher. Overall, the affordability of water charges is considered adequate; the ratio of household expenditure over the average GDP in Pegeia is about 0.4%, much lower than the threshold of 1.5%, which applies to industrialized countries. If tariffs were increased to achieve full recovery of financial costs, the affordability indicator would rise to approximately 0.6%, a value which again falls considerably below the critical threshold of 1.5%. Abstraction charges have not been applied yet; however, these instruments are under consideration by the Water Development Department and the Government.

Until 2003, in the agricultural sector, rates applied were differentiated on a local basis, depending on the district and the Irrigation Scheme, with water prices varying between 0.08 €/m³ and 0.12 €/m³. Since 2004, there has been a gradual increase of water tariffs, with the aim to reach by 2007 the uniform charge of 0.19 €/m³. However, due to the acute drought that is faced in the country today, the

last increase of 0.01 €/m³ that was to be effected in 2007 was not implemented, in order to alleviate some of the pressure imposed to farmers. Overall, it is believed that the currently applied irrigation tariffs encourage cultivation of water intensive crops. The effected tariff increase is expected to render the cultivation of certain crops not profitable; this however is an issue that raises a lot of concern, complaints and political pressure. In this context, the Parliament is always reluctant in approving the increase of tariffs for irrigation water, believing also that this can discourage irrigated agriculture and intensify urbanization in certain areas.

At national level several subsidies are already in place, for example for borehole drilling for garden irrigation or for connecting boreholes to lavatories in areas that do not face groundwater overexploitation problems, for the installation of grey water reuse systems in the lavatories and for garden irrigation, and for the installation of hot water recirculators. The Water Development Department has estimated that if such measures were to be applied to all consumers, they could be able to achieve a 50% reduction in the quantity of freshwater supplied through distribution networks.

With regard to liability, there is the Water Conservation Law of 1991, which applies within the Water Board areas, municipalities and villages. The Law states that hose use for washing sidewalks or streets, verandas or vehicles, is a criminal offence; violators can be imprisoned for up to 3 months and fined up to 1000 Euros or both. Policemen or other licensed persons (WDD personnel) having grounds to believe that a person is committing such an offence could issue a fine of up to 110 €. However, the measure has never been applied apart from drought periods, when there is stricter monitoring. There is also the Well Law, which sets the provisions for obtaining permits for borehole/well drilling. In this case, a permit is needed from the District Officer; permits can be issued without prior consultation with Water Development Department. This means that permits can be obtained even for areas which face severe groundwater overexploitation problems. Overall, supervision and control is relaxed, and penalties imposed are considered very light. This sluggish enforcement of environmental legislation, on the alleged reason of socio-economic concerns is considered as one of the weakest points of the water management framework.

With regard to public participation, the Water Development Department has initiated processes for public consultation and involvement within the framework of the WFD implementation. The process includes open meetings, questionnaires and awareness campaigns. Furthermore, several research projects (e.g. AquaStress) have initiated public participation processes for water management. However, the overall effort has just been initiated. There is lack of information, and people are just beginning to become aware and informed on water management problems, and to be consulted during the decision-making process.

Groundwater overexploitation in Tunisia

The context and outcomes of the INECO Tunisia Case Study on Groundwater overexploitation were presented by *Mr. Ahmed Bouzid,* from the Tunis International Centre for Environmental Technologies.

Tunisia, being arid to semi-arid country, is facing water shortage of increasing severity. Water scarcity problems are expected to intensify, as a result of population growth, rising living standards and accelerated urbanisation. These drivers put significant pressure on available resources and on the agricultural sector, leading to a significant increase in water use and pollution loads. Natural water resources in Tunisia are relatively limited and equal to 4.670 million m³, of which 4.100 million m³ are considered exploitable. The ratio of available water resources per capita had been estimated at 450 m³

in 1996 and will decrease further to 315 m³ in 2030. Thus, the country is considered one of the poorest countries in terms of freshwater availability. In 1996, the total water demand was estimated at 2.528 million m³ and is expected to follow a continuous growth. It is estimated that in 2010 exploitable resources will be equal to 4.600 million m³, whereas water demand is projected at 2.689 million m³.

In the above perspective, policy makers have been compelled to develop additional resources and to take measures in order to preserve existing ones. Currently, the main components of the National Water Resources Management strategy are surface water mobilization, soil and water conservation works, water harvesting, and use of non-conventional water resources, such as reuse of treated wastewater for crop irrigation and aquifer recharge.

Nowadays, demand management is considered an important axis of future water policies with the overall aim of controlling the consumption of the different sectors, and in particularly that of agriculture, which is the largest consumer. Although at present the country does not experience extreme water shortage, there is an increasing pressure on available resources due to accentuated droughts, pollution problems and over-exploitation of resources, which render the current decision-making processes with regard to water management and allocation difficult. In this context, there is wide acknowledgement of the fact that there is need for promoting (a) the use of non-conventional water resources (desalination) in order to meet potable water demand in deficient regions and (b) the exploitation of additional resources for the development of economic sectors, and especially agriculture. In this regard, Tunisia has developed since 1990 an ambitious program for the exploitation and management of natural and non-conventional water resources. At the end of 2002, the main water supply sources included 27 large dams, 182 small dams, 650 artificial lakes, 3.176 boreholes, 130.000 wells and 93 natural springs. For meeting the demand of deficient regions, inter-basin transfer is widely applied between northern regions, towards the coast and from the western to the eastern part of the country. Transferred water is primarily used for domestic and irrigation purposes. The conveyance network for inter-basin transfer is approximately equal to 30.000 km. In the most important water use is irrigation, which uses 80% of the country's available resources.

Currently, the total irrigated area is estimated at 400.000 ha, whereas irrigation demand is around 2.120 million m³. Irrigation water supply originates from large dams, boreholes and wells, and wastewater treatment plants and is managed by the CRDAs and local agricultural development groups. Domestic water demand concerns urban, rural zones, as well as water sources in the Sahara and is approximately equal to 350 million m³/yr. Water supply is provided by the National Water Company (SONEDE) and regional public services (CRDAs and Development groups in the rural zones). Industrial demand corresponds to 120 million m³/yr and tourism demand is estimated at 30 million m³/yr, both of which are supplied by SONEDE.

In spite of the considerable effort for water mobilization, which has played a dominant role in controlling water resources and attenuating the socio-economic impacts of droughts, farmers continue to overexploit phreatic water tables. The average rate of exploitation is 106 %, a fact that has resulted in the gradual depletion of productive aquifers and to increased salinity levels in coastal ones. In this context, the problem selected for Tunisia case Study is "**Aquifer degradation and Overexploitation of groundwater resources"** which is mostly due to uncontrolled abstractions for irrigation purposes and the inadequacy of the presently applied alternatives and disincentives to mitigate groundwater overexploitation. The problem is further exacerbated by the lack of technical capacity in the

agricultural sector, the limited application of water saving methods in irrigation and the current water-intensive cropping patterns.

Ground water resources of Tunisia were estimated in year 2000 at 740 million m³. Exploitable resources through equipped wells represent 106 % of the available resources. Wells and boreholes were developed during the last 20 years; groundwater extraction presently reaches 780 million m³ compared to 395 million m³ in 1980 (total growth of 97 %). Groundwater exploitation occurs mostly through surface wells and boreholes. In total, the number of shallow wells was 128.400 in year 2000 compared to 60415 in 1980. The total number of equipped (authorized) wells is 86.965 units. The largest groundwater abstractions occur in the north- east region of the country (350 million m³/yr or 45% of the total).

Especially with regard to groundwater management, and despite the fact that the overall institutional setting is considered well organized, there are still problems relating to institutional organization and water governance, such as:

- Lack of regulation and control, as illegal borehole drilling, without authorization and issue of the corresponding extraction permits is quite common;
- Need to further develop and enhance user participation in water management, through Agricultural Development Groups;
- Need for abstraction metering, as currently such efforts are hindered mostly due to social and political pressure.

Box 5: Institutions and legislation concerning water management in Tunisia

The main institution responsible for water resource management and exploitation is the Ministry of Agriculture and Water Resources. The Ministry controls 11 institutions for the assessment, monitoring, exploitation, distribution and evaluation of water resources and the construction, operation and maintenance of water works. The Ministry of Public Health, through its central and regional services, is responsible for monitoring the quality of potable water and treated wastewater used for irrigation, in order to prevent and eliminate water-related diseases and epidemics. The Ministry of Environment and Sustainable Development undertakes through its 3 institutions (ANPE, ONAS and CITET) all tasks related to water pollution and quality. Additional ministries involved are the Ministry of Technology and Communication, which controls the National Institute and Meteorology, responsible for the monitoring of meteorological, oceanographic and seismic data, and the Ministry of Scientific Research, which controls the Research Centre on Water Technologies and the Arid Regions Institute. In addition there are 1400 consumers associations, 570 farmers associations and 70 joint groups.

Concerning legislation, water in Tunisia is considered natural patrimony such as defined in the *code des eaux* (law N° 75 –16 of 31 march 1975) where at the first chapter level, water is considered as hydraulic public domain and as an offered natural resource, its use should respect the national management rules of the national natural patrimony. Water regulation in Tunisia started since 1885, but the main law which is currently applied in all the territory is the law N° 75-16 of march 31, 1975 which consists of 9 chapters and 160 articles and focuses on water resources management mobilization, conservation protection and exploitation. One of the main chapters of Code des Eaux is chapter 7 which comprises 46 articles addressing the issues of pollution and flood control. Water pollution prevention is effected through the prohibition of liquid and solid waste discharges in water bodies, the establishment of protected areas in the vicinity of water supply sources and the obligation for wastewater treatment in urban areas. In terms of flood protection, the “waters regulation” requires the construction of infrastructure by the government, development groups of public interest or by individuals. It should be noted that article 106 of chapter 7 regulates wastewater reuse in agriculture, setting the appropriate quality standards and the crops that can be irrigated with treated effluent.

Currently, the main efforts undertaken by the State for the protection of groundwater resources comprise the monitoring and management of water table decline through the optimization of the

corresponding monitoring network, which extends to 3602 water supply sources (2314 shallow wells, 1221 piezometers and 67 boreholes), the establishment of protected areas and the prohibition of extraction from certain water tables, and the promotion of artificial recharge, where hydrogeological conditions allow. Furthermore, the Ministry of Agriculture and Water Resources in view of the increasing severity of the problem, and in order to reduce/prevent pollution of vulnerable water tables from the discharge of solid or liquid waste, has implemented measures related to the protection of water bodies, the establishment of groundwater bodies' vulnerability maps with respect to pollution, the implementation of a survey on main water pollution sources, and the establishment of a network for water pollution prevention and abatement. In this context, the ANPE (Ministry of Environment and Sustainable Development) is currently undertaking a study on the vulnerability of the most important aquifers of Tunisia.

In view of the importance of groundwater and water conservation in general, several measures have been implemented, primarily focusing on capacity building. For example, the National Programme for Water Saving in Irrigated Agriculture has provided many supporting measures and significant financial incentives, implementing the legislation of 1995, which foresees a grant to the investment cost for using water saving techniques in irrigation. The grant varies between 40 and 60% of the total investment cost, depending on farm size, climate and crop type. The National Code of Investment further foresees a 10% of equipment value and the suppression of Value Added Tax and consumption rights.

With regard to national capacity for wastewater treatment and reuse, Tunisia as a sewerage network of 12,771 km and 98 wastewater treatment plants. The actual volume of water treated is currently 201 million m³/yr, escalating at 260 million m³/yr in 2011 and at 480 million m³/yr in 2030, when it will correspond to 10% of the exploited conventional resources. Currently, only 32% of this amount is reused in agriculture.

An additional component of the National Strategy for the mobilization of water resources is the artificial recharge of groundwater tables. Since this strategy first started to be implemented, the total amount injected in water tables is estimated at 387 million m³/yr (total for the period 1992-2003). The main sources of water used to recharge groundwater tables are surface water released from dams and treated wastewater. Only for 2003 it is estimated that a total of 43.2 million m³ was used for aquifer recharge.

For monitoring groundwater extraction, the agreed course of action can be summarized in the following:

- Provision of relevant means and equipment to stakeholders;
- Establishment of a Planning and Hydraulic Equipment Bureau at the Ministry of Agriculture and Hydraulic Resources;
- Evaluation and amelioration of current practices for resources monitoring (optimization of monitoring networks, improvement of telemetering systems, GIS etc.);
- Implementation of a strategy for managing water tables (GIS database and numeric models, prototype processes for the integrated management of phreatic water tables…),
- Undertaking of a pilot project on participatory irrigation water management,
- Control of water pollution and treated wastewater reuse, etc.

Furthermore, measures undertaken towards the reduction of groundwater extraction to meet sustainable aquifer yields can be summarized in the following:

- The undertaking of reviews and detailed research work plans on the basis of recent studies for water saving (1995) and water sector reforms (1999);
- The elaboration, adoption and implementation of water management programmes; and
- The establishment of a National Network for safeguarding and monitoring groundwater resources.

Going back to the INECO participatory process outcomes, in the developed problem tree the identified focal problem is the overexploitation of groundwater resources. One main cause is the operation of illegal boreholes, which can neither be controlled nor monitored. Additional issues (and as groundwater is primarily used for irrigation purposes) concern the current (inefficient) irrigation practices, adopted agricultural development patterns, the low efficiency of irrigation methods, the selection of low-value, water intensive crops, and of course the inability to meter groundwater abstractions.

Following from this exercise, two main objectives can be broadly distinguished. The first concerns reversing current trends with regard to groundwater use, by controlling and regulating borehole drillings, and the second is to rationalize water use in irrigated agriculture. In this regard, the proposed options (mainly institutional and economic) for the Case Study, defined on the basis of the identified deficiencies and international experience, were framed in six (6) categories:

- Category A: Options to control groundwater abstractions;
- Category B: Options to enhance efficiency in irrigation water allocation and use, and thus reduce groundwater abstractions;
- Category C: Options to enhance the use of treated wastewater for crop irrigation;
- Category D: Options to promote aquifer recharge with treated wastewater;
- Category E: Options to strengthen the socio-economic and institutional environment (enhance coordination and integration of policies among institutions involved, develop collective management systems and enhance public involvement);
- Category F: Options to improve the knowledge base on groundwater.

Box 6: Brief overview of the INECO Tunisia Workshops

Within the framework of INECO, CITET organized five (5) Stakeholder Workshops since the beginning of the project. Two (2) meetings were held at the premises of CITET in Tunis and three (3) meetings were held in Nabeul. The objectives of these events were to:

- Provide information on INECO and elaborate on its main premises;
- Discuss on current water management issues, and select a “focal problem” of major significance;
- Review the evaluation framework for the Tunisia Case Study;
- Elaborate on the questionnaire related to the screening of alternative approaches in terms of feasibility and applicability;
- Share and exchange views and knowledge on currently applied institutional and economic instruments in the Case Study context.

Within the course of this process, a set of proposals were formulated towards improved water management:

1- Management and recharge of aquifers:
   - Manage water tables through a shared process.
   - Install meters on wells in order to measure the quantity of water extracted.

- Use of surface water to recharge aquifers during the winter.

2- Improvement of the quality of treated wastewater:
- Develop more efficient control processes for industrial wastewater discharge;
- Develop institutional measures for ensuring coordination between various stakeholders;
- Reinforce capacity building and user awareness on wastewater reuse.

3- Surface Water Management and water allocation control.
- Better water allocation to ensure maximal output on socio-economic terms.
- Equipment of public irrigated schemes for water saving.
- Upgrading, consolidation, and reinforcement of GDA means and capacity.

4- Other proposals
- Implementation of uniform tariffs for irrigation water
- Further exploitation of untapped resources.
- Reinforcement of soil and water conservation projects.
- Development of pilot irrigation schemes and water valorization projects.
- Draw farmers interest to collective management.
- Better management of droughts and floods
- Bringing scientific research results closer to GDAs
- Application of the agriculture map.

The screening of alternative options by local stakeholders was performed through the corresponding survey questionnaire. In total, 64 persons were asked to fill in the questionnaire; these were individuals, water users, representatives of agricultural development groups and technicians. The main conclusions were that most individuals, water users, agriculture development groups, and water resources managers think that groundwater resources are very cheap compared to surface water, thus in order to alleviate groundwater exploitation, it is recommended to reduce surface water cost, and enhance subsidies for water saving methods in the irrigated perimeters that use groundwater. Water resources managers have much concern for enhancement of regulation and control procedures, but water users do not give such importance.

Especially with regard to the experience of Tunisia on the suggested options the following are noted:

- Control of groundwater abstractions: Public and private boreholes are monitored at the regional level by the CRDA. Currently, there is an inventory of groundwater abstraction points per water table. Permits for groundwater abstractions are issued by the CRDAs if the well/borehole has depth of less than 50m or by the Ministry of Agriculture otherwise. No limitations exist, unless the water table is considered vulnerable.
- Enhance efficiency in irrigation water allocation and use: Currently, many forms of assistance are available to those that choose to invest in water saving techniques. It is estimated that 70% of the public irrigated perimeters are equipped with modern systems. For strategic crops, water up to 1500 m^3/ha is provided free of charge. Presently, the market price of cereals is experiencing a continuous increase, and information and awareness campaigns are reinforced. It is estimated that after 2010 there will be a decrease in irrigation water consumption as a result of this strategy (i.e. through incentives for water saving, rationalization of water tariffs, efficiency improvements in hydraulic networks, incentives for less water intensive crops), or through the re-allocation of water according to the value of alternative water uses.

- Increase of the use of treated wastewater for crop irrigation: The option is considered of significant importance for meeting a share of the irrigation demand. Concerning urban development and land use management, the total volume of treated wastewater that will become available by 2030 (480 million m³ - 10% of the total mobilizable resources), will allow the irrigation of 100,000 ha. However, maximum reuse can only be possible if it is specific and there are specific measures taken for the protection of the environment. In this regard, there is need to elaborate the specific legislation according to the outcomes of specific research studies aimed at ensuring the implementation of collective sanitation systems and environmental protection.
- Use of treated wastewater for aquifer recharge: Currently, the option is not widely applied; only 1% of the total wastewater produced is used for aquifer recharge. For wider implementation, there is need to improve the quality of the treated effluent through tertiary treatment to minimize risk of contamination.
- Participation in decision-making: It is widely acknowledged that there is need to reinforce the participation of all users and different stakeholders through their representation in Agricultural Development Groups, and to really implicate them in the decision-making process, and the rehabilitation and maintenance of the relevant hydraulic infrastructure.
- Additional measures to strengthen the overall institutional and socio-economic environment foresee efforts to raise awareness and promote education and capacity building initiatives for all users. Institutional issues should also be further explored in order to ensure wider coordination between institutions concerned. Legislative measures with regard to the establishment of Agricultural Development Groups need to be improved. Especially with regard to water tariffs, there is need to ensure that socio-economic constraints and food security issues are addressed.

Discussion panel on proposed options for the Cyprus and Tunisia Case Studies

The discussion panel on proposed options for the Cyprus and the Tunisia Case Studies was initiated by *Prof. Dionysis Assimacopoulos*, who provided a summary of the main points of the two presentations (Table 3).

Table 3: Summary of the INECO Cyprus and Tunisia Case Studies

	Pegeia area, Cyprus	**Tunisia**
Focal Problem	Groundwater overexploitation due to: ➢ Rapid urbanisation ➢ Increasing demand for tourism	Groundwater overexploitation due to: ➢ Agricultural water use ➢ Limited acceptance of wastewater reuse
Policy orientation	➢ Alternative water supply (desalination & greywater reuse in the home) ➢ Incentives for water conservation & leakage control	➢ Alternative water supply (wastewater reuse) ➢ Incentives for water conservation in irrigated agriculture (choice of crops, irrigation methods)
Suggested options	➢ Subsidies & mandates for the installation of efficient water fixtures and appliances, esp. for new buildings	➢ Abstraction permits & enforcement ➢ Voluntary programmes for water saving/reduction in groundwater use targeted to farmers

	Pegeia area, Cyprus	Tunisia
	➢ Disincentives for excessive water use ➢ Increase of water rates, especially for large residential consumers/hotels to cause shift to other supply sources ➢ Application of seasonal water rates ➢ Groundwater abstraction charges internalizing resource costs ➢ Government subsidies for leakage reduction and control programmes ➢ Compulsory water audits for the large consumers ➢ Awareness & participation	➢ Pricing incentives ➢ Lower price for treated wastewater than surface water and groundwater pumping costs ➢ Abstraction charges for groundwater (public & private boreholes) ➢ Decentralization of activities in GW management – collective management schemes ➢ Awareness campaigning

Prof. Dionysis Assimacopoulos pointed out that the two cases are quite similar, but at the same time different. In both cases, groundwater resources are threatened. The main driver in the Cyprus case is rapid urbanization and increasing tourism demand. In the second case, increased groundwater vulnerability is linked to increased demand for agricultural purposes, also due to the limited acceptance of alternative water supply sources (treated wastewater). In this regard, in both cases stakeholders point out that there is need for developing alternative water supply.

Figure 10: Mitigating water scarcity – Policy goals

Subsequently, and with reference also to the Lebanon and the Morocco Case Studies and the presentation of Prof. Massarutto, Prof. Assimacopoulos described the main policy objectives with regard to water management and use (Figure 10), summarized the main policies currently followed in both countries and the individual preference of stakeholders with regard to the proposed instrument approaches:

- In Cyprus, public participation, water pricing (increase of current water tariffs), and environmental charges are options considered preferable by the majority of stakeholders.

Decentralization is a non-preferred option, and also considered irrelevant with regard to the analyzed problem.

- In Tunisia the main policy is to increase productivity in irrigated agriculture, while at the same time provide subsidies for wastewater reuse and monitor groundwater abstractions.
- In Lebanon and Morocco the consulted stakeholders believe that water pricing and cost recovery are not appreciated options, as they are thought to pose significant burden on water users; people request increased involvement of stakeholders, decentralization, and subsidies.

Furthermore, Prof. Assimacopoulos pointed out that in the cases of both Morocco and Cyprus, previous water policies emphasized on the construction of dams, mostly financed by the World Bank. The moto that characterized the water policy of both countries was "not a drop of water to the sea". However, in Cyprus policies were also formulated towards the enhancement of efficiency in irrigated agriculture, whereas in Morocco this effort has just been initiated.

Subsequently, *Mr. Mohamed Marzouk* addressed two questions to Mr. Yiannis Glekas. The first question concerned the monitoring of irrigation water use in the region, and the second was related to the efficiency of the public water supply systems, which in Cyprus reaches 85% in some urban areas, and 70% in certain rural areas; he pointed out that according to his opinion, leakage reduction efforts cannot achieve larger percentages due to the high cost entailed in such efforts.

With regard to leakage reduction and control, *Mr. Glekas* noted that the 15% losses percentage cited in his presentation concerned only the Municipality of Limassol, the second largest urban area of Cyprus, where there has been significant investment to reduce water losses. This figure in fact is the lower limit with regard to water losses in urban areas. However, in other regions of Cyprus, losses exceed 30%. Concerning the monitoring of irrigation water consumption, Mr. Glekas pointed out that all quantities supplied from the Public Irrigation Schemes of Cyprus are metered and charged by the Water Development Department of MANR&E of Cyprus. In this regard, they can have a clear idea on the evolution of irrigation water supply and use in the region of Pegeia, which is currently supplied by the Paphos Irrigation Scheme.

Prof. Evan Vlachos subsequently commented on the situation in Cyprus and Morocco, pointing out that previous water policies were based on the old paradigm concerning water management and use, which was based on the concept that "development is needed at any cost", in order to alleviate poverty, but disregarding the environment. Currently, the main orientation of water policies is more towards changing this development pattern by giving priority or investing in high valued uses and eliminating low value ones. In this case however, users need to be compensated for the damage they would suffer and for the corresponding income loss.

2.2.3 Session 4: Case Studies on Water Pollution prevention and control

Pollution of the Seybouse River, Algeria

Mr. Abdoullah Bouchedja presented the progress of the INECO Algeria Case Study, which focuses on the pollution of the Seybouse River. Pollution problems experienced in the Seybouse River are primarily associated with the discharge of industrial effluents, especially waste from the oil industry. The problem is becoming more acute, due to the increase of population and the industrialization of the country. Presently, and as since the establishment of the five River Basin Authorities of the country, the ABHCSM has accumulated some data and information on the pollution experienced in the river;

however, there is still lack of information on the most significant pollution sources and lack of collaboration among the stakeholders and actors involved in the management of the river waters. In this framework, the ABHCSM decided through INECO to foster the establishment of a participatory process, aimed at enhancing collaboration for the development of an integrated approach aimed at the protection and rehabilitation of the river.

Box 7: The Seybouse River Basin

Seybouse is a permanent river of eastern Algeria, which discharges near the city of Annaba. The River Basin sustains multiple water uses (irrigated agriculture, industry, urban centres).

Several cities are located along the river course. Annaba is the largest, with a permanent population of approximately 300,000 people. There is also significant industrial activity. From the 86 industrial premises, only 8 have individual wastewater plants. The industrial sector comprises activities for sugar processing, steel manufacturing, phosphates, fabrication. A large industrial unit is located exactly at the confluence of the Meboudja and the Seybouse rivers. There are also two large irrigation perimeters.

Figure 11: The Seybouse River

The recent institutional reforms of the water sector (e.g. in water service provision), although in the right direction, have not been accompanied by thorough evaluation studies. In this context, presently, the situation remains unclear as to the responsibilities of the different actors involved. For example, the main unit responsible for administrative operations at local level is the wilaya, which is the local equivalent of the French Department or Prefecture. There are regional authorities, but these do not have significant responsibilities. Only the ANPE (the National Agency for Water Resources) has regional departments. In this context, the coordination between the regional water management authorities and the local administration is difficult. Finally, a limited amount of information is made available to the public, and there is limited public participation.

The ANPE is the authority responsible for monitoring water quality. In the Seybouse River there are four sampling points. Measurements from one of these sampling points were not reliable. Water quality parameters measured in the other three stations include COD, BOD, phosphates ammonium, nitrates and nitrites. Measurements reveal that there is significant deterioration of water quality from upstream to downstream. The quality of the waters is classified according to the worst indicator value. At the downstream part of the basin, measurements for all quality parameters reveal a very bad state of the river. Similar results were obtained by the water quality survey of Prof. Djabri in the University Annaba.

Presently, there is a licensing system for pollution discharges, which is based on discharge standards. Furthermore, there is a zoning approach, through the designation of perimeters in areas where water quality needs to be protected, especially around drinking water abstraction points. There are also specific zones for rehabilitation and protection of raw water quality. The applied tariff systems and financing tools are supposed to be designed so as to provide incentives for water conservation. In most of the country, Increasing Block Tariffs are applied; charges are set for both water supply and sewerage services. Further to that, and similarly to the French model, a levy system is applied for pollution discharge and water abstraction, implementing the “user pays” and the “polluter pays” principles. However, presently these levies are collected by the five River Basin Agencies but revenues are not used at local level; instead they are allocated to the Ministry and to the national budget.

Overall, it can be argued that the institutional framework is strongly influenced by the French regulatory system, as it is the traditional administrative level that has the overall responsibility for legislation enforcement. Local administrations are those responsible for issuing licenses for pollution discharge, abstraction and which undertake the monitoring of river water quality, pollution abatement measures and start prosecution against polluters. River Basin Authorities have no role in this respect.

The five River Basin Authorities were first established in 1996. Since then, and particularly in the Seybouse River Basin, it has been realized that water pollution has become a very important problem. However, pollution does not only originate from water discharges but there is also a tremendous solid waste problem. Solid waste is usually disposed in the rivers, a fact that exacerbates pollution issues. There is no system of garbage and waste collection. Similar issues also exist in many Mediterranean countries, but in this case it has become very serious. Perhaps one of the main causes is the inability of the current institutional set-up to address the problem. However, one of the responsibilities of the ANPE is to develop appropriate information and data, and to enhance public information and awareness through relevant campaigns etc. There is also a programme funded by the National Government for the construction of sewage treatment plants; the total capacity will equal 180,000 m^3/d. Additional wastewater treatment facilities will be constructed for other cities.

Integrative and participative actions are under implementation, not only through INECO but also through other initiatives. A specific meeting was organized in April 2008 for industrialists and local authorities; representatives from industries attended the event, however, local authorities did not come. Further to that, a significant effort is undertaken for improving knowledge on water quality, particularly by collaborating closely with the University of Annaba. This was one of the outcomes of the INECO Regional Workshop, where local researchers were able to present their views on the problem and their expertise. In this regard, presently there is better representation and participation of NGOs on environmental protection issues.

It has been made obvious that the first task is to build the foreseen sewage treatment plants today, which is an issue of funding and not an issue of public participation. However, still there are tremendous problems as there is no control over discharges and there is need for a better system for monitoring water quality along the Seybouse River. The four sampling points are not sufficient. This in turn requires additional funding, first for being able to monitor the river. For this purpose, it has been proposed to increase charges to polluters in order to build the information system, while at the same time develop awareness. The different proposals of stakeholders converge to the need for a better operation of the water police. There are requests for the prosecution of polluters, and for eliminating polluting discharges and illegal dumping of solid waste along the river. In the World Water Day (March 2008), we have jointly decided to establish an Association, the "Friends of the Seybouse", however this has not been yet implemented.

Box 8: Outcomes of the INECO Algeria Stakeholder Workshop Questionnaire

The questionnaire of the INECO Stakeholder Workshop was completed by 42 participants, 32 of which were local stakeholders. The most important outcomes of this survey were the following:

Twenty six (26) participants acknowledge that water pollution is a very important issue that calls for immediate action. There is agreement that industry is the main polluting activity. All participants are much in favour of public participation, acknowledging the need to involve the local population and to enhance public control over the operation of industrial establishments.

Twenty four (24) participants consider that the current pollution charge system is unfair, because charges are not set according to the pollution loads discharged but take the form of a lump sum. Therefore, all industries pay the same amount, regardless of the pollution they incur. According to the views of respondents, environmental charges should be proportional to the amount of water discharged, but this requires monitoring of industrial discharges.

Pollution of the Barada River, Syria

Mr. M. Haddad (Project Manager, Studies and Integration Consulting) provided an overview of the INECO Syria Case Study on pollution and water quality deterioration in the Barada River Basin. The Barada River springs are located from mountains north-west of Damascus. The river flows southward for 84 km, through Damascus, and discharges at the al-Utaybeh Lake. The Barada River Basin, being a rapidly developing area, concentrates most of the economic activity of Syria. The flow of the Barada River is nearly doubled by the Fijeh Spring, which is also used for supplying drinking water to the Damascus Metropolitan Area. Furthermore, the Barada River irrigates an area of 375 km^2, and sustains the Ghoutah Oasis, which surrounds Damascus.

The pollution of the Barada River is induced by high loads of domestic waste and wastewater. Presently, wastewater is discharged to the river from spring to discharge, whereas the riverbed and surrounding areas are also used for waste disposal. There is also discharge of polluted industrial wastewater from tanneries and marble factories. Furthermore, agricultural activities also contribute to the problem, through the excessive use of fertilizers and abstraction of river water (which in fact is wastewater, as it is significantly polluted) for crop irrigation. The Barada spring lake is also drying up; this is due to the use of the Barada and Fijeh springs for drinking water supply, well drilling by the Government for drinking water supply, and the abstraction from numerous illegal wells, which are used by farmers, house owners, factories and tourist establishments along the river course. Therefore, water quality deterioration is also linked to the decrease in river flows. The exploitation of the aquifer underlying the Barada lake has affected river flow. All the above are revealed from water quality measurements taken in recent years, all of which portray clearly that there are problems manifested by

the increased concentrations of BOD, COD, ammonium and many other parameters. The increasing use of surface and groundwater in the area further reduces the quantities and quality of water for irrigation, which leads to further depletion of groundwater and water stress. Food industries contribute to increased loads of organic pollution, which requires oxidation (measured by the dissolved oxygen depletion in the water), and leads to the destruction of aquatic life. Marble factories also contribute to water quality deterioration. Water pollution has also resulted in abandoning more than 200 drinking water supply wells in 2005.

A drainage pipe pours water in the river 1200 m from the Barada Spring, Zabadani Area, Feb 2008

A river tributary, which is completely dry and polluted with solid waste, Sep 2007

Photos of the Barada River Basin, illustrating pollution problems

In terms of secondary effects, the drying-up of the lakes has had considerable impact in agriculture and tourism; for example, there used to be many restaurants and tourist establishments around the Barada lake, all of which are now closed. Furthermore, the decrease in river flow has forced farmers to intercept wastewater conduits in order to use water for land irrigation. The loss of agricultural and tourism income induces migration towards the city of Damascus, and further increases demand for drinking water and other services in the metropolitan area. Overall, the overexploitation of water resources, in addition to urban development over the years has caused deforestation of land and degradation of soil quality due to erosion.

In Syria, the ministries involved in water management operations are the Ministry of Irrigation, the Ministry of Agriculture and Agrarian reform, the Ministry of Housing and Utilities, and the Ministry of Local Administration and Environment. The Ministry of Irrigation and its directorates are responsible for administering and developing water resources, for the regular monitoring of surface and groundwater quality and for ensuring the availability of water resources for irrigation purposes. The Ministry of Irrigation is also responsible for controlling drilled wells and boreholes and for licensing future wells. The Ministry of Agriculture and Agrarian Reform is responsible for the use of water for agricultural purposes. This includes the promotion of modern irrigation techniques and the cultivation of crops with lower irrigation requirements. The Ministry of Housing and Utilities is responsible for drinking water distribution networks in urban and rural areas and for sewage treatment. The Ministry of Local Administration and Environment is responsible for monitoring and controlling water quality, and for issuing national standards for the protection of water resources. In addition, the

Ministry of Health undertakes chemical and biological analysis of ground and surface water resources when demanded by the other four ministries.

At local level, Governorates are also involved in the aforementioned tasks. Governorates have an important role in offering technical support, especially for small-sized local authorities, which do not have the required technical capacity. In each Governorate, there is a water authority, responsible for water services at the entire Governorate area. Public companies, falling under the control of the Governorate, have been established in the cities which have wastewater treatment plants; their number is increasing as wastewater facilities are being developed.

A significant problem faced by the water management sector today comprises the integration of functions between authorities. Additional issues concern the efficient application of economic instruments, the lack of an efficient monitoring system, the disregard concerning the role of beneficiaries in water management, and the multiplicity of authorities and overlaps in responsibility among the different parties. There is also significant lack of communication and data exchange between policy and decision-makers; this is considered one of the major problems in Syria, affecting not only the water management sector. It is difficult to obtain information; this also applies to the ministries themselves.

Four recent laws and decrees related to the water sector in Syria are indicative of the current policy pursued by the Government. The first law concerns the Establishment of the Higher Institute for Water Management, which was implemented in 2005. The role of the Institute is to promote research and scientific progress, through the implementation of training programmes and the development of technical resources in all Ministries involved in water management. Additionally, Law 31 defines very clearly responsibilities in water management, including provisions for rights on water resources and use, water networks and water infrastructure, licensing of wells, penalties, etc. The Law also foresees the establishment of water user associations, which are completely absent in the present framework, and the establishment of the General Board of Water Resources for the management, development and protection or all rivers, and supervision of investment and control of the operation of water works in all river basins. Additionally, the Environmental Law also sets the Syrian Standards for water quality, air etc.

Especially with regard to the Barada River Basin, the Syrian Government is working on several projects in an effort to control water pollution. The new legislation requires that tanning manufactories move from the river vicinity to the new industrial area of Adra, in northern Damascus. The problem however that has arisen with regard to the implementation of the law is that it requires development of on-site wastewater treatment facilities; relevant costs have to be borne by the industries. This has been the subject of a long debate, because the factory owners requested additional state funding for the development of the industrial wastewater facilities. Eventually, at the end of last year, the Damascus Governorate agreed to finance wastewater treatment for the industrial city. However, even though the issue has been resolved, nothing has happened yet. Tanneries have not moved yet, and instead raise different issues. In this context, the discussion for incentives towards the relocation of industries and tannery workshops to the Adra industrial city is still ongoing.

With regard to water quality monitoring, the State, supported by International Agencies, has undertaken successful initiatives for monitoring surface and groundwater quality. A project has been launched for the development of a shared database on water quality monitoring under the responsibility of the Ministry of Irrigation. Furthermore, there are also plans to further expand the

Adra wastewater treatment plant, in order to be able to also treat industrial wastewater, and improve the quality of treated effluents. In the surrounding rural area there is a programme for the construction of 30 small wastewater treatment plants, to ensure that all wastewater has been treated before it is discharged to the river. Furthermore, the Government decided to move forward in the modernization of irrigation, by providing non-interest 10-year loans to farmers, who choose to install new irrigation systems. At national level, the Environmental Law and the Water Law are considered very important steps in defining the legal and regulatory framework for all other initiatives. The new tariff system, presented in Box 9 is also considered an important incentive towards water saving.

Box 9: Cost recovery for water services in the Barada River Basin, Syria

The water pricing system changed in November 2007. The previous system incorporated Increasing Block Tariffs, and involved four consumption tiers. The tariff structure was preserved in the reform, but an additional tier (consumption block) was added. The rate for the first block was decreased in comparison to the other blocks. Wastewater charges are set as percentage of water supply charges. Furthermore, the new law increased rates for government institutions and for commercial and industrial establishments. The new tariff was introduced 2 months after the INECO Syria Stakeholder Workshop, where it was suggested to increase tariffs for the industrial, commercial and tourist sector.

Currently, the average household expenditure for water services is around 2% of the income in Syria, and is considered fair both for households and for the industrial sector. Cost recovery for irrigation water is fixed, around 3,500 SP/yr. However, the corresponding charges are not paid, as farmers used to directly abstract water from the river, free of charge. The only costs borne by the users are those related to abstraction equipment (pump installation). Charges are uniform, and do not depend on the type of crop.

The main problem encountered in the industrial sector is related to illegal industrial establishments. There are a lot of micro- and small industrial workshops in the Basin that use water directly from the distribution network and are not charged with the industrial water tariff. This is also translated into problems with the management of industrial wastewater, which is directly discharged in the sewerage network, without the necessary prior treatment. The damage (both economic and environmental) is very high, and no measures can recover that cost. The main wastewater treatment plant, which is located in North Damascus (Adra area), is equipped for sewage treatment only; therefore, the uncontrolled discharge of industrial wastewater causes a lot of problems to the plant's operation.

Additional important steps are the effort to develop Water Users' Associations, which presently are completely lacking, and as a result there is no representation and participation of water users in decision-making. The new water law opened the road for the establishment of these associations, but little progress has been made to that end. It can also be argued that the 10th 5-year plan (2006-2010) has managed to develop an adequate short and long-term road map towards the achievement of IWRM. Additionally, the establishment of a Higher Institute for water management is critical in providing water establishments with the experience required and in fostering capacity building. Many awareness campaigns for farmers have been implemented in relation to modern irrigation methods, risks involved in the use of polluted water, the excessive application of fertilizers and pesticides, etc.

In this context, the INECO workshop which was held on September 10th 2007 managed to gather all important stakeholders. The overall approach, through the development of the "problem tree" was found useful by the Ministries involved. The Ministry of Local Administration and the Environment used this illustration to explain the focal problem to the Prime Minister. All steps followed (Objective Tree development, questionnaires, surveys, evaluation of options from stakeholders) yielded significant results, some of which are illustrated in Box 10.

Box 10: Outcomes of the instrument screening process in the Barada River Basin

With regard to the screening of potential responses, stakeholders clearly indicated preference for subsidies, liability systems, environmental charges and taxes, and pricing. With regard to subsidies, stakeholders indicated that additional incentives need to be provided to industrialists for relocating their businesses to the industrial city of Adra; additionally, water and power supply should be provided at low price in the newly designated industrial area. Furthermore, grants and other forms of fiscal and financial incentives should be provided to businesses to encourage environmentally friendly behaviour, such as investment in water saving equipment, in order to reduce water use and improve water quality. In agriculture, there is need to provide incentives to facilitate the wide implementation of modern irrigation methods and the transfer of knowledge on new systems and technologies. It was noted that technology transfer and developing capacity in the agricultural sector is one of the main problems experienced today.

Liability systems were an additional proposal that was supported by stakeholders. Furthermore, stricter environmental liability rules for both the public and the private sector is one of the main problems faced by central and local authorities. As many industrial establishments are owned by the State, it becomes important to start law enforcement from these publicly owned industrial premises, through the development of wastewater treatment plants. In addition, legislation with regard to illegal connections and water theft needs to be fully implemented. With regard to the enhancement of regulations and their enforcement, stakeholders proposed:

- The implementation of tools like the 'polluter pays' principle and cost recovery, possibly in combination with incentives for environmentally-friendly activities.
- For environmental charges and taxes, improving performance standards in water supply and treatment.
- Increasing or decreasing costs for well and borehole permit issuing according to the state of groundwater bodies.
- Institutional and legal reforms, which would provide more liberty to water and wastewater authorities in establishing tariffs.
- A more effective water pricing system is needed to enable water authorities to recover their costs.
- Adopted pricing policies should make clear distinction between cultivated crops (in irrigation) and industrial process types (in the industrial sector).

In addition to the above, the stakeholders consulted in Syria noted that the key responsibility of the Government is to develop a policy and strategic planning framework for water management, including short, medium and long-term goals and actions. This framework should clearly define priority areas for interventions, while at the same time addressing issues such as private sector involvement, water pricing and cost recovery policies, value of water in irrigated agriculture, and institutional overlaps. The issue of capacity building is crucial, as there is need for increasing the efficiency of operations and for the development of human resources through technical training, introduction of information technologies, knowledge transfer and exchange of experiences. With regard to water use, water conservation measures need to be promoted and possibly, the water sector should be re-organized so as to develop appropriate institutions for river basin management where appropriate. In general, organizational issues are tackled by the governorate authorities, and in several cases, a river basin falls under the responsibility of different governorates, which often creates management problems. This is the case of the Barada River Basin, which is shared between the Governorate of the Damascus Metropolitan Area and the Governorate of the Damascus Rural Area.

Finally, it is necessary to take concrete action and strengthen the role of Water User Associations, in order to enhance the participation of water users in decision-making. Additional requirements towards information sharing (primarily between the administrative departments concerned) include the development of a database on water-related issues, and mechanisms to ensure transparency in information exchange.

Subsequently, Mr. Haddad provided an overview of the INECO activities in Syria. Overall, many meetings have been organized; additionally, and in order to better record the problems of the Barada river, the INECO team visited many villages along the river and met with farmers and industrialists. The team further provided the Media with many newspaper articles on the issue, and several interviews on TV and radio were given. Furthermore, important stakeholders received CDs with information on the progress of the INECO Case Study.

Mr. Haddad closed his presentation noting that INECO will not solve the problem in the Barada River, but is a good step towards this process. Important stakeholders, including policy makers have shown particular interest on the approach; the problem tree illustration has been presented in many meetings with highly ranked government officials, and also to the Prime Minister, in order to better describe the issue at hand, and discuss potential course of action.

Water quality deterioration in the Bahr Basandeila Canal, Egypt

Dr. Fathy El Gamal, Director of the Water Management Research Institute, presented the context and outcomes of the INECO Egypt Case Study on water quality deterioration in the Bahr Basandeila area. Key information on the area is presented in Box 11.

Box 11: Background information on the Dakahlia Governorate and the Bahr Basandeila area

The population of the area is around 5 million inhabitants. The average population growth rate is around 1.9%. In terms of water supply, the amount of water distributed by the water supply company is around 1 billion m³. On a per capita basis, the daily average consumption is around 200 l/cap/d. The losses of the water distribution network are around 50%. The tariffs set for potable water vary according to consumption and activity, ranging from 5 cents/m³ for drinking water and 20 cents for industrial production.

The share of population served by sewerage networks is around 30%. The rest of the population is served by septic tanks and open drains. Only 25% of the total produced wastewater is treated. Significant investments have been made in the water sector during the last 25 years. Around 900 million US$ have been allocated for sewerage network projects, corresponding to approximately 200$ per person. Almost all costs relating to sewerage infrastructure are recovered.

The main problem experienced in the Bahr Basandeila area is the deterioration in canal water quality. According to the outcomes of the Egypt Stakeholder Workshop, also presented in the corresponding problem tree, the main causes of the problem are related to the:

- Discharge of industrial and municipal effluent without proper treatment,
- Excessive application of agrochemicals, fertilizers, pesticides and herbicides,
- Lack of proper infrastructure for wastewater treatment,
- Limited awareness of farmers towards improved agricultural practices and environmental protection
- Lack of proper maintenance of the drinking water supply system.

In this regard, lines of action towards the improvement of the quality of canal waters should focus on the: (a) control over the discharge of untreated industrial effluents, (b) control of fertilizer, pesticide and herbicides application, (c) proper maintenance of the drinking water supply system, (d) improvement of the quality of water services especially with regard to the safety and reliability of drinking water supply and sanitation services, and (e) establishment of commitment among water users to implement pollution mitigation measures. To that end, potential measures towards the achievement of these objectives are portrayed in Figure 12.

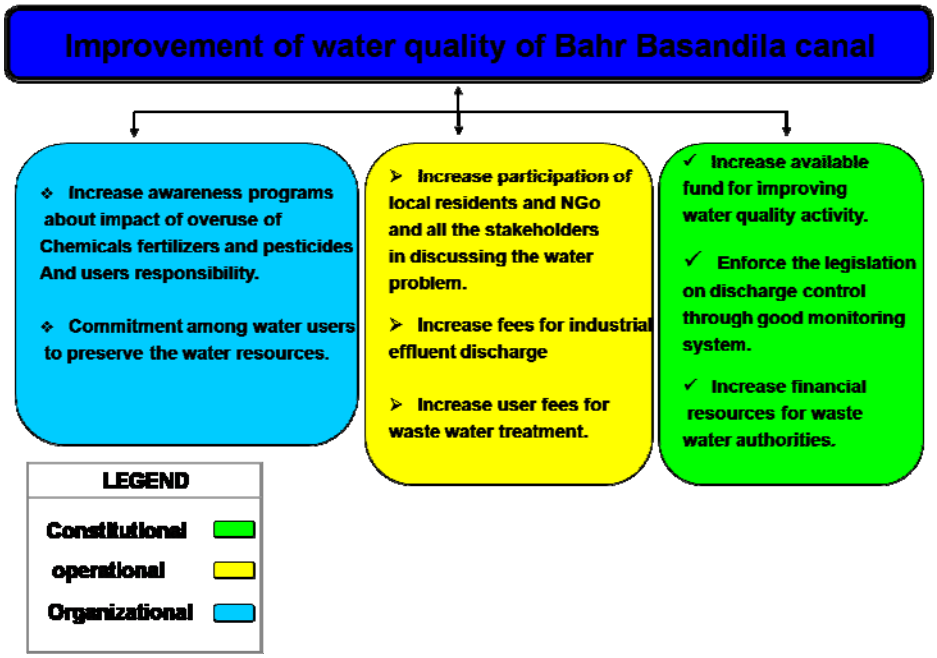


Figure 12: Potential measures towards improving water quality in the Bahr Basandeila Canal

In order to identify the relative importance of the problem, water quality indicators (faecal coliforms, BOD, COD, Dissolved Oxygen and nitrate concentrations) were developed, with the aim to quantify potential impacts on crop quality, human health and fish production. In addition, and especially with regard to impacts on crop production and agricultural land, additional water quality parameters (heavy metals) were measured. Following from this evaluation it became evident that the main source of pollution is sewage water. Pollution from agricultural and drainage water is still limited, whereas pollution from industrial effluents is inexistent.

The results from the evaluation of alternative instruments in terms of applicability portrayed that decentralization and public participation are presently considered by the majority of stakeholders a key element for the implementation of successful water management policies. With regard to water pricing, it should be noted that the term is not very well accepted; decision-makers prefer to use the term “cost recovery” when referring to charges set for the provision of water services. Presently, volumetric charges are used only for recovering the costs for drinking water supply. Liability systems exist but are not enforced.

The Bahr Basandeila canal is considered representative of most of the irrigation canals of Egypt. Pollution of waterways has become a problem experienced throughout the country; it is not always a result of increased loads, but it can also result from the decrease in water flows. For example, in winter, when irrigation water requirements are very low, the discharge in canals is minimum; during these months, pollution is more evident than during the summer season.

Presently, in recognition of the increasing importance of water scarcity and pollution, the Ministry of Water Resources and Irrigation developed a National Water Plan for 2017. The Ministry is presently working for the update of this plan up to 2050. With regard to water pollution, the main source is considered to be sewage water, mainly due to the lack of provisions for the construction of sewerage networks in parallel to distribution network development. Other pollution sources comprise agriculture (salt, agrochemical residues from fertilizers, pesticides and herbicides), and industrial activities which discharge wastewater without the appropriate prior treatment. Within the framework of the National

Water Plan, activities aimed at water quality improvement are directed towards (a) pollution prevention, (b) reduction of pollution loads through treatment or (c) impact mitigation. The overall goal, which however is case-dependent, is to combine the interests of socio-economic activities that are the main pollution sources to the need for adequate water quality to protect human health and the environment. The overall policy objectives of the water quality strategy comprise the improvement of water-related public health conditions, the sustainable use of groundwater resources and to meet the water quality requirements for the various functions of waterways. According to the precautionary principle, measures should be aimed at preventing emissions, treatment of discharges and emission control. Every polluter is responsible for their emissions. Pollution problems should not be transferred downstream the water system; measures that do not need institutional or legislative changes and reforms are to be preferred in the short-term. It is further pointed out that measures that are not supported by the current institutional and legal framework are not to be considered.

Box 12: Policy recommendations from the INECO Egypt Stakeholder Workshops

Within the frame of mapping stakeholder views and arriving towards broader policy considerations, three workshops were organized. The main recommendations derived from these events were the following:

- Increase applied research in the field of water and health.
- There is need to further work towards raising awareness on water-related issues among all citizens, so as to rationalize water consumption
- It is required to transfer the need for reducing industrial pollution in the Nile River to the appropriate executive bodies.
- Groundwater should be protected from pollution, through the rationalization of the use of pesticides, fertilizers and chemicals in agriculture
- There is need to strengthen cooperation with the international community and the civil society so as to ensure that the quality of water used for drinking, animal husbandry and agricultural purposes is good.

With regard to the promotion of demand management initiatives, the following are recommended: (a) enhancement of the area in which irrigation improvement project is carried out; (b) use of modern methods of irrigation instead of flood irrigation in old lands and new irrigation methods in new lands; (c) promotion of industrial recycling; (d) promotion of wastewater reuse; (e) reduction of losses in drinking water distribution networks. Additional options are developed on the:

- Protection of water resources from pollution.
- Increasing awareness of all sectors of society to change users' behaviour, also emphasizing on the role of women.
- Law enforcement
- Enhancement of the role of the Urban Society, the People's Assembly and religious and cultural forums in raising awareness towards efficient water use and environmental protection.
- Application of simple technical solutions in areas where no water distribution networks are available.

With regard to demand management for municipal and industrial water use, the measures foreseen in the National Water Plan are to:

- Install/rehabilitate metering system and apply Increasing Block Tariff structures;
- Initiate public awareness campaigns to reduce wasteful use of water;
- Promote the application of water saving technologies in the industrial sector through appropriate incentives.

With regard to the reduction of losses, the provisions of the National Water Plan are to:

- Reduce leakage losses through leak detection and repair based on priorities for the most urgent rehabilitation work,
- Reduce other losses through the repair/installation of the metering system.

Finally, concerning the reuse of treated wastewater, the main priority is to carry out feasibility studies, including environmental impact assessment to implement reuse in the New Industrial Cities and the Canal Cities.

Discussion panel on proposed options for the Algeria, Syria and Egypt Case Studies

The discussion panel on proposed options for the Algeria, Syria and Egypt Case Studies was initiated by *Prof. Dionysis Assimacopoulos*, who provided a summary of the main points of the two presentations (Table 4).

Table 4: Summary of the INECO Algeria, Syria and Egypt Case Studies

	Seybouse River Basin, Algeria	**Barada River Basin, Syria**	**Bahr Basandeila area, Egypt**
Focal Problem	Pollution of the Seybouse River ➢ Lack of sewage treatment schemes (under implementation) ➢ Uncontrolled discharge of industrial effluents, esp. in urban areas	Water quality degradation of the Barada River ➢ Uncontrolled disposal of domestic waste, sewage, and industrial wastewater & excessive use of agrochemicals ➢ Reduction of river flow	Drinking water quality problems & health risk ➢ Water quality deterioration of drinking water supply sources (canal water) ➢ Lack of proper maintenance of distribution & sewerage networks/facilities
Policy orientation	➢ Improving the environmental performance of the industrial sector ➢ Ensuring the sustainability of the sewage treatment schemes under implementation ➢ Cost recovery for sewage collection & treatment	➢ Improving the environmental performance of the industrial sector ➢ Water conservation in domestic use & improvement of the performance of urban water services	➢ Control over the discharge of industrial effluents ➢ Controlled and wise use of chemical fertilizers & pesticides ➢ Maintenance of the Nile distribution network, maintenance & expansion of facilities and networks ➢ Commitment among water users to implement pollution mitigation measures & community empowerment
Suggested options	➢ Stricter discharge & technology standards for industries ➢ Regular monitoring of discharges ➢ Effluent charge	➢ Stricter discharge & technology standards for industries ➢ Regular monitoring of discharges ➢ Effluent charge systems,	➢ Stricter discharge and technology standards for industries ➢ Effluent charge systems ➢ Voluntary agreements (industry & agriculture)

	Seybouse River Basin, Algeria	Barada River Basin, Syria	Bahr Basandeila area, Egypt
	systems, Tradable permits ➢ Voluntary agreements, eco-labelling schemes ➢ Grants & incentives for industrial wastewater treatment ➢ Training of industrial operators ➢ Awareness campaigning & participation	Tradable permits ➢ Voluntary agreements with industries & farmers, eco-labelling schemes ➢ Grants & incentives for industrial wastewater treatment ➢ Relocation incentives ➢ Reform of water pricing policies (cost recovery, incentives) ➢ Decentralization, institutional reform, awareness & participation	➢ Increased taxation of agricultural inputs (fertilizers & pesticides) ➢ Reform of utility pricing policy ➢ Cost recovery for water supply & sewage collection and treatment ➢ Community management for water supply and wastewater treatment in villages

Following from this introduction, *Dr. Fathy El Gamal* pointed out that in all the analyzed Case Studies, public participation was the cross-cutting issue. Public participation is not simply a workshop and asking some questions. At the end, what is required is to transfer water management to the public. In Egypt, this is not at all easy. The effort to transfer irrigation water management to agricultural associations took a lot of time. First, there needed to be an institutional reform to allow the establishment of Water Users' Associations. The Egypt experience pointed out that this was very difficult, it took a lot of time, and user training was required. In this task, the involvement of the public sector and the administration was necessary, especially at the beginning. Concerning water supply and sanitation, decentralization was easier, and was implemented through the establishment of holding companies.

Continuing the discussion on public participation, *Dr. Yannis Glekas* pointed out that the example of Pegeia shows that public participation should start by sharing knowledge at the local level; in Cyprus, and despite the huge amount of information publicly available on water management issues, little information actually reaches the public. This in fact has been the main expectation of local stakeholders from INECO, because they have seen the positive impact that the project has as far as discussions are concerned, and this is what the Cyprus Case Study will build on.

Subsequently, the discussion evolved on whether public participation is a prerequisite for "standard" pollution abatement solutions, such as the construction of infrastructure for sewage collection and treatment. *Prof. Barraque* pointed out that often there are objections from stakeholders even on these issues (e.g. on the location of wastewater treatment plants). Prof. Barraque further commented that in certain countries the main problem is the very low degree of involvement of local authorities in environmental projects planned by the central administration. Along the same line, *Mr. Ridha Boulabiar (Director of ONAS)* commented that in Tunisia sewage treatment plants have been built through international funding; however, the programme has stopped because the plants do not operate successfully. Industries in the vicinity still discharge their wastewater without prior treatment and are not connected to the plant.

Prof. Antonio Massarutto commented further on the issue of public participation, noting that if the solution to the problem was simply to build a sewage treatment plant, then there would not be need for projects like INECO. INECO, and not only INECO but also other research efforts start from the concept that such solutions will not last and are not sustainable or adequate because of many reasons, some of which were discussed during the workshop. There are limitations in this narrow way of imagining solutions only on the technical side, assuming that funding can come from an endless source, and that political consensus is achieved because the government has decided on the issue.

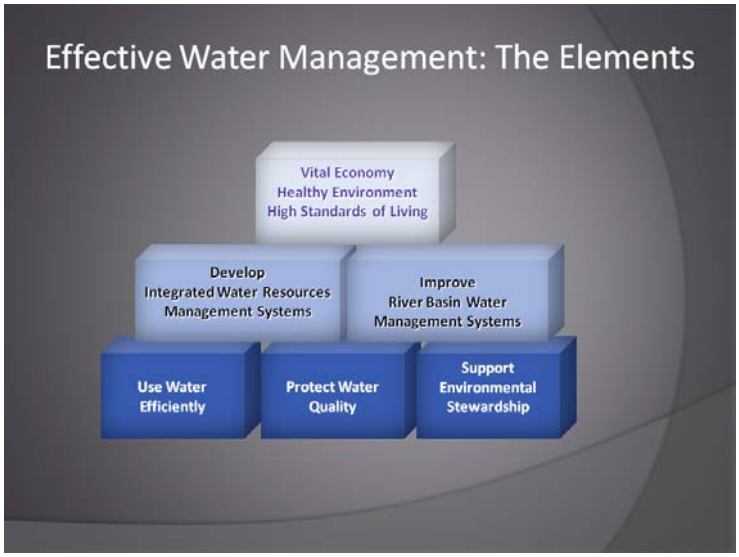
3 Workshop proceedings

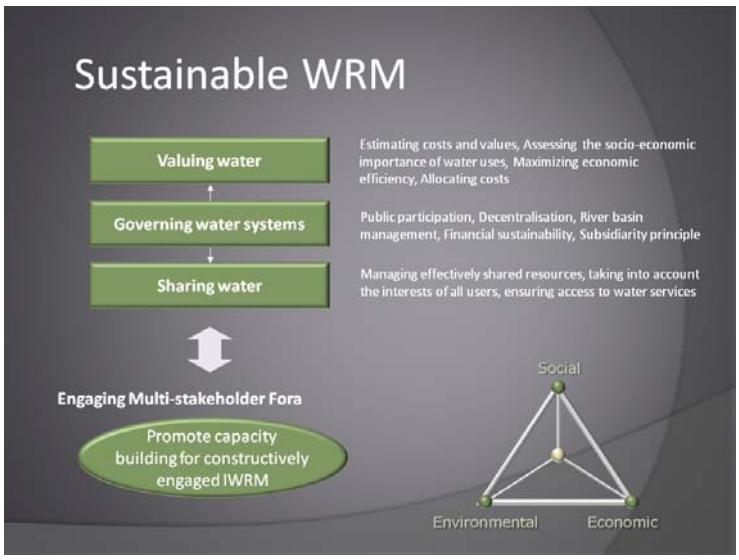
This section provides the proceedings of the INECO Stakeholder Assembly Workshop. It includes all presentations given by the event speakers. Presentations and additional material is also available at the INECO Project Web Site, at http://environ.chemeng.ntua.gr/ineco/Default.aspx?t=475.

3.1 Welcome & Introduction: The INECO Stakeholder Assembly Workshop scope and expected outcomes

by Prof. D. Assimacopoulos, INECO Project Coordinator, National Technical University of Athens, Greece


The Challenges of WRM
Inefficient land use
Poor infrastructure maintenance
Overuse of non-renewable water resources
Lack of access to basic water services
Pollution, environmental damage
Climate change & increasing water stress
Potential solutions to water problems are in most cases well known but have often not been implemented

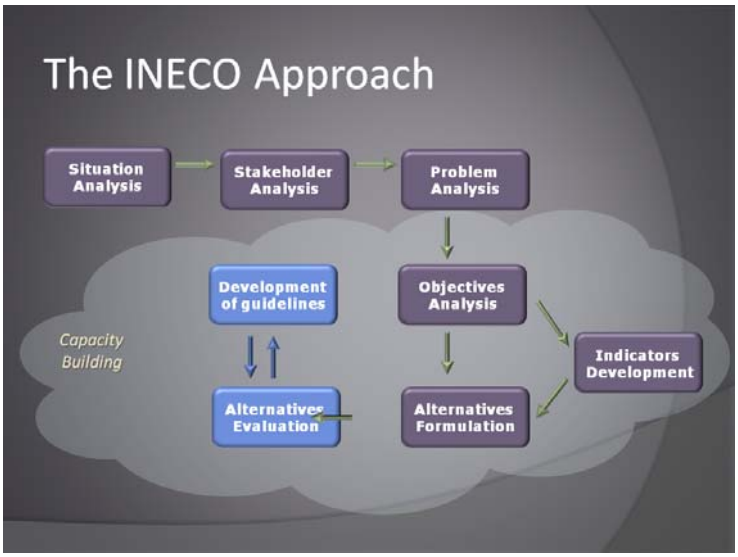

Effective Water Management: The Elements
Vital Economy
Healthy Environment
High Standards of Living
Develop
Integrated Water Resources
Management Systems
Improve
River Basin Water
Management Systems
Use Water
Efficiently
Protect Water
Quality
Support
Environmental
Stewardship


Sustainable WRM
Valuing water
Governing water systems
Sharing water
Estimating costs and values, Assessing the socio-economic importance of water uses, Maximizing economic efficiency, Allocating costs
Public participation, Decentralisation, River basin management, Financial sustainability, Subsidiarity principle
Managing effectively shared resources, taking into account the interests of all users, ensuring access to water services
Engaging Multi-stakeholder Fora
Promote capacity building for constructively engaged IWRM
Social
Environmental
Economic

Building on local participation: Why?

- Project implementation is largely the job of the local community
- Communities are instigators of policies
- Community-needs must be addressed when projects are formulated and not after they have been implemented
- Enforcement by the community, empowers community's responsibility

The INECO Approach



From Situation to Problem Analysis

- Situation analysis in regions
  - Water supply, demand & water use patterns
  - Water pollution, resource depletion
  - Provision of water services, infrastructure
  - Current institutional and financial context for water resource management and protection
- Stakeholder analysis & consultation

- Identification of critical (focal) water management problems – The INECO Case Studies
- Problem Analysis
  - Mapping of causal interrelationships
  - Problem Tree Analysis
  - Development of indicators relevant to the specific water management issues, their causes and effects

The INECO Case Studies:
A typology of water management problems

River Basin Management

- Water stress & sectoral allocation
  - **Lebanon:** Water stress in the Damour River Basin
  - **Morocco:** Inefficient water use in the Oum Er Rbia River Basin
- Groundwater management
  - **Cyprus:** Aquifer depletion and sea intrusion
  - **Tunisia:** Aquifer depletion and salinisation

Urban water management

- Water quality degradation & inadequate services
  - **Egypt:** Water quality deterioration in the region of Bahr Basandeila Canal
  - **Syria:** Water pollution in the Barada River Basin (Greater Damascus Area)
  - **Algeria:** Water pollution in the Seybouse River Basin

… and of underlying causes

Country	Sharing			Valuing			Governing				
	S1	S2	S3	V1	V2	V3	G1	G2	G3	G4	G5
Syria		✓	✓	✓	✓		✓	✓	✓	✓	✓
Tunisia		✓		✓	✓		✓	✓	✓		
Cyprus	✓	✓			✓				✓	✓	✓
Morocco	✓	✓		✓	✓			✓			
Lebanon	✓	✓	✓	✓	✓		✓		✓		✓
Egypt		✓	✓	✓	✓		✓	✓		✓	
Algeria		✓		✓	✓		✓		✓		✓

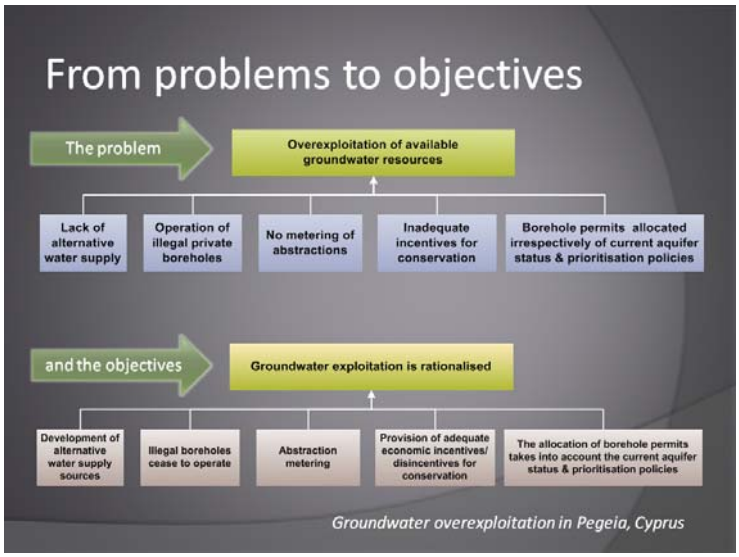
S.1 Water allocation conflicts (scarcity & stress)
S.2 Inefficient management of shared resources
S.3 No access to basic water services

V.1 Low recovery of costs
V.2 Ineffective application of the polluter-pays principle
V.3 Inefficient water allocation

G.1 No financing/planning for technical solutions & water works
G.2 Limited/no public participation
G.3 Inability/unwillingness to enforce legislation
G.4 Overlaps in responsibility
G.5 Lack of human resources

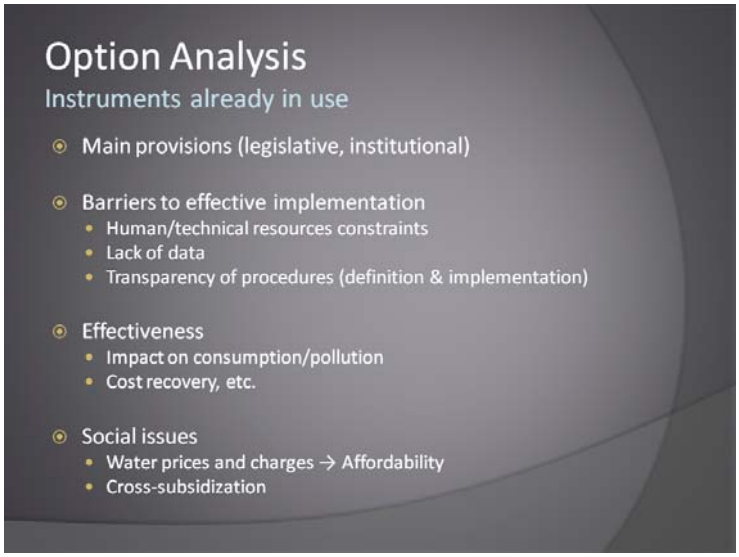
The INECO Workshops: A Decisive Step

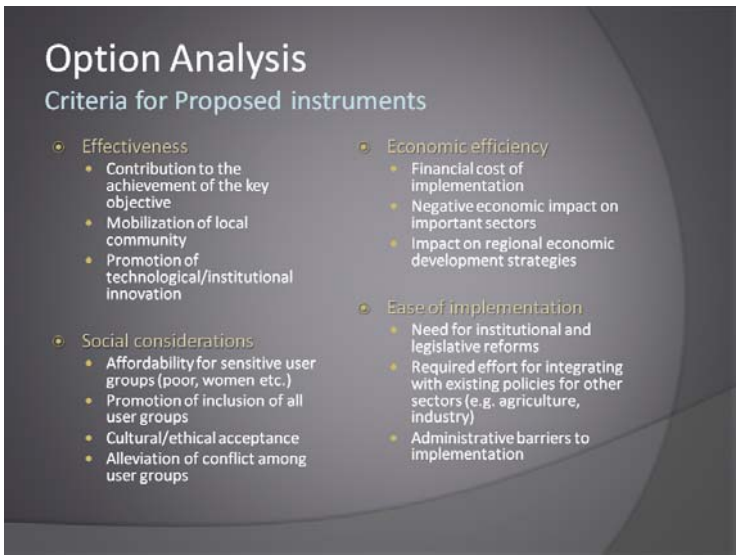

Regional workshops
Objectives & Focus of discussions
Engagement in a constructive dialogue
Maximize opportunities for multi-faceted solutions
Learn from stakeholders
Establishment
Shared frame of reference
Shared goals
Shared design of process to achieve goals
Main water management issues in each region
Importance of the selected issue (focal problem)
Primary causes of the focal problem
Water use sector(s) where action is needed & possible objectives
Identification of possible {institutional and economic} options for problem mitigation


From problems to objectives
The problem
Overexploitation of available groundwater resources
Lack of alternative water supply
Operation of illegal private boreholes
No metering of abstractions
Inadequate incentives for conservation
Borehole permits allocated irrespectively of current aquifer status & prioritisation policies
and the objectives
Groundwater exploitation is rationalised
Development of alternative water supply sources
Illegal boreholes cease to operate
Abstraction metering
Provision of adequate economic incentives/ disincentives for conservation
The allocation of borehole permits takes into account the current aquifer status & prioritisation policies
Groundwater overexploitation in Pegeia, Cyprus


From objectives to options:
Types of alternative instruments
Economic instruments & voluntary measures
Aim: Promote self-regulation
Pricing, subsidies, environmental taxation, indirect taxation, tradable permits, voluntary agreements
Command-and-control approach
Regulation by authorities
Stricter enforcement of legislation/stricter standards/stricter forms of sanction
Supporting & enabling instruments
Public participation processes
Awareness, education, stewardship
Decentralization & collective management

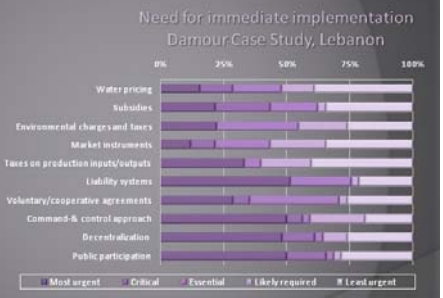

From objectives to options:
Development of alternative options
Industrial pollution abatement - Seybouse River Basin, Algeria
(Stricter) effluent standards and delineation of vulnerable/protected areas
Technology standards for specific industrial processes
Discharge permits
Surveillance, monitoring and enforcement of legislation on wastewater discharge:
Penalties for non compliance with emission standards
Reduction of potential government subsidies in case of non-compliance
Effluent charge systems – Environmental taxation (e.g. pollution taxes, pollution charges)
Voluntary agreements with industries to reduce wastewater production and discharge of polluting effluents
Environmental performance bonds for industries
Training on wastewater treatment and water recycling in the industrial sector
Revolving funds for financing collective effluent treatment schemes
Grants, tax incentives for the relocation of polluting industries
Tradable discharge permits


Option Analysis
Instruments already in use
Main provisions (legislative, institutional)
Barriers to effective implementation
Human/technical resources constraints
Lack of data
Transparency of procedures (definition & implementation)
Effectiveness
Impact on consumption/pollution
Cost recovery, etc.
Social issues
Water prices and charges → Affordability
Cross-subsidization


Option Analysis
Criteria for Proposed instruments
Effectiveness
Contribution to the achievement of the key objective
Mobilization of local community
Promotion of technological/institutional innovation
Social considerations
Affordability for sensitive user groups (poor, women etc.)
Promotion of inclusion of all user groups
Cultural/ethical acceptance
Alleviation of conflict among user groups
Economic efficiency
Financial cost of implementation
Negative economic impact on important sectors
Impact on regional economic development strategies
Ease of implementation
Need for institutional and legislative reforms
Required effort for integrating with existing policies for other sectors (e.g. agriculture, industry)
Administrative barriers to implementation

Screening of instruments by stakeholders

- Criteria
  - Preference
  - Relevance/Feasibility to address current WM challenges
  - Relevance to address the regional focal problem
  - Need for immediate implementation
  - Relevance to future WM challenges (national level)
  - Applicability



The objectives of today's workshop

- Present and evaluate the outcomes of regional analyses on the applicability of institutional and economic instruments
- Share, exchange and integrate experience associated with the application of solutions across the Mediterranean Basin
- Assess the corresponding economic, environmental and social trade-offs
- Derive recommendations for enabling the effective implementation of proposed instruments

Workshop agenda (1/2)

Tuesday, 15th July 2008

Session 1: Introduction

9:00 Welcome & Introduction: The INECO Workshop Scope and expected outcomes
Prof. D. Assimacopoulos, INECO Project Coordinator

9:30 Information exchange, participation & networking for sustainable water management
Mr. D. Valensuela, International Network of Basin Organizations

09:45 Evaluating current & potential institutional and economic options at the INECO Case Studies: Context and Methodology, *Prof. A. Massarutto, IEFE, Italy*

10:15 Coffee Break

Session 2: Presentation & discussion on the INECO Case Study Outcomes - Focus on River Basin Management

10:30 Water stress in the Damour River Basin, Lebanon
Mr. C. Tabbal, Conseil et Développement s.a.l.

11:15 Enhancing efficiency in irrigation water use in the Oum Er Rbia Basin, Morocco.
Mr. A. Affia, ISKANE Ingenierie

12:00 Discussion panel on proposed options for the Lebanon & Morocco case studies

13:00 Lunch Break

14:30 Groundwater exploitation in Pegeia, Cyprus
Dr. I. Glekas, Aeoliki Ltd

15:15 Groundwater overexploitation in Tunisia
Mr. A. Bouzid, CITET

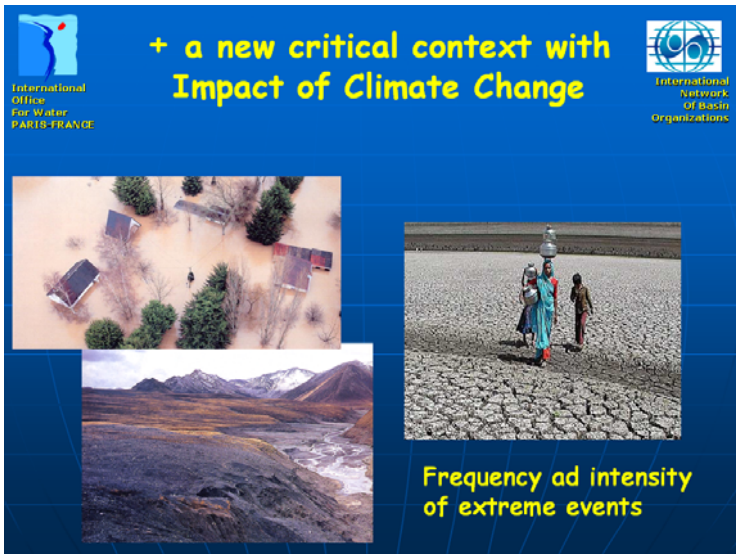
16:00 Discussion panel on proposed options for the Cyprus and Tunisia case studies

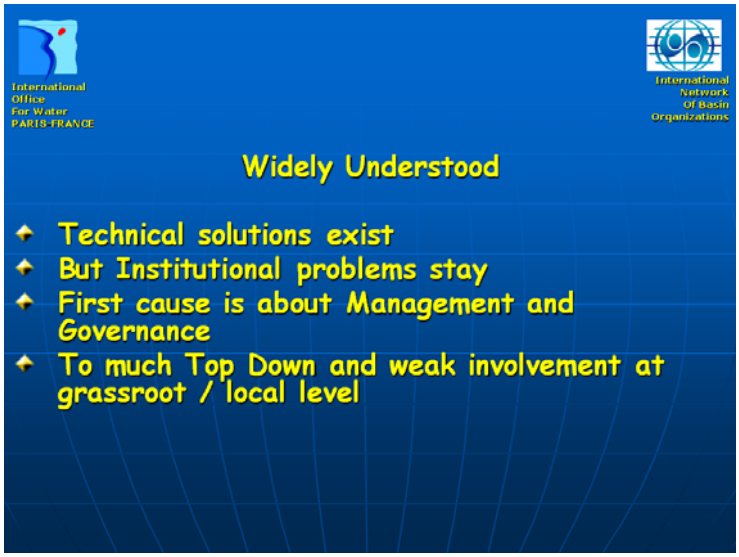

Workshop agenda (2/2)
Wednesday, 16th July 2008
9:00 Link to first day outcomes
Prof B. Barraqué, ENGREF & Prof. E. Vlachos, Colorado State University
Session 3: Presentation & discussion on the INECO Case Study Outcomes - Focus on water quality management
9:15 Pollution of the Seybouse River, Algeria
Mr. A. Bouchedja, Agence de Bassin Hydrographique de Constantinois-Seybouse-Mellegue, Algeria
10:00 Pollution of the Barada River, Syria
Mr. M. Haddad, Studies & Integration Consulting
10:45 Coffee Break
11:00 Water quality deterioration in the Bahr Basandeila Canal, Egypt and drinking water quality issues
Prof. M. Abou Rayan, International Consultants Egypt
11:45 Discussion Panel on proposed options for the Algeria, Syria and Egypt case studies
13:00 Wrap-up and conclusion
Prof. D. Assimacopoulos, Prof. E. Vlachos, Prof. B. Barraqué
13:30 End of Workshop


What is next
December 2008
• Analysis of prerequisites for the implementation of selected instruments at the regional level
December 2008
• Development of guidelines on the application of institutional and economic instruments
March 2009
• Formalisation of INECO outcomes in web toolbox
May/June 2009
• The INECO Final Conference Event

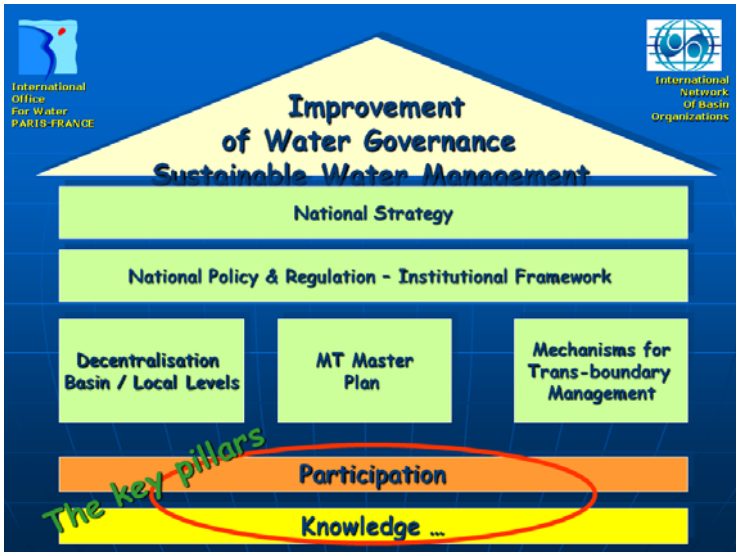
3.2 Information exchange, participation and networking for sustainable water management

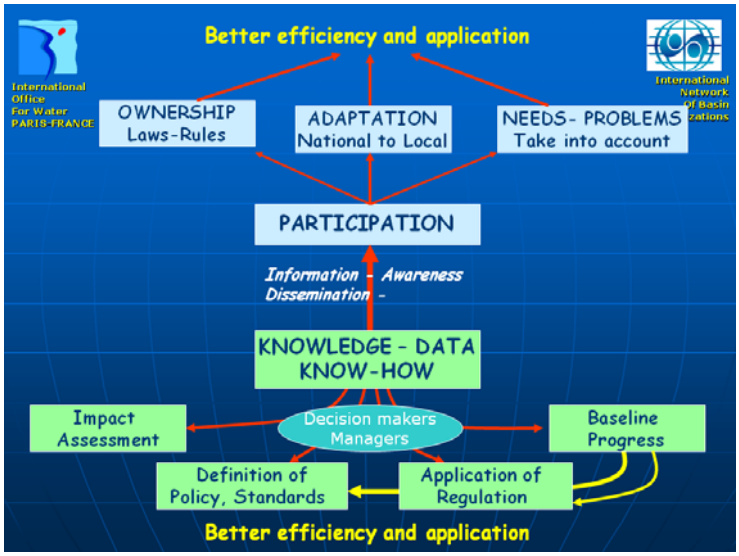
Mr. D. Valensuela, International Network of Basin Organizations

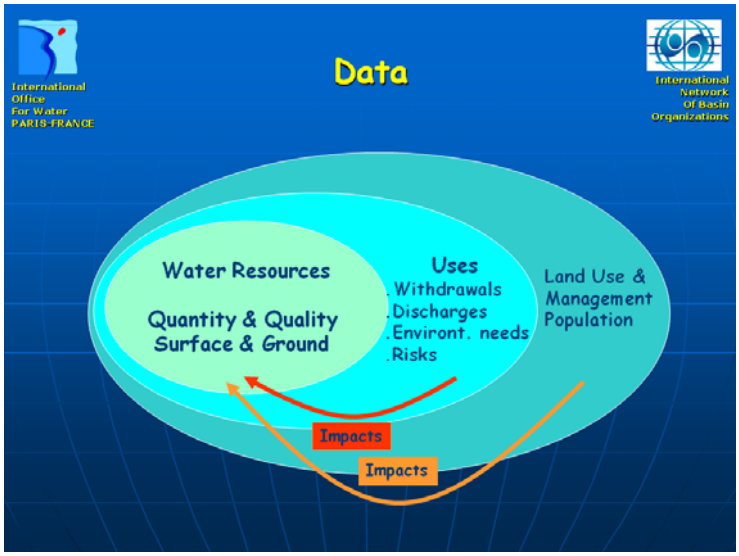

International Office For Water PARIS-FRANCE
+ a new critical context with Impact of Climate Change
International Network Of Basin Organizations
Frequency ad intensity of extreme events

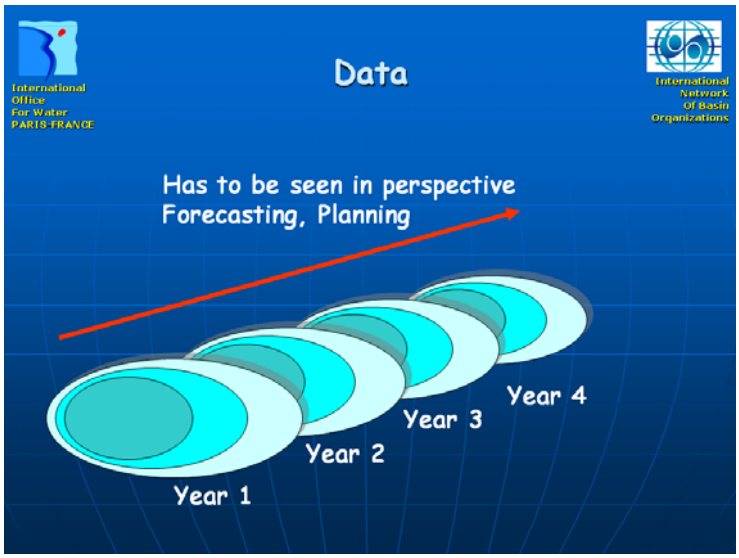

International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
Widely Understood
Technical solutions exist
But Institutional problems stay
First cause is about Management and Governance
To much Top Down and weak involvement at grassroot / local level

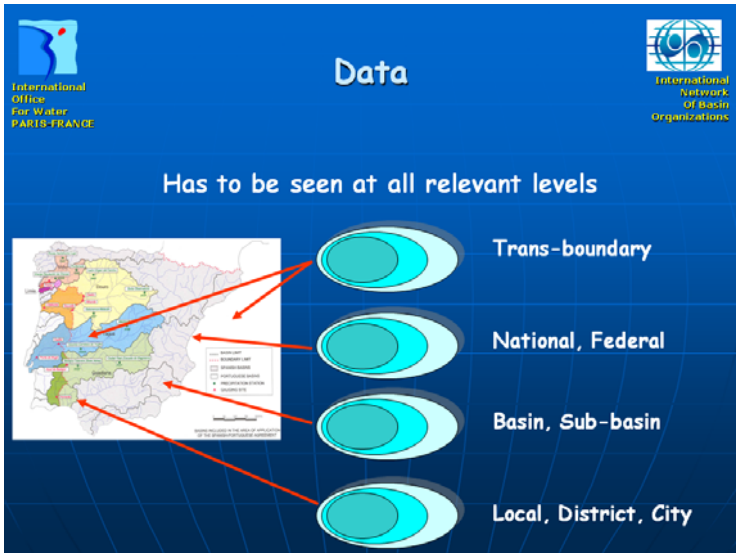

International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
This is why we must focus on Improving Water Management & Water Governance
Put in place IWRM

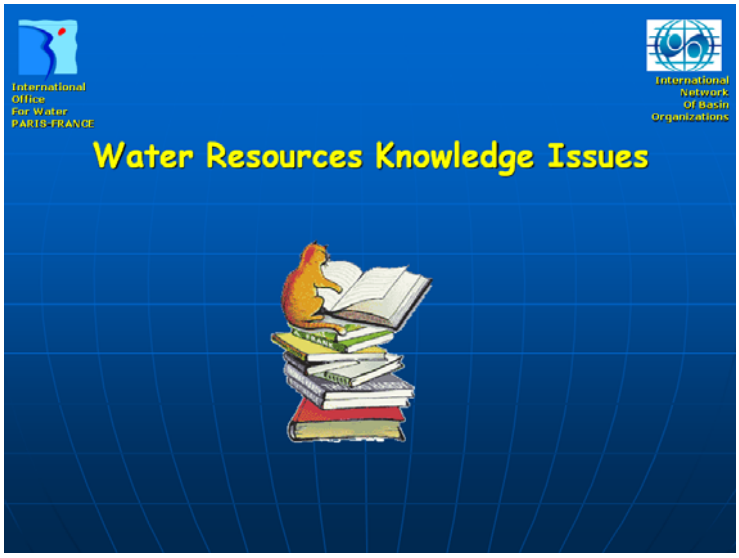

International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
Improvement of Water Governance
Sustainable Water Management
National Strategy
National Policy & Regulation - Institutional Framework
Decentralisation Basin / Local Levels
MT Master Plan
Mechanisms for Trans-boundary Management
The key pillars
Participation
Knowledge ...

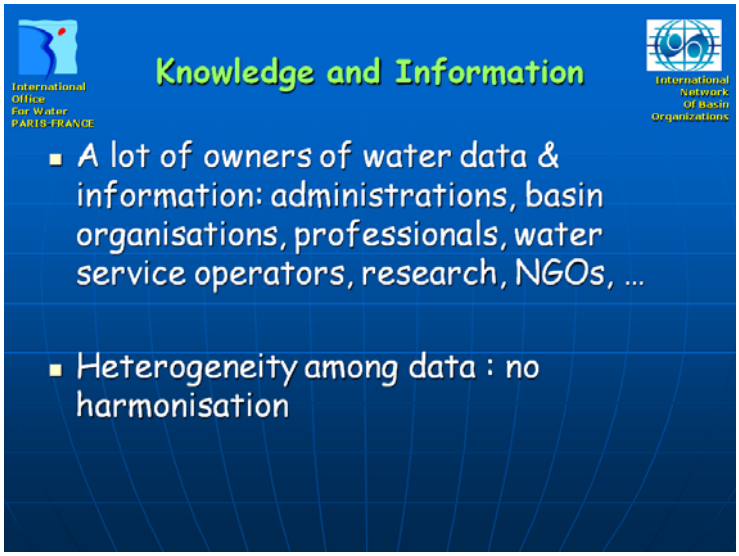

Better efficiency and application
OWNERSHIP Laws-Rules
ADAPTATION National to Local
NEEDS - PROBLEMS Take into account
PARTICIPATION
Information - Awareness Dissemination -
KNOWLEDGE - DATA KNOW-HOW
Impact Assessment
Decision makers Managers
Baseline Progress
Definition of Policy, Standards
Application of Regulation
Better efficiency and application

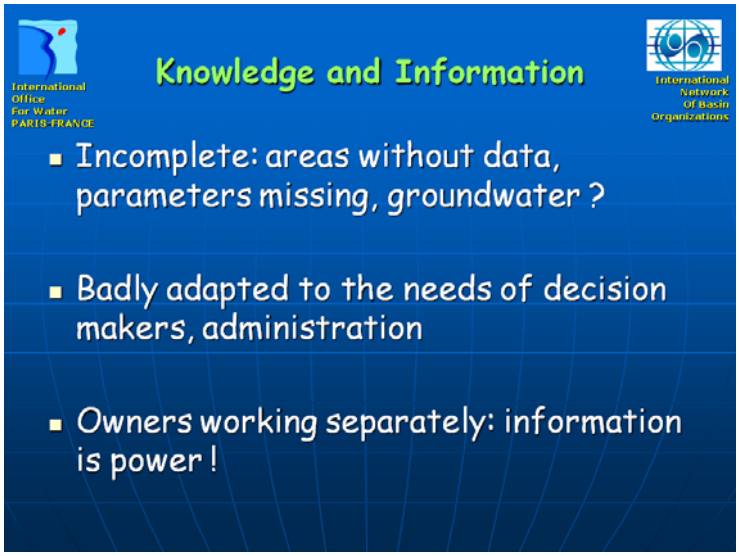

Data
Water Resources
Quantity & Quality
Surface & Ground
Uses
.Withdrawals
.Discharges
.Environt. needs
.Risks
Land Use & Management
Population
Impacts
Impacts

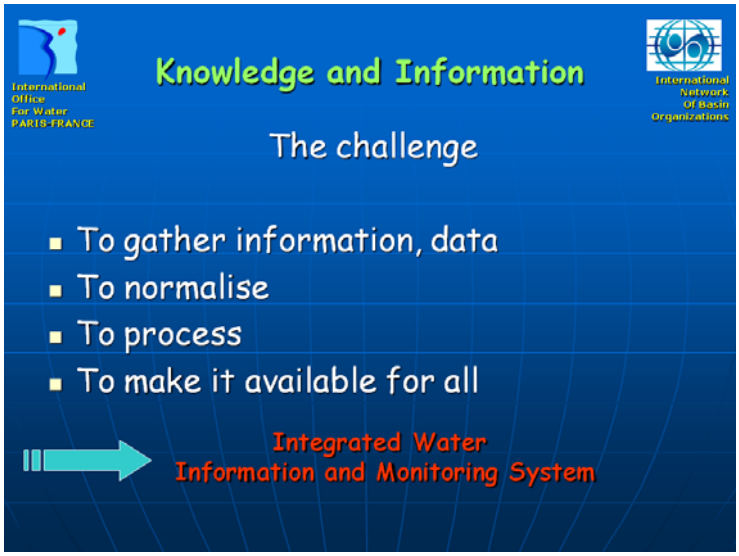

International Office For Water PARIS-FRANCE
Data
International Network Of Basin Organizations
Has to be seen in perspective
Forecasting, Planning
Year 1
Year 2
Year 3
Year 4

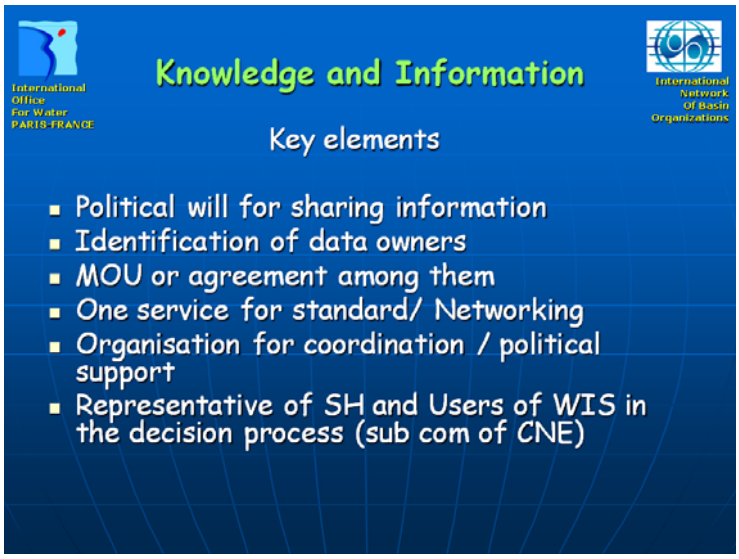

International Office For Water PARIS-FRANCE
Data
International Network Of Basin Organizations
Has to be seen at all relevant levels
Trans-boundary
National, Federal
Basin, Sub-basin
Local, District, City


International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
Water Resources Knowledge Issues


International Office For Water PARIS-FRANCE
Knowledge and Information
International Network Of Basin Organizations
A lot of owners of water data & information: administrations, basin organisations, professionals, water service operators, research, NGOs, ...
Heterogeneity among data : no harmonisation

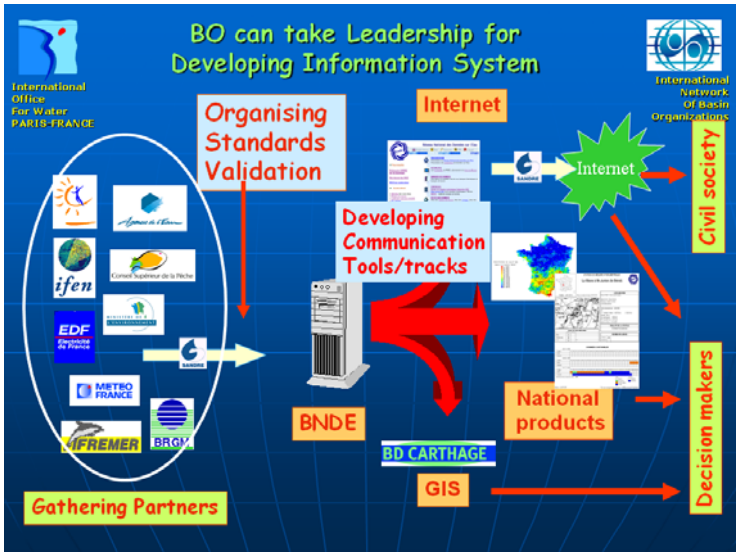

International Office For Water PARIS-FRANCE
Knowledge and Information
International Network Of Basin Organizations
Incomplete: areas without data, parameters missing, groundwater ?
Badly adapted to the needs of decision makers, administration
Owners working separately: information is power !

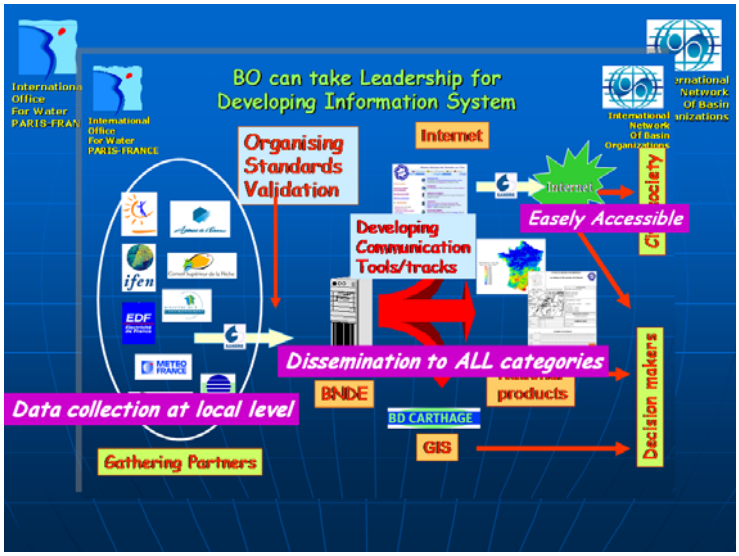

International Office For Water PARIS-FRANCE
Knowledge and Information
International Network Of Basin Organizations
The challenge
To gather information, data
To normalise
To process
To make it available for all
Integrated Water Information and Monitoring System

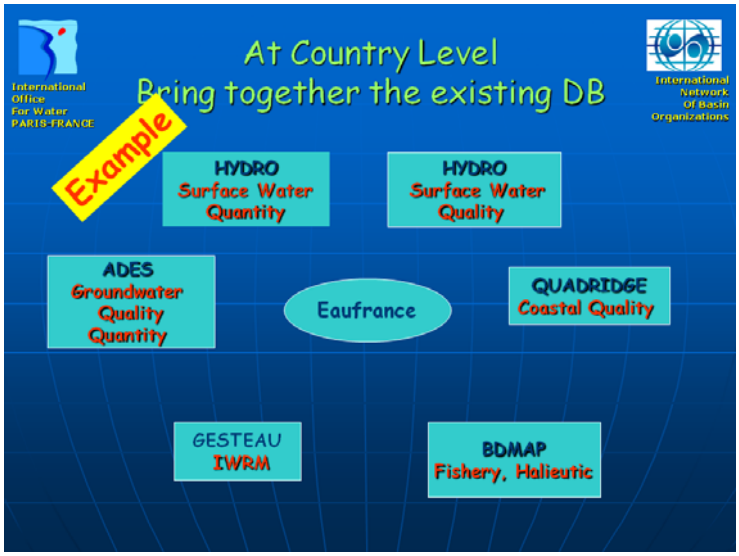

International Office For Water PARIS-FRANCE
Knowledge and Information
International Network Of Basin Organizations
Key elements
Political will for sharing information
Identification of data owners
MOU or agreement among them
One service for standard/ Networking
Organisation for coordination / political support
Representative of SH and Users of WIS in the decision process (sub com of CNE)

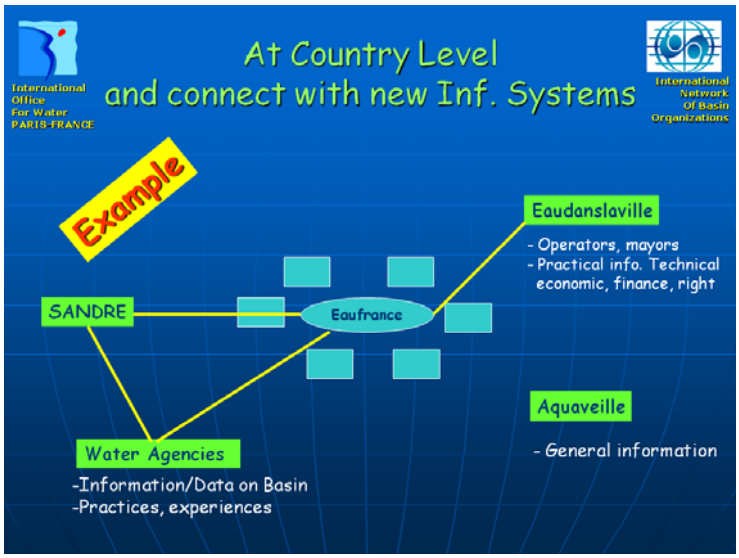

International Office For Water PARIS-FRANCE
Knowledge and Information
International Network Of Basin Organizations
An Integrated Water Information and Monitoring System …
Reliable
Representative
Harmonized
Easily accessible
Close enough to the ground (Basin)


International Office For Water PARIS-FRANCE
Knowledge and Information
International Network Of Basin Organizations
Water Information System …
Needs of Stakeholders
Control of activities impacting WR
Monitoring water resources
Assessing policies, plans
Communication flow: WR status, Risks
Bank data / Streamline models

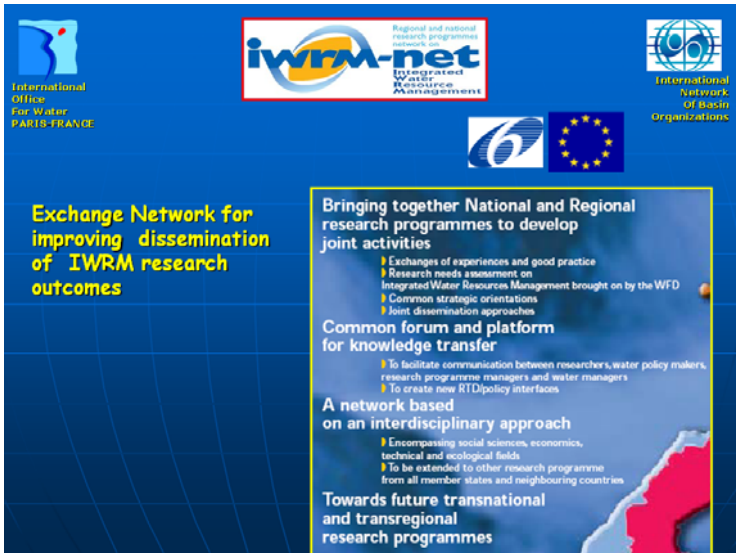

BO can take Leadership for
Developing Information System
International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
Organising
Standards
Validation
Internet
Internet
Civil society
Developing
Communication
Tools/tracks
ifen
EDF
METEO FRANCE
IFREMER
BRGM
BNDE
BD CARTHAGE
GIS
National
products
Decision makers
Gathering Partners


BO can take Leadership for
Developing Information System
Organising
Standards
Validation
Internet
Internet
Easely Accessible
Developing
Communication
Tools/tracks
Dissemination to ALL categories
Data collection at local level
BNDE
BD CARTHAGE
GIS
products
Decision makers
Gathering Partners


At Country Level
Bring together the existing DB
International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
Example
HYDRO
Surface Water
Quantity
HYDRO
Surface Water
Quality
ADES
Groundwater
Quality
Quantity
Eaufrance
QUADRIDGE
Coastal Quality
GESTEAU
IWRM
BDMAP
Fishery, Halieutic

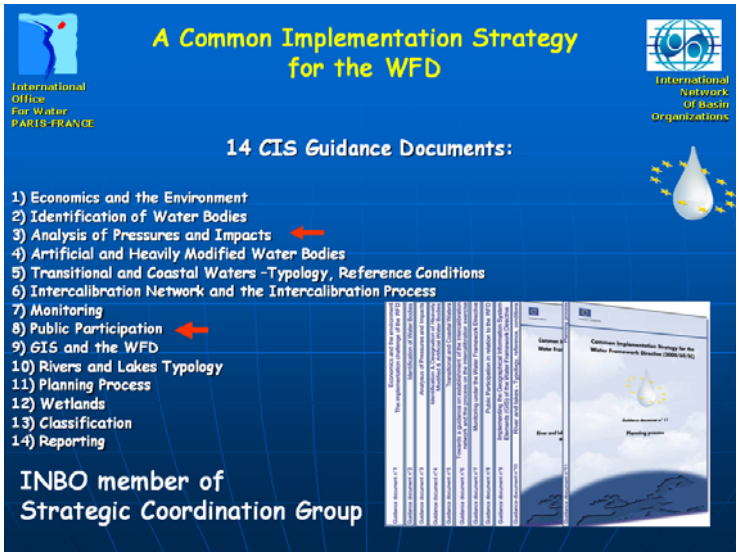

International Office For Water PARIS-FRANCE
At Country Level
and connect with new Inf. Systems
International Network Of Basin Organizations
Example
Eaudanslaville
- Operators, mayors
- Practical info. Technical economic, finance, right
SANDRE
Eaufrance
Aquaveille
- General information
Water Agencies
-Information/Data on Basin
-Practices, experiences


International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
Networking of
Water Resources Knowledge
at Global / Regional Levels
can help
Not reinvent the wheel !

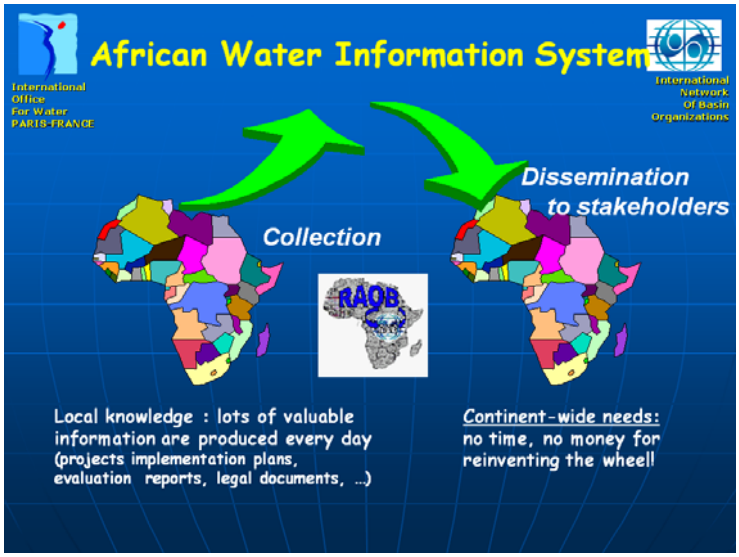

International Office For Water PARIS-FRANCE
iwrm-net
Integrated Water Resource Management
International Network Of Basin Organizations
Exchange Network for improving dissemination of IWRM research outcomes
Bringing together National and Regional research programmes to develop joint activities
Exchanges of experiences and good practice
Research needs assessment on Integrated Water Resources Management brought on by the WFD
Common strategic orientations
Joint dissemination approaches
Common forum and platform for knowledge transfer
To facilitate communication between researchers, water policy makers, research programme managers and water managers
To create new RTD/policy interfaces
A network based on an interdisciplinary approach
Encompassing social sciences, economics, technical and ecological fields
To be extended to other research programme from all member states and neighbouring countries
Towards future transnational and transregional research programmes

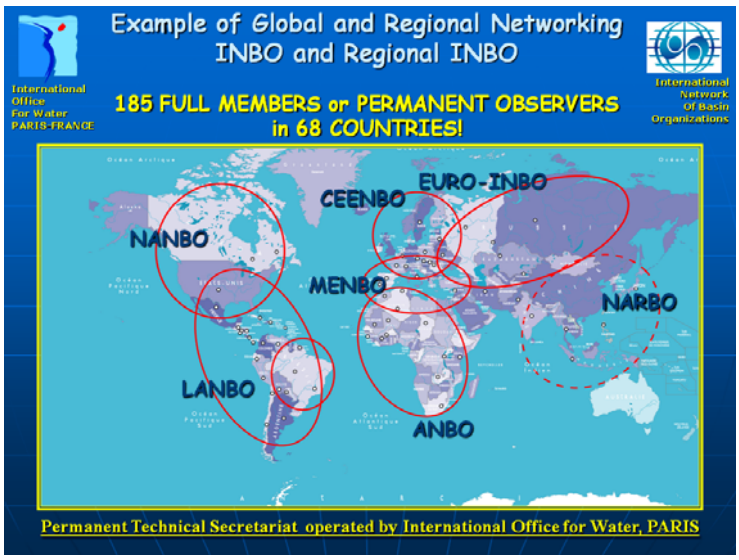

International Office For Water PARIS-FRANCE
iwrm-net
Integrated Water Resource Management
International Network Of Basin Organizations
SEPA
SYKE
SNIFFER
ICS
RIZA
EA
CENTA-ULG
PTKA
MEDD
UBA-A
VKK
MMGA
OIEau
ECOBAG
MEC
NTUA
14 countries
18 Research Centres
List of Partners

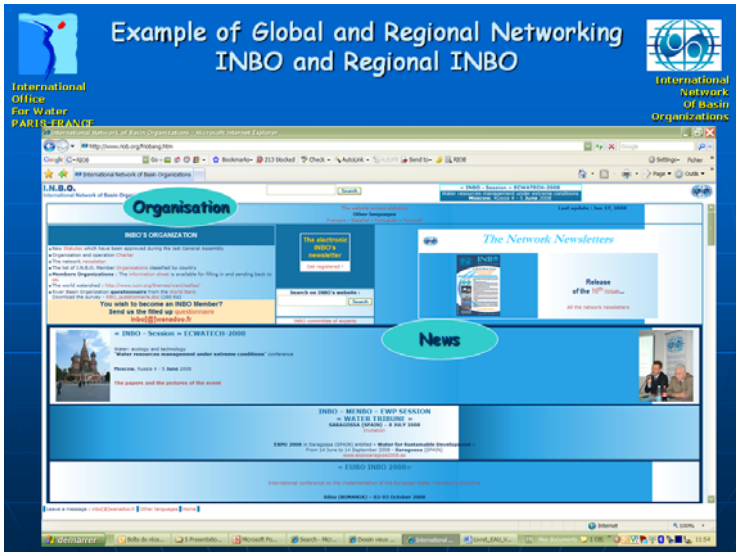

International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
Water Framework Directive in EU
An experience of sharing information

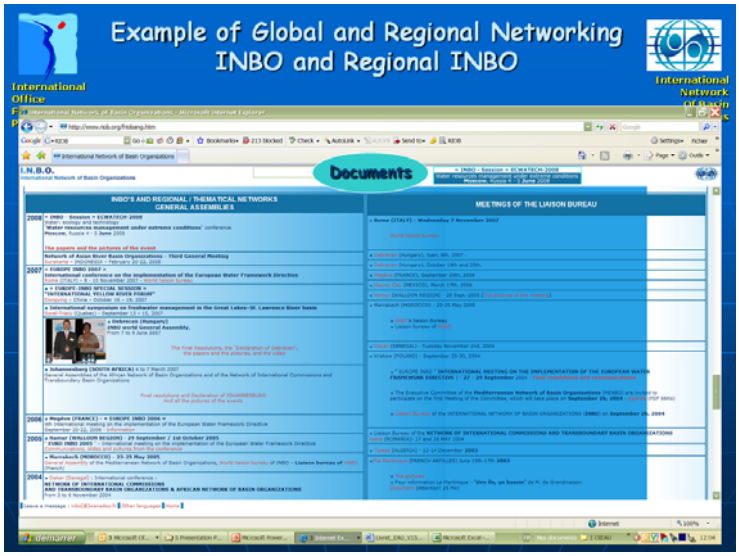

International Office For Water PARIS-FRANCE
A Common Implementation Strategy for the WFD
International Network Of Basin Organizations
14 CIS Guidance Documents:
1) Economics and the Environment
2) Identification of Water Bodies
3) Analysis of Pressures and Impacts
4) Artificial and Heavily Modified Water Bodies
5) Transitional and Coastal Waters -Typology, Reference Conditions
6) Intercalibration Network and the Intercalibration Process
7) Monitoring
8) Public Participation
9) GIS and the WFD
10) Rivers and Lakes Typology
11) Planning Process
12) Wetlands
13) Classification
14) Reporting
INBO member of
Strategic Coordination Group


International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
SEMIDE
www.semide.org
Système Euro-Méditerranéen d'information sur les savoir-faire dans le domaine de l'Eau
نظام المعلومات الأورو-متوسطي حول المهارات في مجال المياه
EMWIS
www.emwis.org
Euro-Mediterranean Information System on know how in the water sector
EURO-MEDITERRANEAN PARTNERSHIP

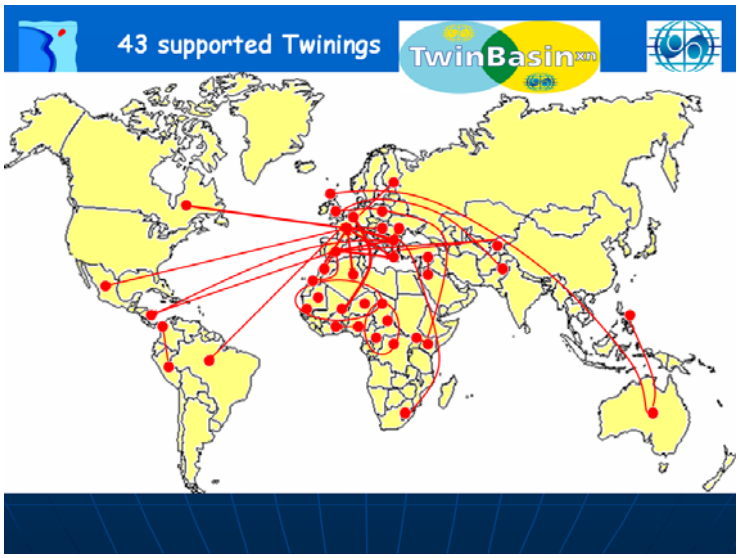

African Water Information System
International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
Collection
Dissemination to stakeholders
RAOB
Local knowledge : lots of valuable information are produced every day (projects implementation plans, evaluation reports, legal documents, ...)
Continent-wide needs: no time, no money for reinventing the wheel!

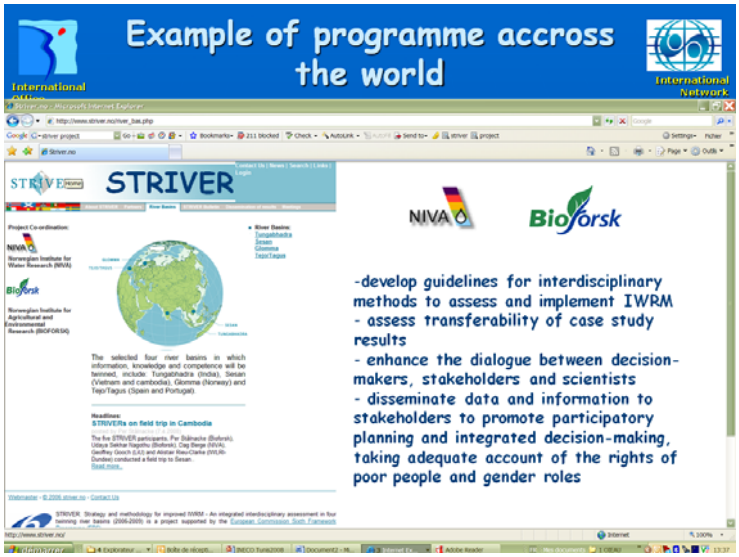

Example of Global and Regional Networking
INBO and Regional INBO
185 FULL MEMBERS or PERMANENT OBSERVERS in 68 COUNTRIES!
International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
CEENBO
EURO-INBO
NANBO
MENBO
NARBO
LANBO
ANBO
Permanent Technical Secretariat operated by International Office for Water, PARIS

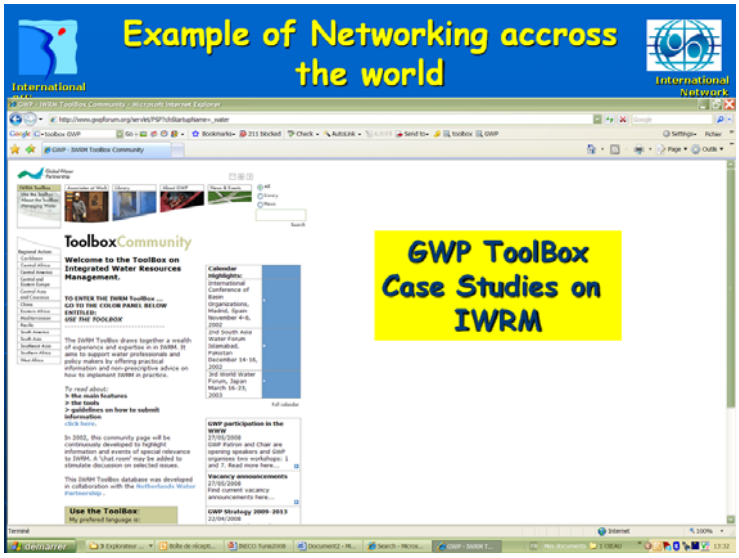

Example of Global and Regional Networking
INBO and Regional INBO
International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
Organisation
The Network Newsletters
News

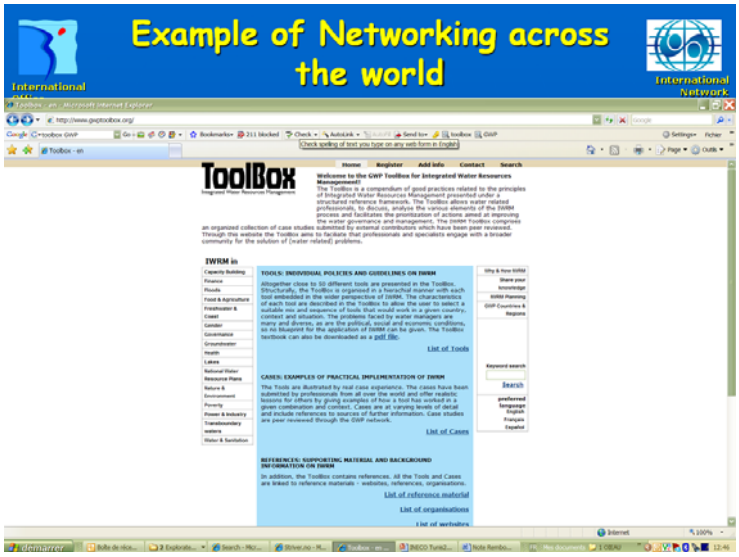

Example of Global and Regional Networking
INBO and Regional INBO
International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
Documents


Example of Programme accross the world
International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
TwinBasin
· TWINING = one way for exchanges of practices, knowledge, know-how
· Twinbasin project supported by EU:
· sponsorship for missions to BO Twiners
· based on twinning agreement between them
· aims at exchanging their staffs on specific topics

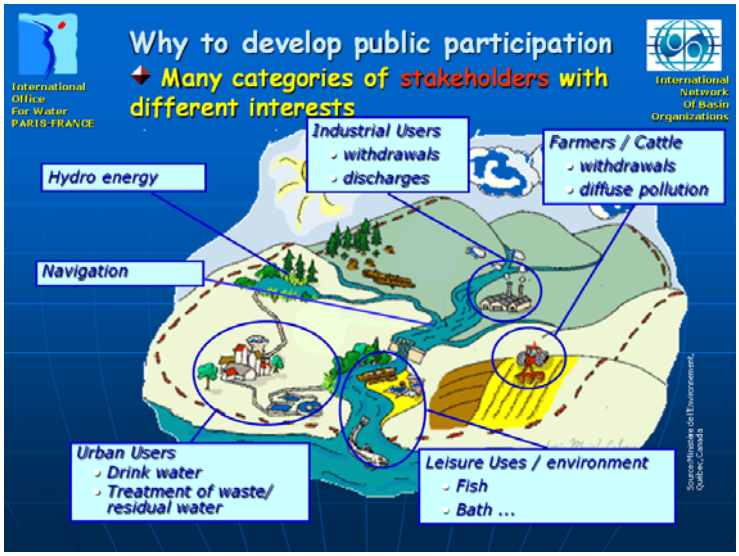

43 supported Twinings
TwinBasin

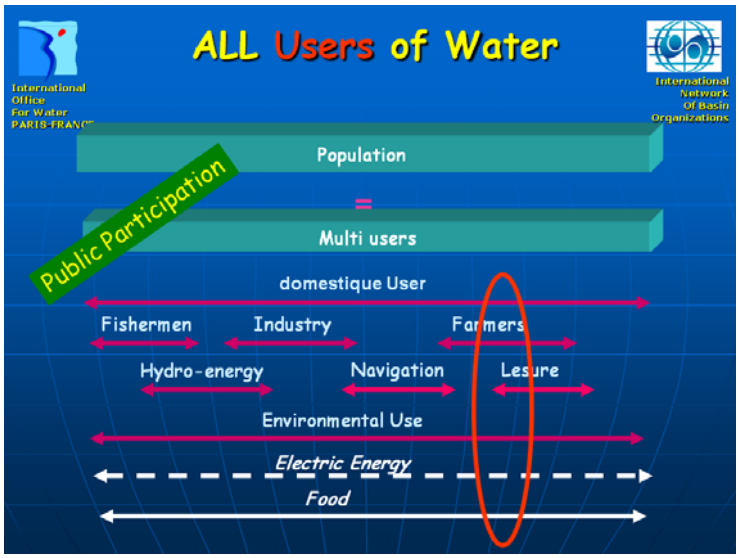

Example of programme accross the world
International Office
International Network
STRIVER
NIVA
Bioforsk
-develop guidelines for interdisciplinary methods to assess and implement IWRM
- assess transferability of case study results
- enhance the dialogue between decision-makers, stakeholders and scientists
- disseminate data and information to stakeholders to promote participatory planning and integrated decision-making, taking adequate account of the rights of poor people and gender roles

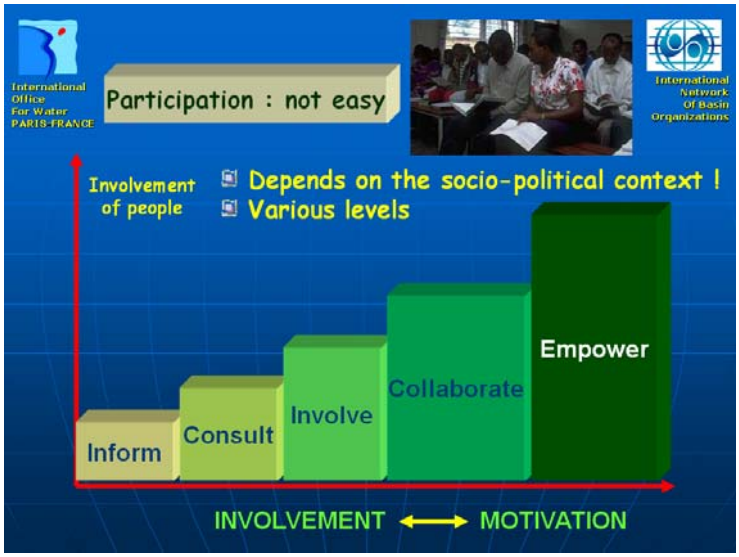

Example of Networking accross the world
International Office
International Network
ToolboxCommunity
GWP ToolBox Case Studies on IWRM

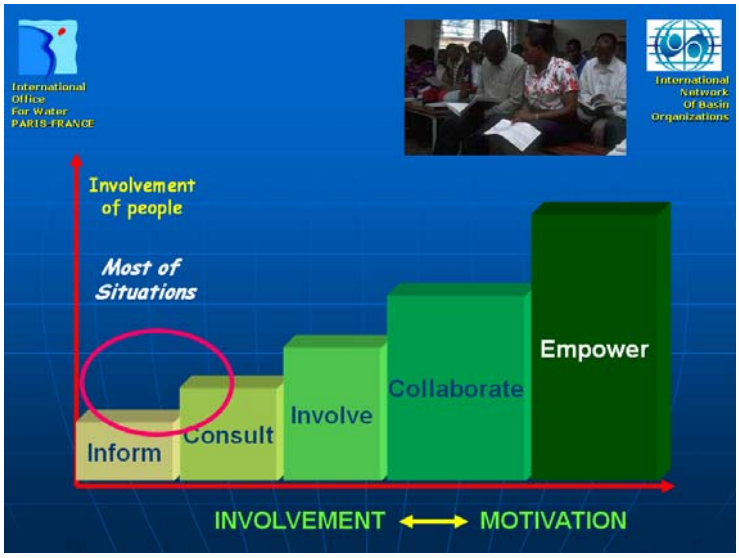

Example of Networking across the world
International Office
International Network
ToolBox
Home
Register
Add info
Contact
Search
IWRM in
TOOLS: INDIVIDUAL POLICIES AND GUIDELINES ON IWRM
List of Tools
CASES: EXAMPLES OF PRACTICAL IMPLEMENTATION OF IWRM
List of Cases
REFERENCES: SUPPORTING MATERIAL AND BACKGROUND INFORMATION ON IWRM
List of reference material
List of organisations
List of websites

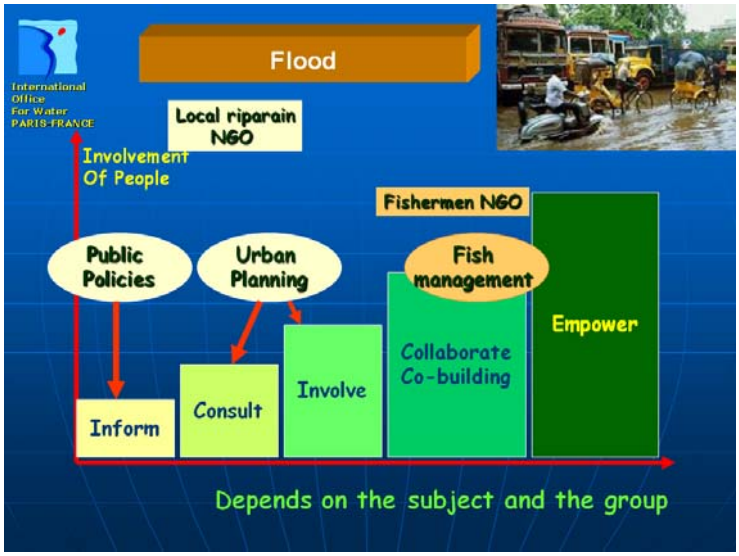

International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
Developing stakeholders, users and public participation

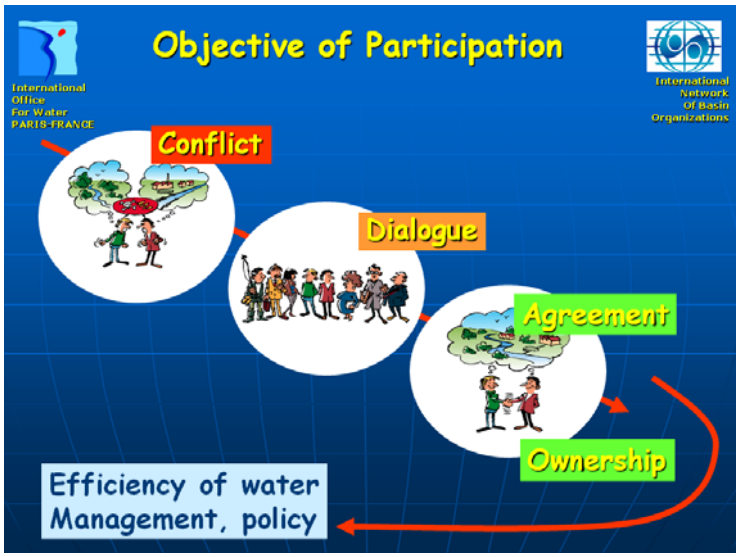

International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
Why to develop public participation
Many categories of stakeholders with different interests
Industrial Users
withdrawals
discharges
Farmers / Cattle
withdrawals
diffuse pollution
Hydro energy
Navigation
Urban Users
Drink water
Treatment of waste/ residual water
Leisure Uses / environment
Fish
Bath ...
Source: Ministère de l'Environnement, Québec, Canada

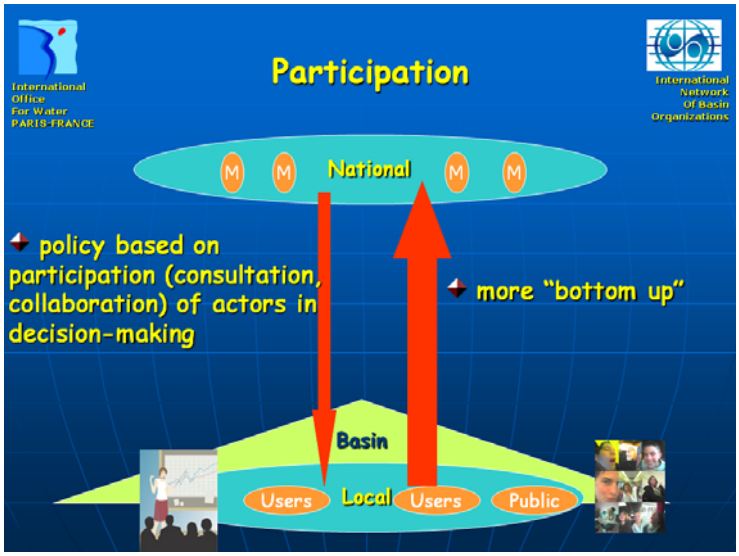

ALL Users of Water
International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
Population
=
Multi users
Public Participation
domestique User
Fishermen
Industry
Farmers
Hydro-energy
Navigation
Lesure
Environmental Use
Electric Energy
Food

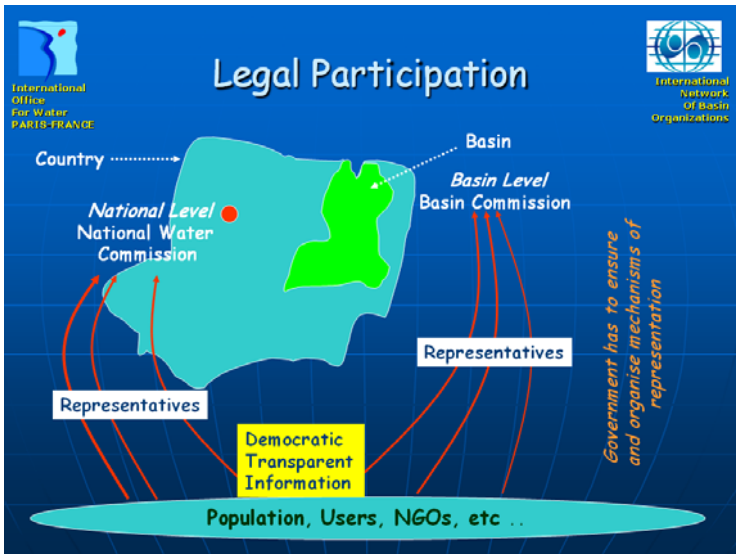

International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
Participation : not easy
Involvement of people
Depends on the socio-political context !
Various levels
Inform
Consult
Involve
Collaborate
Empower
INVOLVEMENT
MOTIVATION

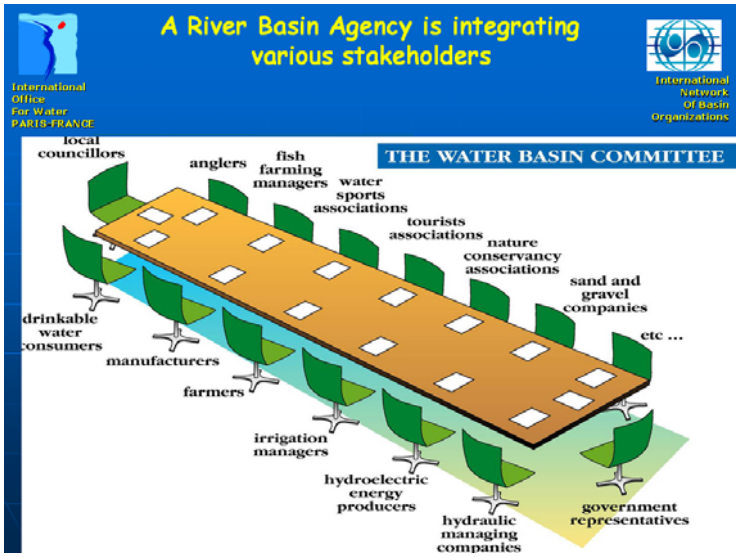

International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
Involvement of people
Most of Situations
Inform
Consult
Involve
Collaborate
Empower
INVOLVEMENT
MOTIVATION

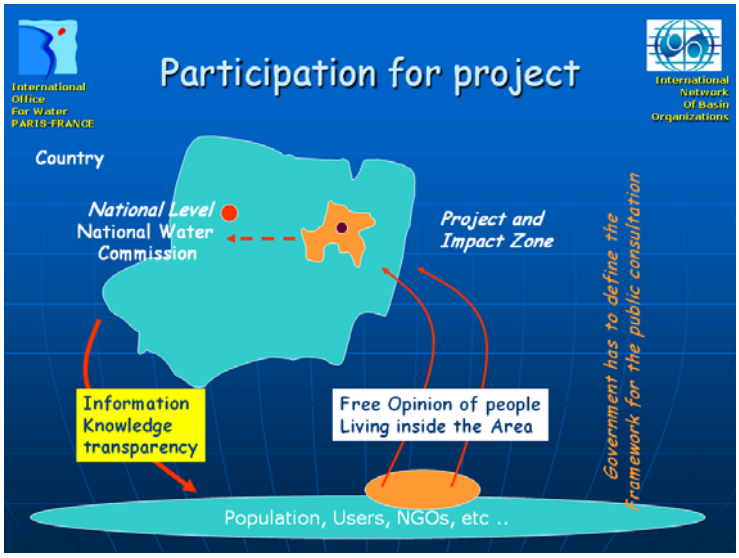

International Office For Water PARIS-FRANCE
Flood
Local riparain NGO
Involvement Of People
Fishermen NGO
Public Policies
Urban Planning
Fish management
Empower
Collaborate Co-building
Involve
Consult
Inform
Depends on the subject and the group

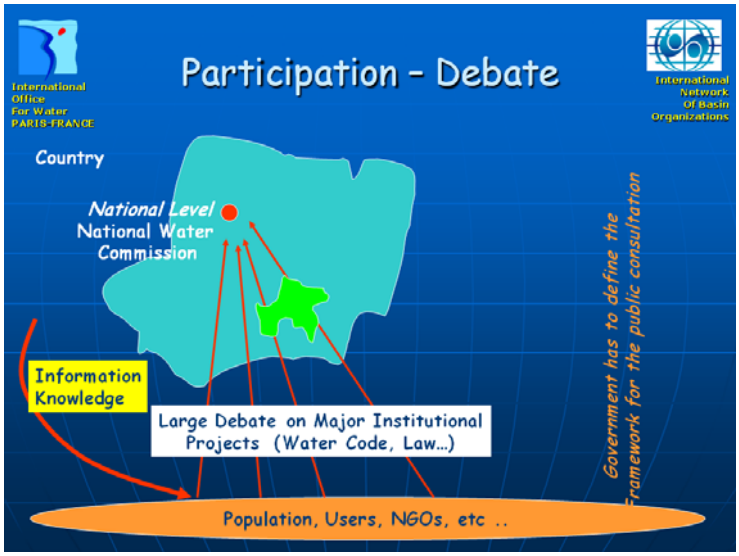

Objective of Participation
International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
Conflict
Dialogue
Agreement
Ownership
Efficiency of water Management, policy


Participation
International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
National
M
policy based on participation (consultation, collaboration) of actors in decision-making
more "bottom up"
Basin
Users
Local Users
Public


Legal Participation
International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
Country
Basin
Basin Level
Basin Commission
National Level
National Water Commission
Representatives
Representatives
Democratic
Transparent
Information
Government has to ensure and organise mechanisms of representation
Population, Users, NGOs, etc ..


A River Basin Agency is integrating various stakeholders
International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
THE WATER BASIN COMMITTEE
local councillors
anglers
fish farming managers
water sports associations
tourists associations
nature conservancy associations
sand and gravel companies
etc ...
drinkable water consumers
manufacturers
farmers
irrigation managers
hydroelectric energy producers
hydraulic managing companies
government representatives


Participation for project
International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
Country
National Level
National Water Commission
Project and Impact Zone
Information
Knowledge
transparency
Free Opinion of people
Living inside the Area
Government has to define the framework for the public consultation
Population, Users, NGOs, etc ..


International Office For Water PARIS-FRANCE
Participation - Debate
International Network Of Basin Organizations
Country
National Level
National Water Commission
Information Knowledge
Large Debate on Major Institutional Projects (Water Code, Law…)
Government has to define the Framework for the public consultation
Population, Users, NGOs, etc ..


International Office For Water PARIS-FRANCE
International Network Of Basin Organizations
Thanks fot your attention
d.valensuela@oieau.fr
www.oieau.fr
www.riob.org

3.3 Evaluating current & potential institutional and economic options at the INECO Case Studies: Context and Methodology

Prof. A. Massarutto, IEFE, Italy

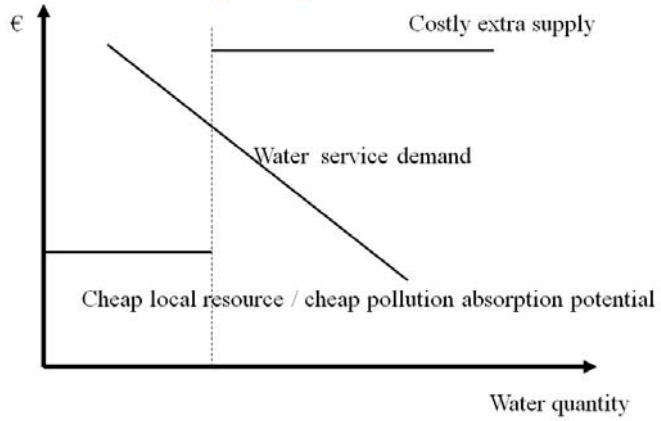
INECO
Institutional and Economic Instruments for Sustainable Water Management in the Mediterranean Region

Evaluating current and potential institutional and economic options from the INECO case studies: context and methodology

Antonio Massarutto
University of Udine, Dept of Economic Sciences
IEFE, Bocconi University, Milano
antonio.massarutto@uniud.it

CONTEXT

The policy dilemma



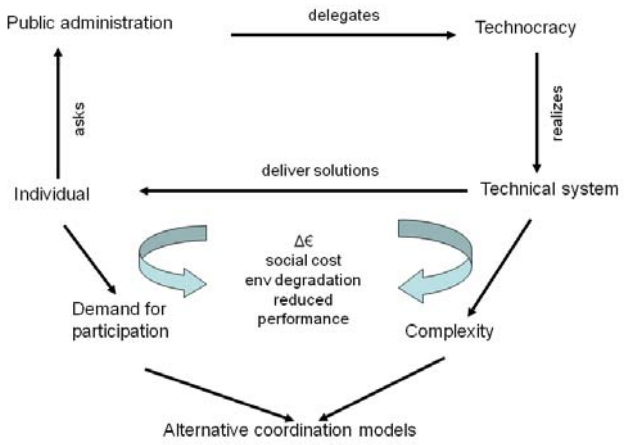
The policy dilemma – way out

- Expand supply ⇔ more with more raw water
  - Pump more from the underground
  - Water transfers
  - Desalination
- Δ productivity ⇔ more with same raw water
  - Integrated water management schemes
  - Water-efficient irrigation
  - Wastewater reuse
- Reduce demand ⇔ less with same raw water
  - Increase water prices up to the scarcity value in order to phase-out uses with the lowest value
  - Reallocate existing water rights ⇏ "irrigar los turistas vale mas que irrigar los campos"
  - Promote "soft" demand reduction (eg virtual water trade; change of agricultural patterns

The limit of the traditional approach

- Δ supply ⇏ more with more raw water
  - Very costly; most of the times inefficient (eg transfers)...
  - ... or might entail high resource/external costs (eg GW)
  - Unaffordable without public spending
  - Access to capital markets possible but very costly without public guarantees ⇔ recovery of sunk cost difficult
- Δ productivity ⇏ more with same raw water
  - Requires professional water management (PSI?)
  - Costs cannot be easily transferred to the public sector (mostly operational and management costs instead than infrastructure)
  - Not necessarily good for the environment
- Reduce demand ⇏ less with same raw water
  - socially or politically difficult ⇔ distributive and affordability issues
  - Empowerment of water authorities problematic
  - Enforcement difficult (point vs. non-point)
  - compensation can alleviate political opposition but is unfeasible under the sectoral management model

The vicious circle of traditional solution



New water policy conventions

- Traditional :
  - water as a social right; role of government to guarantee this right
  - water services as public goods; role of government to supply them and finance out of general/local taxation
  - water management as a supply-side problem; sectoral approach
  - little attention to ecosystems' value
- Present / WFD
  - water as a scarce resource having an economic value; role of government to ensure its efficient and fair allocation and promote sustainability
  - recognition of the importance of ecosystem services and non-market values
  - water services as utilities; role of government to guarantee universal access (but not, or not necessarily, to pay for the cost via taxation)
  - water management as both a supply- and demand-side problem; integrated approach

Economic approach: myths …

- The scarcity problem is (just a) pricing problem ⇔ get the price right
- Inefficient allocation derives from lack of economic support to decision ⇔ do CBA and allocation will be efficient
- Inefficient management derives from the public sector ⇔ provide water services as commercial utilities
- State vulnerable to "capture": let market operate

Some more realistic views

- Efficiency vs. distributive vs. financial vs. environment
- Water governance issues depend on many different factors (not only economic)
- Pricing: trade-offs entailed by alternative tariff structures (eg IBT vs. affordability, cost recovery)
- Economic instruments ⇔ new costs (eg metering)
- Stakeholder response to EI not obvious
- State continues to be necessary, but increasingly weaker and poorer
- Difficulty to create appropriate economic regulatory institutions allowing PSI ⇔ difficult to introduce market-based mechanisms for WS&S provision

What can we expect from economic approach

- The usefulness of economic instruments
  - Provide incentives to users and allow more efficient allocation of existing water
  - Provide a "true" representation of users' WTP for improving the water management system
  - Recover cost of alternative actions and ensure financial viability of WS&S ⇅ attractiveness for investors
  - Reveal information on individual values
  - share the cost more equitably
- The importance of insitutional reforms
  - Encourage a watershed vision of problems
  - Enhance cooperation among users
  - Favour a multidisciplinary decisionmaking
  - Establish property rights in a more efficient way
  - Allow professionalization of water management through the creation of adequate counterbalances

Categories of instruments - I

- Water resource (re)allocation
  - Marketable permits
  - Fostering voluntary agreements
  - Auctions for releasing use licenses
  - Segregation of uses
- Efficient water use & reduction of pollution
  - Taxes / prices / charges based on marginal cost
  - Promoting water saving, wastewater reuse, rainwater harvesting …
- Implement a long-term vision
  - Liability systems
  - Ownership of the resource ⇅ ownership of problems
  - FCR of artificial water capital including decommissioning

Categories of instruments - II

- Promoting IWRM
  - Compensation of ecosystem services
  - Bargaining "a-la-Coase"
  - Users' associations
  - Subsidizing opportunities of cooperation among users
  - Sharing costs in a more effective and acceptable way
- Addressing macro-drivers
  - Urban development, agricultural policy …
- Promoting self-sufficiency of WS&S undertakings
  - Cost recovery (whatever scheme)
  - Securitization & other financial arrangements
  - Commercialization / privatization of WS&S provision + economic regulation

What have we learned

- Economic instruments are helpful but do not work alone nor automatically
- Economic instruments are not "magic sticks" ⇨ no invisible hand delivering the solution automatically
- Trade-offs among sustainability targets ⇨ no "double dividends"; cost recovery (especially of sunk costs) often at odds with incentive structures
- Constraints arising from the actual capacity to develop robust and effective institutional solutions
- Need to add a bottom-up component (public participation; voluntary agreements; "market-based" instruments)
- Addressing macro-drivers more important than providing micro-economic incentives to final uses
- EI pose affordability problems, but distinguish collective affordability vs. "affordability for the poor" (which may not be considered as a water policy issue)
- Need to "tailor" solutions and instruments to specific needs and policy targets

METHODOLOGY

The INECO approach

- Diagnosis of the situation ("problem tree")
  - What are the main problems and to whom do they belong
  - What are the main drivers behind them
  - how far is the lack of IWRM the root of the problem
- Understanding policy options
  - Policy objectives
  - Categorizing available alternative actions
- Understanding the potential of economic instruments and institutional reform
  - What EI are already in use and how could be improved
  - What can we expect from them
  - How do stakeholders react about them
  - What constraints hamper their adoption

"Personalized" questionnaires

- Sent in march 2008 for each case-study area
  - Background analysis /understanding of the problem and delimiting the space of solutions
  - EI actually used
  - EI that might help solving the problem
  - Understanding of constraints and institutional gaps
- Most complete now; outcomes will be presented in the next sessions
- Next phase: completion of a comparative report discussing the data returned

INECO

Institutional and Economic Instruments for Sustainable Water Management in the Mediterranean Region

Thank you !!

Antonio Massarutto
University of Udine, Dept of Economic Sciences
IEFE, Bocconi University, Milano
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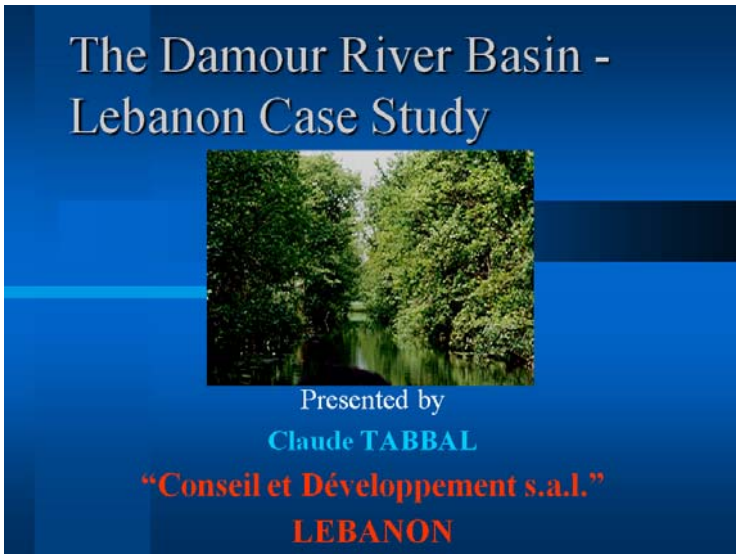
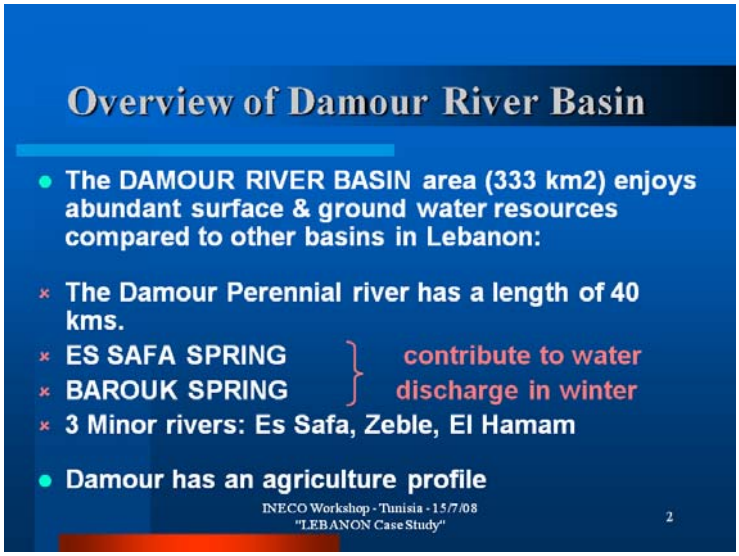
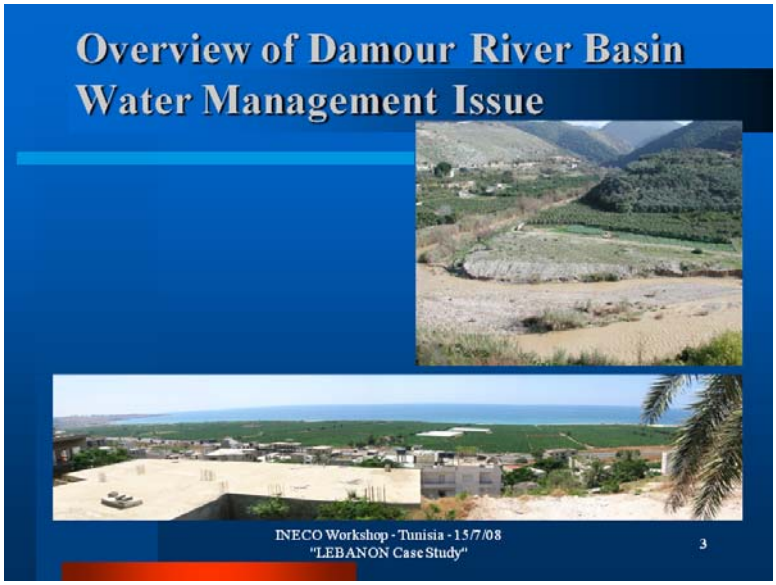
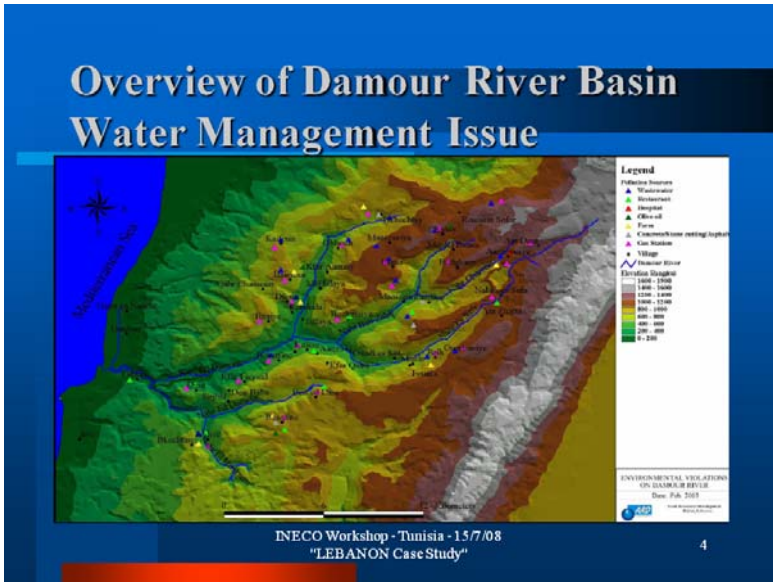
3.4 Water stress in the Damour River Basin, Lebanon

Mr. C. Tabbal, Conseil et Developpement s.a.l






Overview of Damour River Basin
Water Management Issue
INECO Workshop - Tunisia - 15/7/08
"LEBANON Case Study"
3


Overview of Damour River Basin
Water Management Issue
Legend
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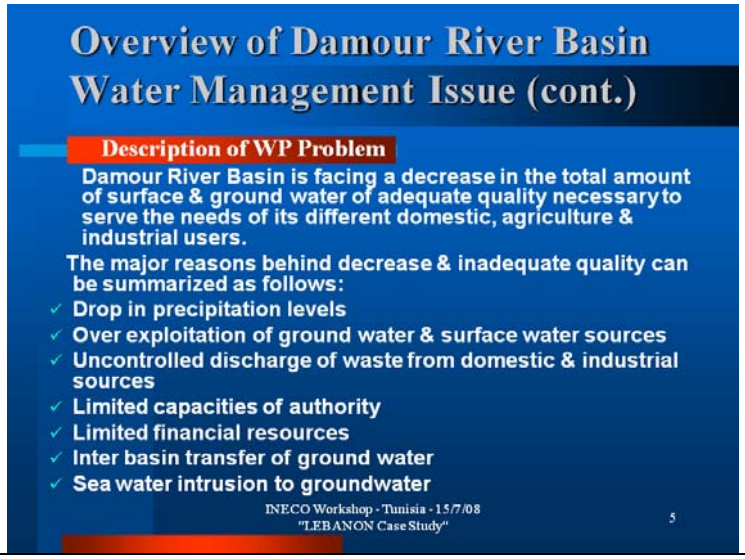
Overview of Damour River Basin
Water Management Issue (cont.)
Description of WP Problem
Damour River Basin is facing a decrease in the total amount of surface & ground water of adequate quality necessary to serve the needs of its different domestic, agriculture & industrial users.
The major reasons behind decrease & inadequate quality can be summarized as follows:
Drop in precipitation levels
Over exploitation of ground water & surface water sources
Uncontrolled discharge of waste from domestic & industrial sources
Limited capacities of authority
Limited financial resources
Inter basin transfer of ground water
Sea water intrusion to groundwater
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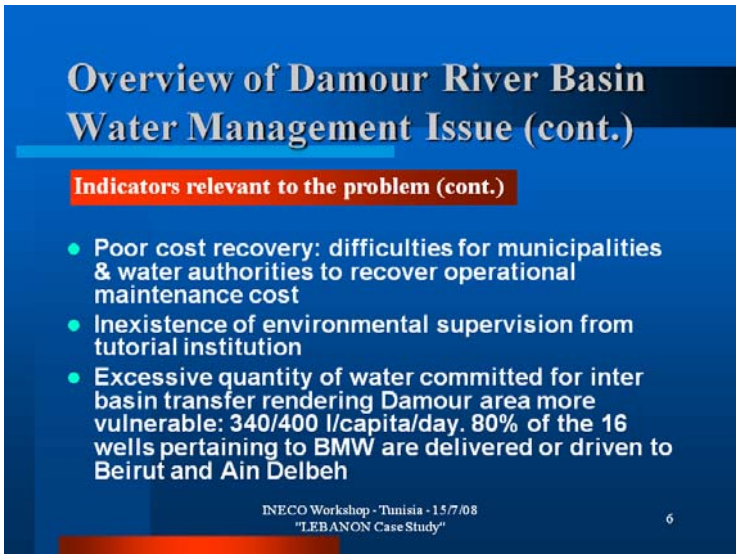
Overview of Damour River Basin Water Management Issue (cont.)
Indicators relevant to the problem (cont.)
Poor cost recovery: difficulties for municipalities & water authorities to recover operational maintenance cost
Inexistence of environmental supervision from tutorial institution
Excessive quantity of water committed for inter basin transfer rendering Damour area more vulnerable: 340/400 l/capita/day. 80% of the 16 wells pertaining to BMW are delivered or driven to Beirut and Ain Delbeh
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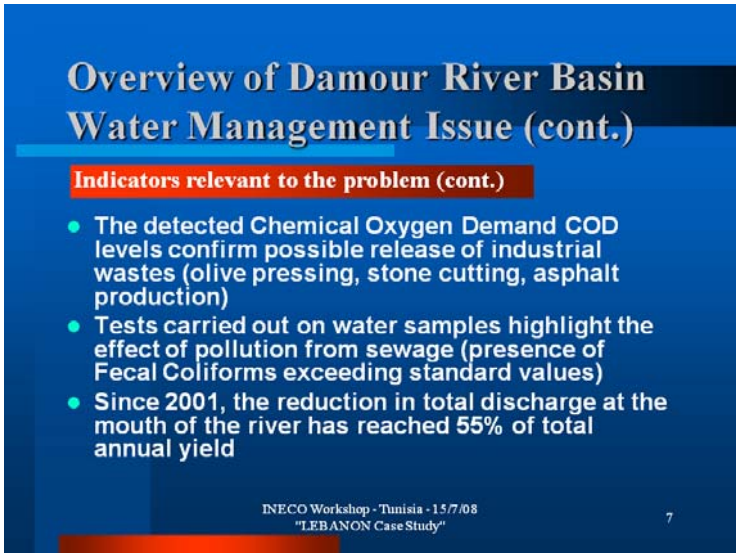
Overview of Damour River Basin Water Management Issue (cont.)
Indicators relevant to the problem (cont.)
The detected Chemical Oxygen Demand COD levels confirm possible release of industrial wastes (olive pressing, stone cutting, asphalt production)
Tests carried out on water samples highlight the effect of pollution from sewage (presence of Fecal Coliforms exceeding standard values)
Since 2001, the reduction in total discharge at the mouth of the river has reached 55% of total annual yield
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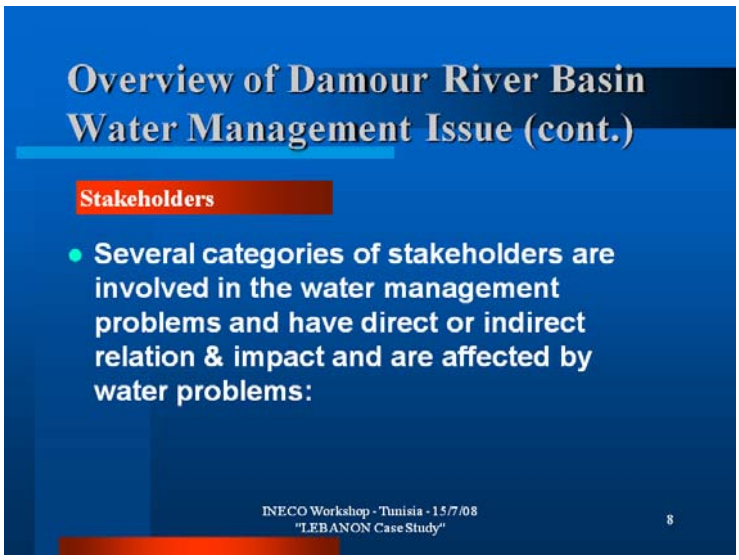
Overview of Damour River Basin Water Management Issue (cont.)
Stakeholders
Several categories of stakeholders are involved in the water management problems and have direct or indirect relation & impact and are affected by water problems:
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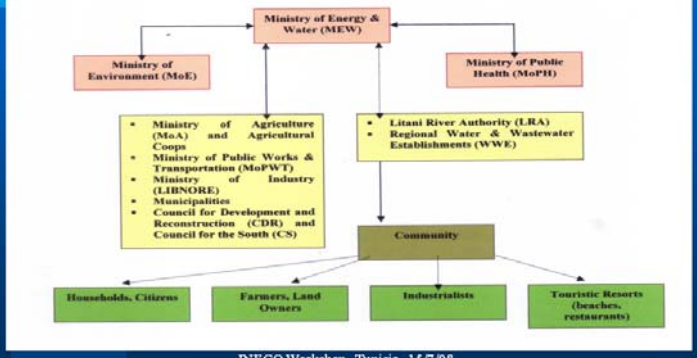
Overview of Damour River Basin Water Management Issue (cont.)

Stakeholders Chart



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Overview of Damour River Basin Water Management Issue (cont.)

The current legislation & governance of water sector:

A- Legislation

- The Lebanese law governing the water sector dates back to Ottoman & French regime. The significance of sustainable water management urged policy makers to develop new laws:
- Law # 221/2000 on management of water sector. This law aimed at inducing institutional changes, yet it is controversial & resulted in several draw backs (modification of laws, decrees & decisions often contradictory)
- Law #444/2002 on environmental protection & sustainable use of natural resources & prevention of environmental pollution

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Overview of Damour River Basin Water Management Issue (cont.)

B- Governance

- The main authority responsible for Damour management resources is the Ministry of Energy and Water:
  - Setting planning framework for sustainable water management
  - Building dams
- Beirut & Mount Lebanon water authority responsible for supplying potable water to its subscribe customers.
- MOE controls sources of pollution
- MOPH monitors safety of drinking water
- CDR plays the role of mobilizing resources for the execution of contemplated projects

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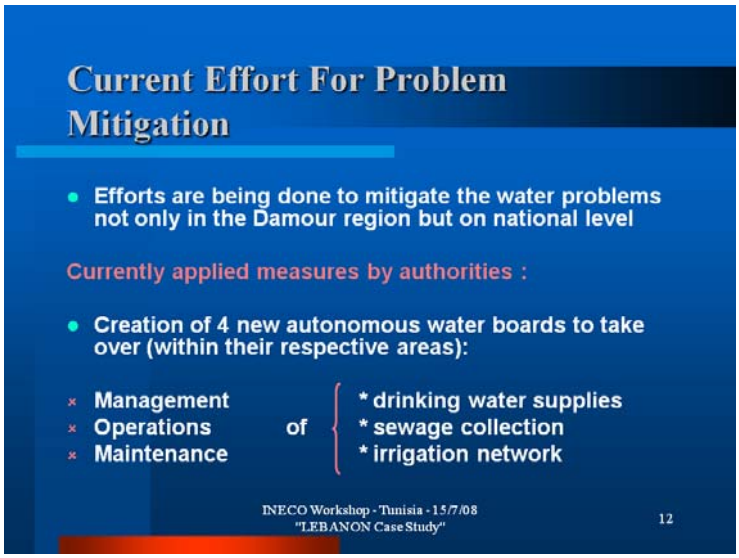
Current Effort For Problem Mitigation
Efforts are being done to mitigate the water problems not only in the Damour region but on national level
Currently applied measures by authorities :
Creation of 4 new autonomous water boards to take over (within their respective areas):
Management
Operations
Maintenance
of
* drinking water supplies
* sewage collection
* irrigation network
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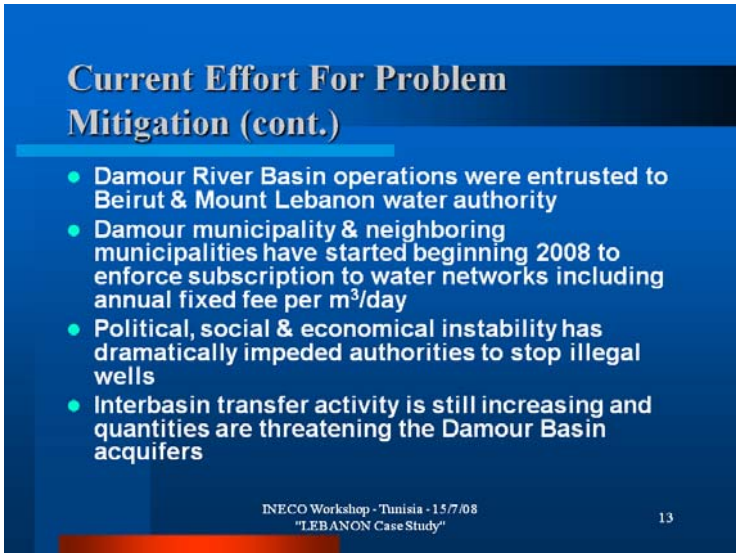
Current Effort For Problem Mitigation (cont.)
Damour River Basin operations were entrusted to Beirut & Mount Lebanon water authority
Damour municipality & neighboring municipalities have started beginning 2008 to enforce subscription to water networks including annual fixed fee per m3/day
Political, social & economical instability has dramatically impeded authorities to stop illegal wells
Interbasin transfer activity is still increasing and quantities are threatening the Damour Basin acquifers
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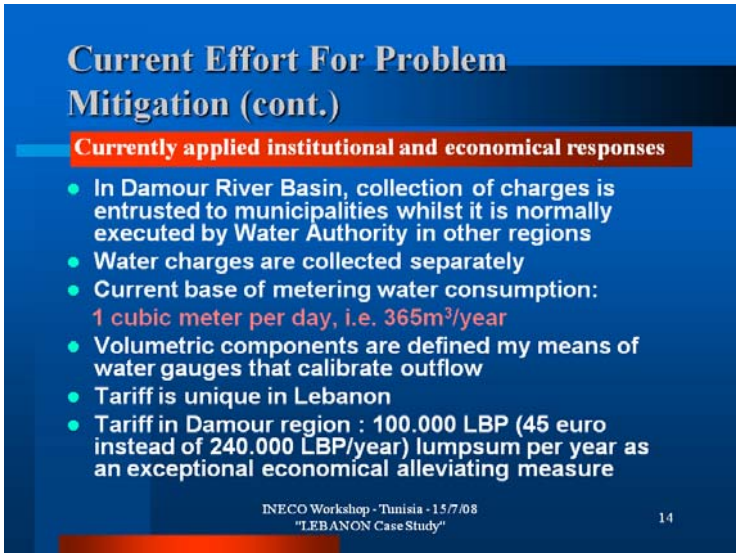
Current Effort For Problem Mitigation (cont.)
Currently applied institutional and economical responses
In Damour River Basin, collection of charges is entrusted to municipalities whilst it is normally executed by Water Authority in other regions
Water charges are collected separately
Current base of metering water consumption:
1 cubic meter per day, i.e. 365m3/year
Volumetric components are defined my means of water gauges that calibrate outflow
Tariff is unique in Lebanon
Tariff in Damour region : 100.000 LBP (45 euro instead of 240.000 LBP/year) lumpsum per year as an exceptional economical alleviating measure
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Current Effort For Problem Mitigation (cont.)

Currently applied institutional and economical responses (cont.)

- Some zones of the studied area are declared protected upstream the Damour River & water wells are restricted in these zones
- However, economic consequence of this measure is the high cost of expropriation in the area
- Extraction permits are subject to drastic conditions & require republican order or decree except for those under 150 meters depth & not exceeding 100 m^3/day
- Abstraction charges are fixed by a Ministerial decree that takes into consideration depth and flow

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INECO Participatory Process

- The workshop held on September 12th 2007 gathered a panel of different stakeholders who participated in the debate on water problems and alternative solutions
- A tentative analysis of the focal water management problem in the Damour River Basin had revealed different causes as displayed in the Focal Problem Tree:

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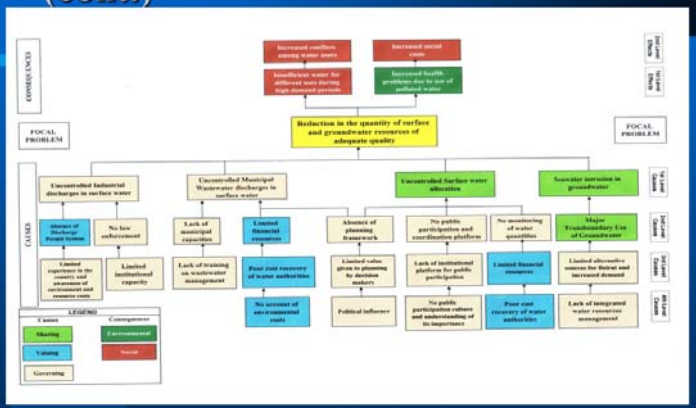
INECO Participatory Process (cont.) Problem Tree



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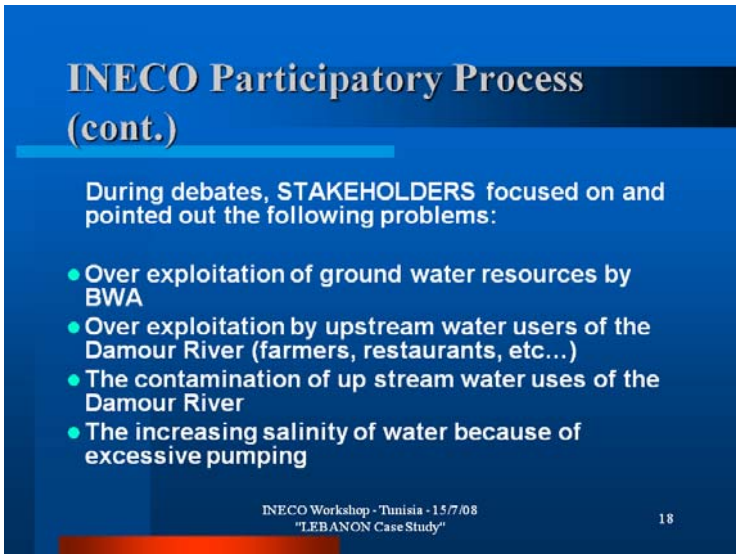
INECO Participatory Process (cont.)
During debates, STAKEHOLDERS focused on and pointed out the following problems:
Over exploitation of ground water resources by BWA
Over exploitation by upstream water users of the Damour River (farmers, restaurants, etc…)
The contamination of up stream water uses of the Damour River
The increasing salinity of water because of excessive pumping
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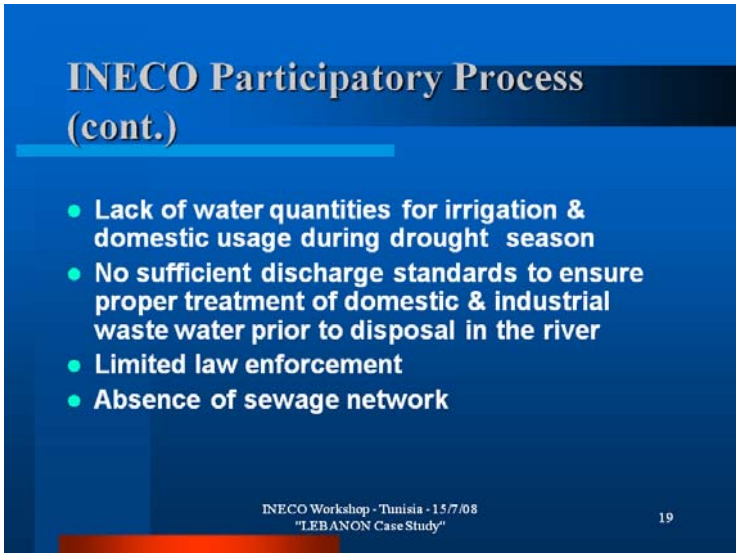
INECO Participatory Process (cont.)
Lack of water quantities for irrigation & domestic usage during drought season
No sufficient discharge standards to ensure proper treatment of domestic & industrial waste water prior to disposal in the river
Limited law enforcement
Absence of sewage network
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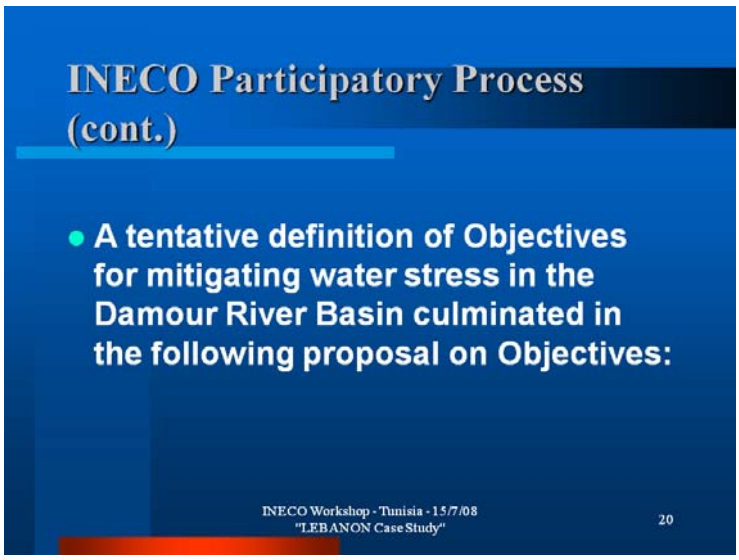
INECO Participatory Process (cont.)
A tentative definition of Objectives for mitigating water stress in the Damour River Basin culminated in the following proposal on Objectives:
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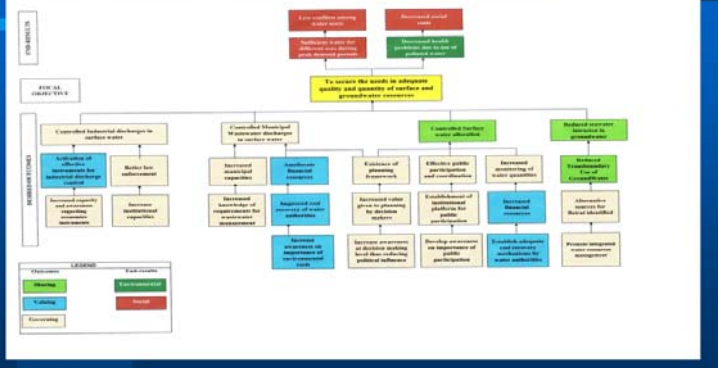
INECO Participatory Process (cont.)

Objective Tree



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INECO Participatory Process (cont.)

The objectives defined in collaboration with local stakeholders articulated around 4 main elements:

- To secure necessary quantity & adequate quality of surface & underground water particularly during drought seasons
- Rehabilitate infrastructure & reinforce monitoring & control of institutions over the water matters
- Stress on water pollution prevention
- Allocation of water based on a comprehensive socio economic survey & analysis

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INECO Participatory Process (cont.)

The alternative solutions were also examined by stakeholders & the following suggestions were formulated:

- Secure water quantities by building the promised Dam on the Damour River
- Reduce inter basin water transfer
- Limit the underground wells
- Prevent pollution by creating water treatment plants

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INECO Participatory Process (cont.)

- Prevent misuse of water & limit violation & illegal use
- Rehabilitate infrastructure net & install canalization instead of open air
- Install water meters
- Implement liability system
- Create citizen awareness via campaigns on usage of water and pollution prevention

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Evaluation of Options by Local Stakeholders and Comments

- The questionnaires distributed to the different categories of stakeholders revealed a convergence of opinions with regards to water problems & their solutions :

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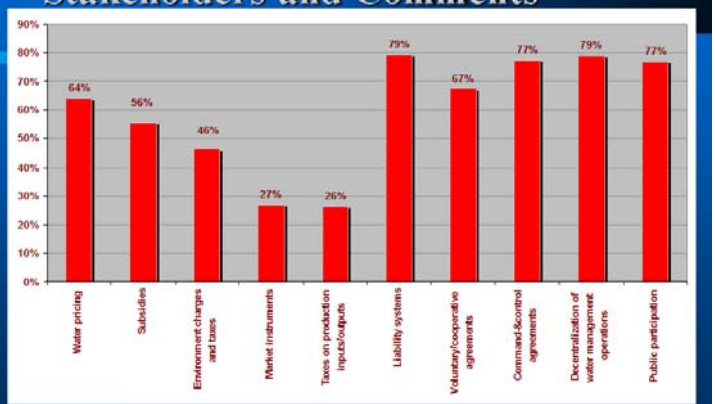
Evaluation of Options by Local Stakeholders and Comments



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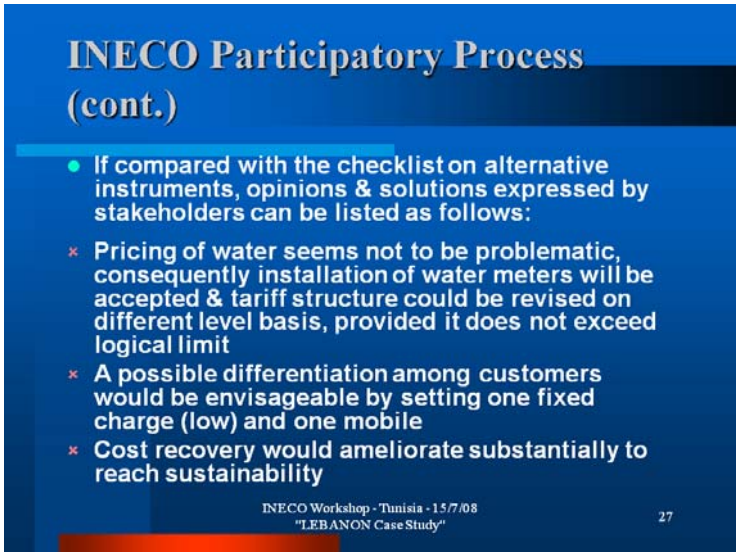
INECO Participatory Process (cont.)
If compared with the checklist on alternative instruments, opinions & solutions expressed by stakeholders can be listed as follows:
Pricing of water seems not to be problematic, consequently installation of water meters will be accepted & tariff structure could be revised on different level basis, provided it does not exceed logical limit
A possible differentiation among customers would be envisageable by setting one fixed charge (low) and one mobile
Cost recovery would ameliorate substantially to reach sustainability
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INECO Participatory Process (cont.)
Command & Control which implies establishment of discharge permit system, penalty & sanction, implementing of technology standard would be easy to adopt
Market based instruments are not a preferred nor appreciated option. Stakeholders ignore such option & are not currently applied in Lebanon for different socio-economic reasons
Voluntary agreements: Though not currently implemented in Lebanon, yet this option rallies 67% of stakeholders preference
Implementing of such agreements would have a certain economical impact & would necessitate compensations & financing policies
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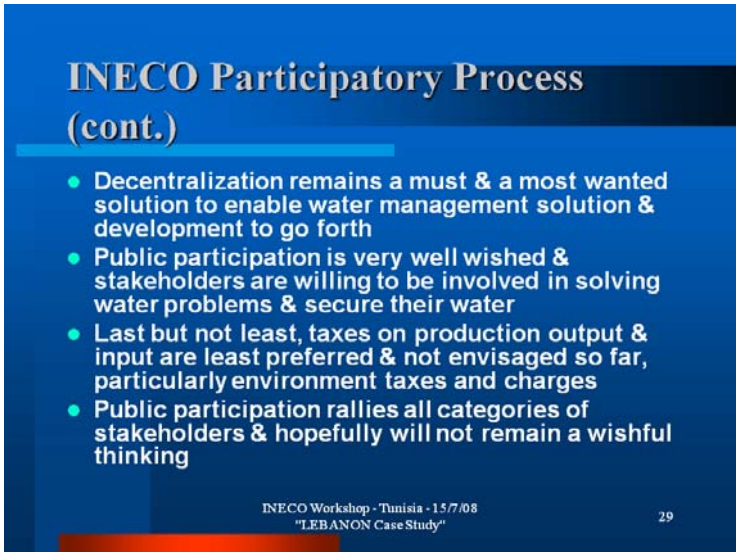
INECO Participatory Process (cont.)
Decentralization remains a must & a most wanted solution to enable water management solution & development to go forth
Public participation is very well wished & stakeholders are willing to be involved in solving water problems & secure their water
Last but not least, taxes on production output & input are least preferred & not envisaged so far, particularly environment taxes and charges
Public participation rallies all categories of stakeholders & hopefully will not remain a wishful thinking
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Meetings & Workshops

Dedicated meetings to Water Management problems in the Damour River Basin area:

- INECO Workshop on 12/09/07
- Follow-up meetings with Damour & Meshref municipalities (October 2007, January 2008)
- Preparatory meeting & distribution of questionnaires to stakeholders (Meshref: April 2008)

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Proposals for WM solutions

- The proposals that won the stakeholders approval on Water Management problems &solutions :

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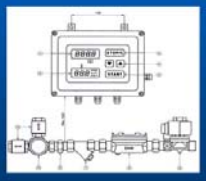
Proposals for WM solutions (cont.)

Building dam

Limit extractions



Install Watermeters

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Proposals for WM solutions
POLICE
Law Enforcement
Prevent Pollution
Community Respect to Rules
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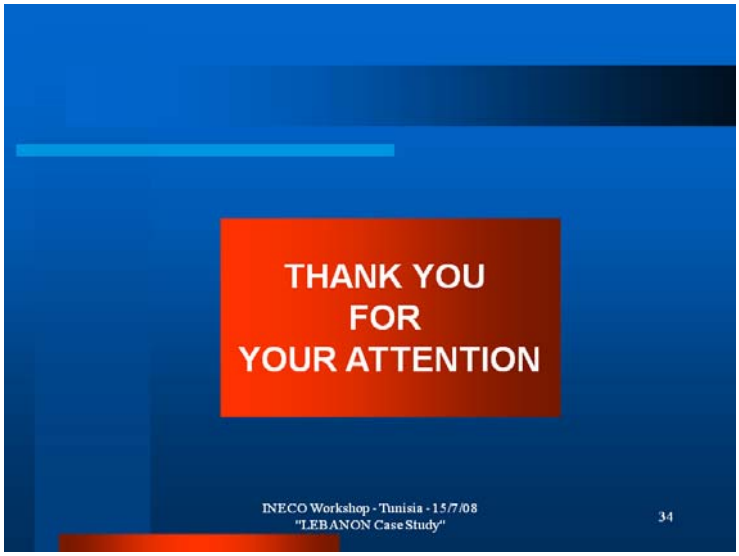
THANK YOU
FOR
YOUR ATTENTION
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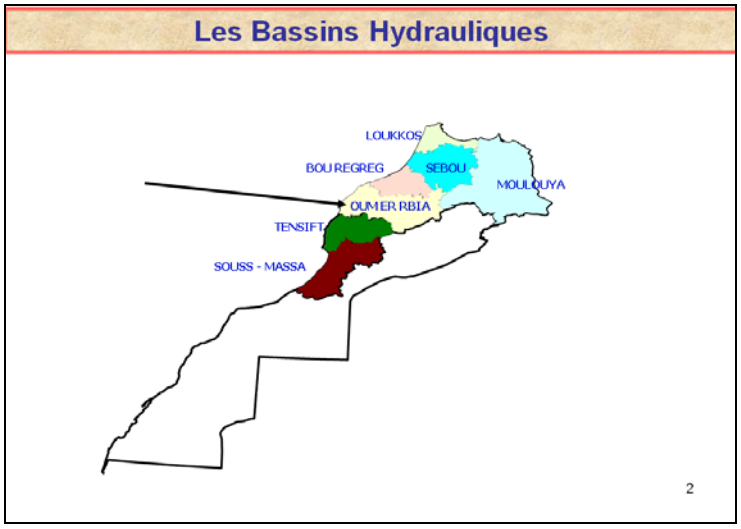
3.5 Enhancing efficiency in irrigation water use in the Oum Er Rbia Basin, Morocco

Mr. M. Marzouk, Oum Er Rbia Hydraulic Basin Agency



Importance de la zone d'action de l'Agence/National

- 7% de la superficie du pays
- 17% de la population
- 19% des ressources en eau
- 36% de la capacité de stockage
- 33% de la surface irriguée
- 47% de la puissance installée (portée à 80% par la STEP)
- 70% de la production moyenne

4

Ressources en eau

Eaux de surface

Précipitations:

Période	Pluie moyenne (mm)	Écart (%)
1935-2007	370	
1935-1980	403	18
1981-2007	330	

Mini :185 mm

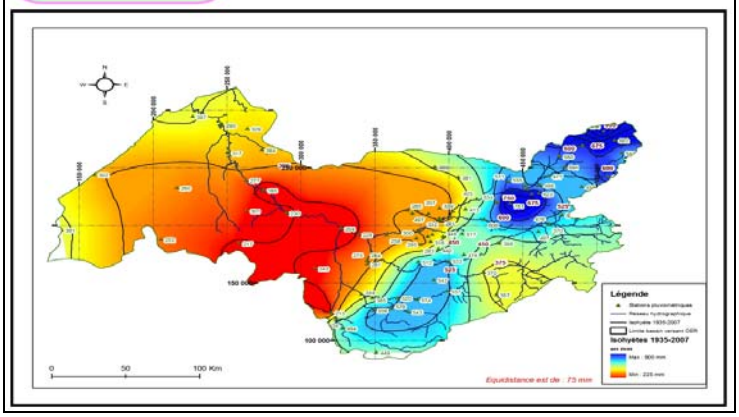
Max: 955 mm

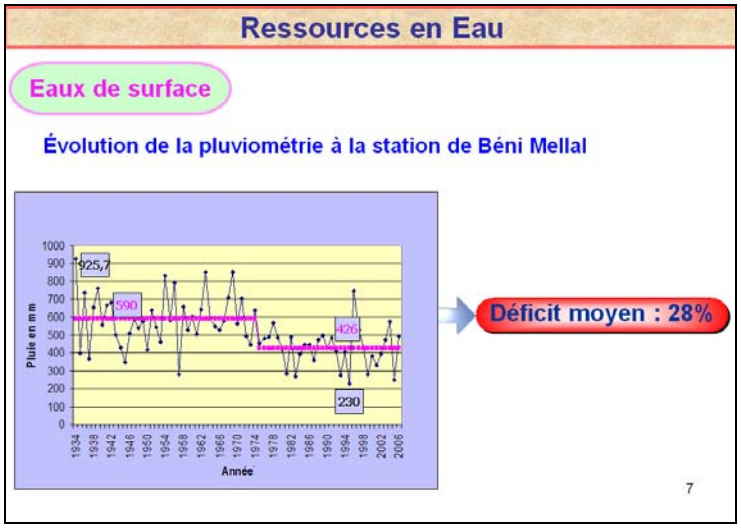
- **90% (Octobre - Mai)**
- **Réduction / ancien PDAIRE: 29 %**

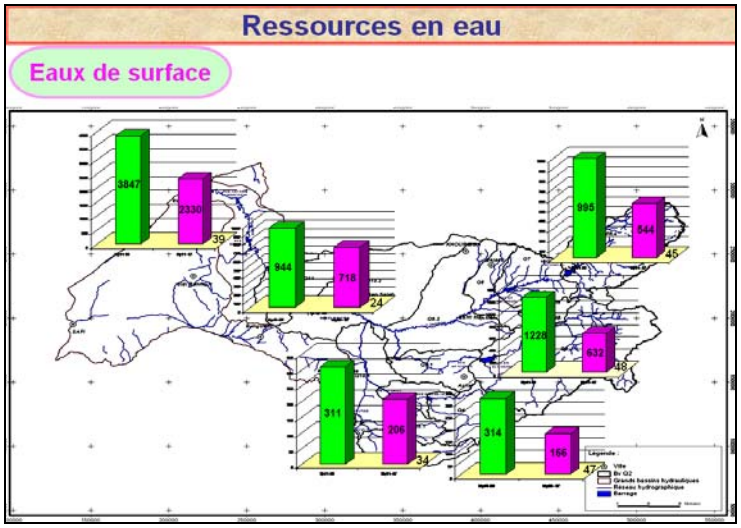
5

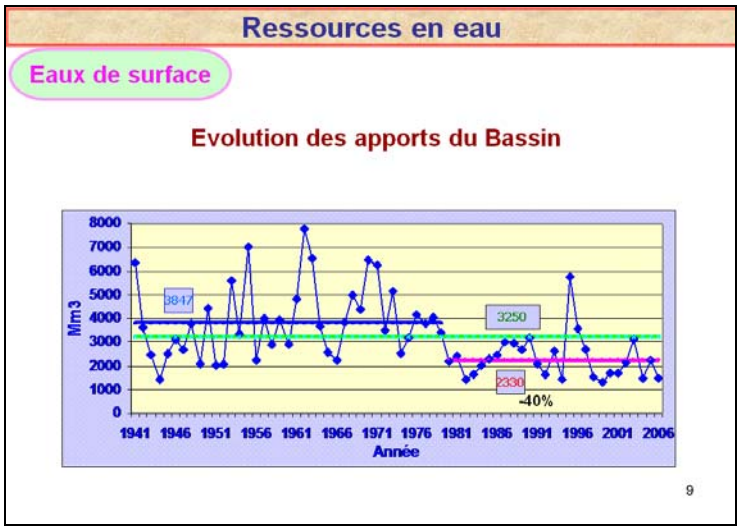
Ressources en eau

Eaux de surface




Ressources en Eau
Eaux de surface
Évolution de la pluviométrie à la station de Béni Mellal
Pluie en mm
Année
925,7
590
426
230
Déficit moyen : 28%
7

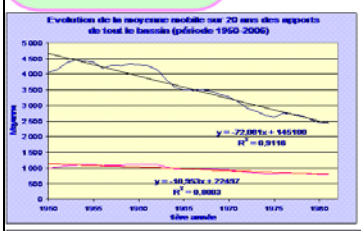

Ressources en eau
Eaux de surface
3847
2330
39
944
718
24
895
644
45
1228
632
48
311
206
34
314
166
47

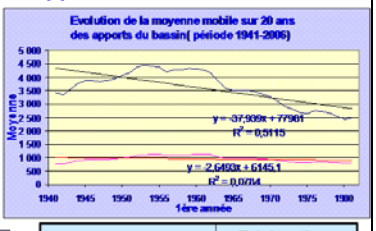

Ressources en eau
Eaux de surface
Evolution des apports du Bassin
Mm3
Année
3847
3250
2330
-40%
9

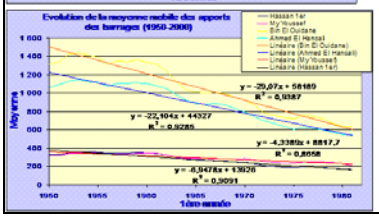
Ressources en eau

Eaux de surface

Réduction des apports au niveau du bassin





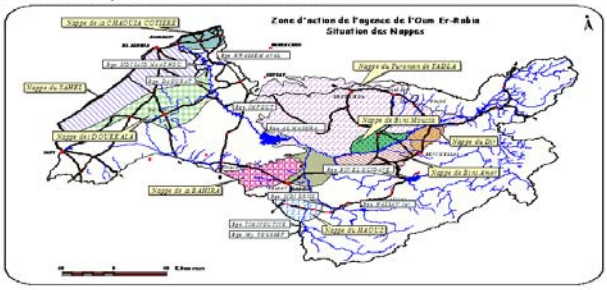


Barrage	Réduction Mm³
Ahmed El Hansali	22
Bin El Ouidane	29
Hassan 1er	7
My Youssef	4
Total Bassin	72

Ressources en eau

Eaux souterraines

- 12 Aquifères superficiels et profonds ;
- Potentiel exploité : 610 Mm3/an(70% dans la zone du Tadla 367 Mm3/an);
- Potentiel exploitable : 350 Mm3/an.



11

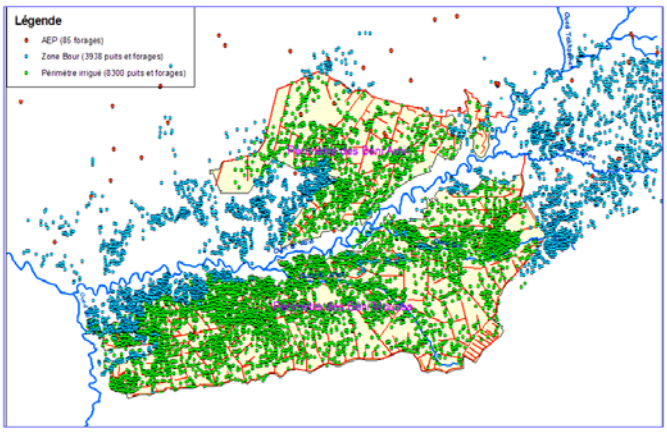
Ressources en eau

Eaux souterraines

BILAN GLOBAL

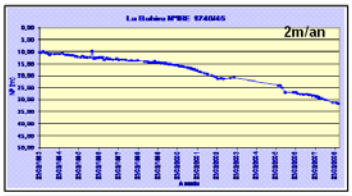
Nappe	Entrées (Mm³)					Sorties (Mm³)							Bilan (1)-(2)	Volume exploitable
	Pluie	Retour d'irrigation	Infiltration oued	Ecoulement	Total (1)	Prélèvements AEP	Prélèvements Irrigation	Ecoulement	Sources	Drainage par les cours d'eau et Sebkhas	Pertes en mer	Total (2)		
Beni Amir	8	94	-	-	102	0.7	65	11	-	74	-	151	-49	30
Dir	21	22	-	-	43	-	67	5	-	5	-	77	-34	40
Beni Mouzza	26	164	-	5	195	2	104	-	-	140	-	246	-51	55
Rocène	154	5	-	154	313	15	110	146	-	121	-	392	-79	55
Sénonien	149			182	331		3	326		6		335	-4	5
Turonien	127	-	17	2	146	44	18	57	12	37	-	168	-22	35
Tessaout Aval	10	70	5	5	90	2	25	25	-	47	-	99	-9	30
Bahira	42	24	7	5	78	15	78	3	-	25	-	121	-43	40
Khéminet-Chaouia	2.3	-	-	0.7	3	0.2	2.5	-	0.5	-	-	3	0	2
Nappes montagnes	5.6	-	-	-	5.6	1.2	0.1	-	0.7	-	-	2	3.6	5
Sahel-Doukkala	100	35	3	5	143	5	50	-	3		90	148	-5	50
TOTAL	645	414	32	358.7	1450	85.1	522.6	573	16.2	455	90	1742	-292	12347

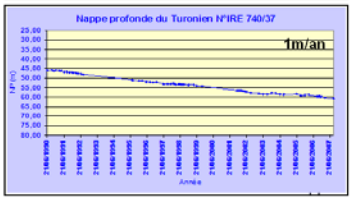
Points de prélèvement d'eau dans les périmètres du Tadla



Impact sur les eaux souterraines

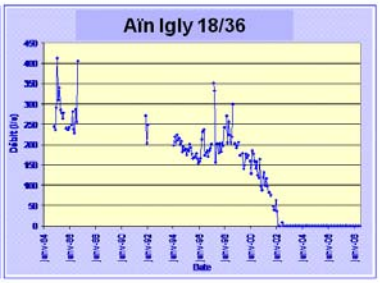
- Surexploitation
- Baisse piézomètriques





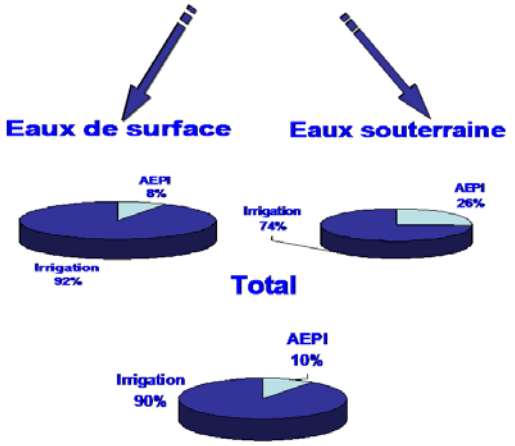
Impact sur les sources

Tarissement de certaines sources



15

Utilisation des ressources en eau



16

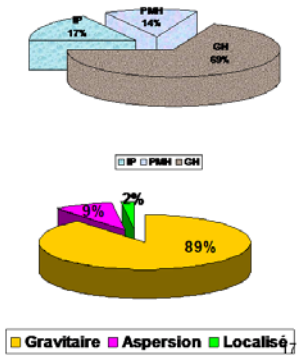
Besoins en eau agricole

Superficie totale irriguée: **464 530 ha**

- **GH : 322849 ha :**
  - 97 870 ha: ORMVA Tadla
  - 98 717 ha: ORMVA Doukkala:
  - 126 262 ha: ORMVA Haouz :
- **PMH : 64 380 ha**
- **IP : 77 300 ha**

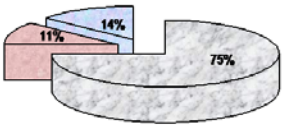
Mode d'irrigation:

- Gravitaire: **413 503 ha**
- Aspersion: **40 736 ha**
- Localisé: **10290 ha**



Besoins en eau agricole

Besoin total: **3890 Mm³/an**

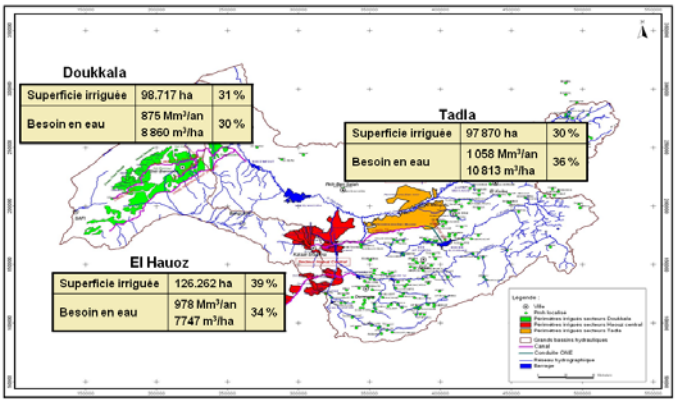


- **GH : 2911 Mm³/an :**
  - **1058 Mm³/an : ORMVA Tadla**
  - **978 Mm³/an :ORMVA Doukkala**
  - **875 Mm³/an ORMVA Haouz**
- **PMH : 428 Mm³/an**
- **IP : 552 Mm³/an**

18

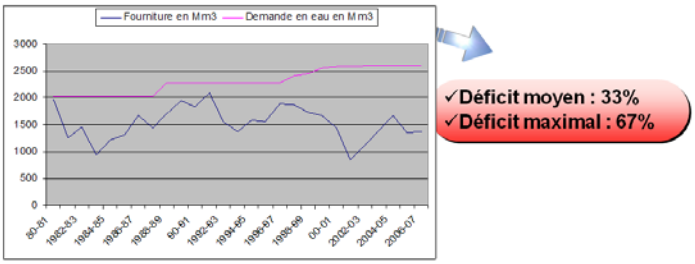
Demande en eau agricole

Situation des périmètres irrigués (constats)



Impact sur l'irrigation

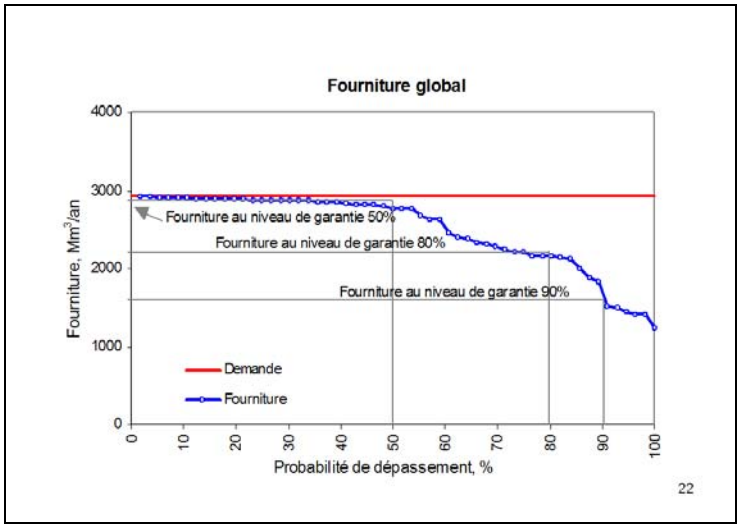
❑ **Déficit en eau des périmètres irrigués**

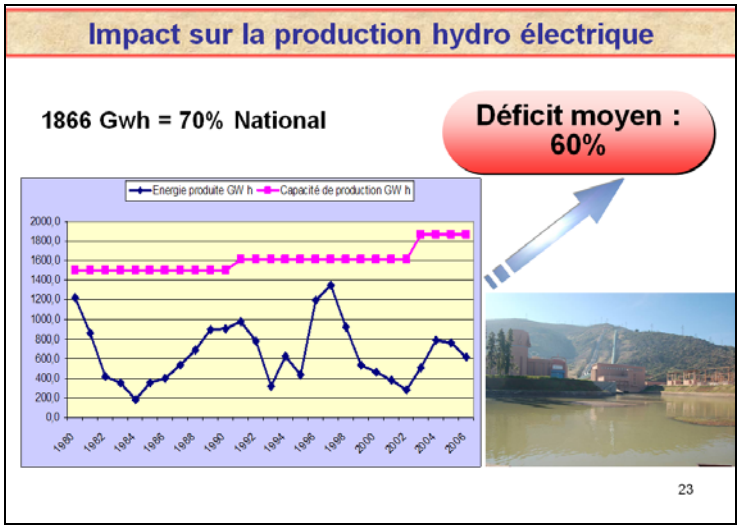


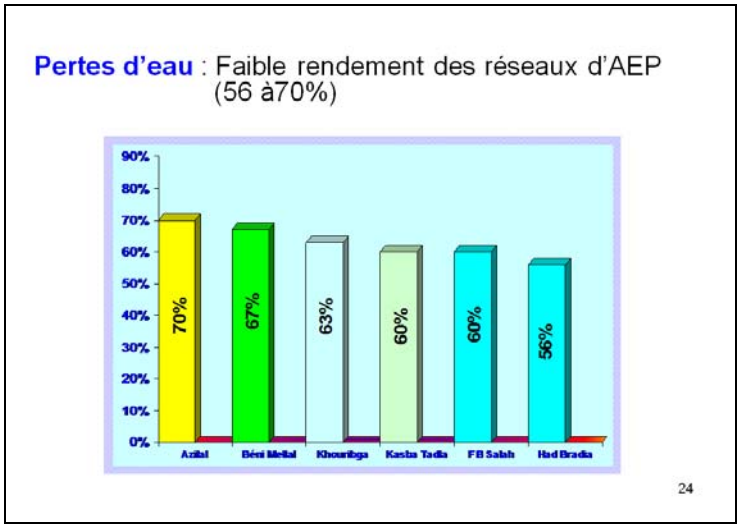
✓Déficit moyen : 33%
✓Déficit maximal : 67%

20

Impact sur l'irrigation

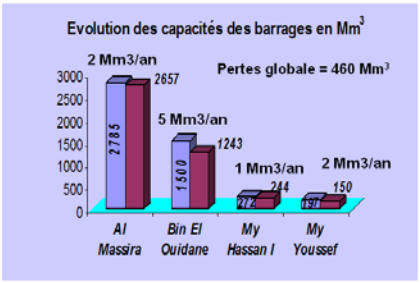

Fourniture global
Fourniture, Mm³/an
Fourniture au niveau de garantie 50%
Fourniture au niveau de garantie 80%
Fourniture au niveau de garantie 90%
Demande
Fourniture
Probabilité de dépassement, %
22

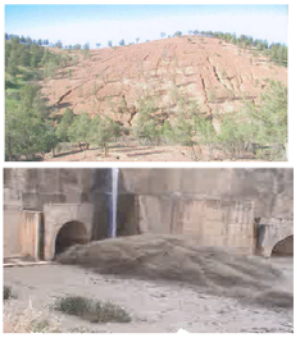

Impact sur la production hydro électrique
1866 Gwh = 70% National
Déficit moyen : 60%
Energie produite GW h
Capacité de production GW h
23


Pertes d'eau : Faible rendement des réseaux d'AEP (56 à70%)
70%
67%
63%
60%
60%
56%
Azilal
Béni Mellal
Khouribga
Kasba Tadla
FB Salah
Had Bradia
24

Impact sur les barrages

- Envasement des Barrages
  - Perte par envasement 10 Mm³/an





Contraintes

❑ **Pollution domestique**

- Déversement des rejets des centres ;
- 40 Mm³/an milieu naturel
- 16 stations d'épuration
- Oued Oum Er Rbia « Collecteur des eaux usées »

26

Contraintes

❑ **Pollution industrielle**

- Déversement de 16 Mm³/an
- Pollution organique 11000T DBO et 21500T DCO

27

Contraintes

- Prolifération des algues dans les retenues et bassins
- Empoissonnement par les carpes a donné des résultats importants

Avant de traitement | En cours de traitement | Après traitement

28

Aspects institutionnels

Loi 10-95 - Cadre législatif de base

Objectif général :

asseoir une politique national de l'eau visant :

- Rationalisation de l'utilisation de l'eau ;
- Solidarité entre les régions ;
- Généralisation de l'accès à l'eau ;
- Sécurisation d'approvisionnement en eau pour tout le Territoire National.

29

Principaux objectifs spécifiques :

- Planification cohérente et souple de l'utilisation des Ressources en Eau (B.V et national)
- Mobilisation optimale et gestion rationnelle des Ressources en Eau (priorité PNE)
- Gestion des Ressources en Eau dans le cadre d'une unité géographique (B.V) :
  - Gestion décentralisée.
  - Solidarité effective
  - Protection et conservation du DPH

30

• Administration adéquate en associant les usagers de l'eau dans la prise des décisions (CSEC, CPPE de l'eau, ABH-CA, …)(Rappeler les principes en option)

➥Principes « Pollueur payeurs » « Préleveur payeur » ;

➥Octroi des aides financiers

➥Subvention « Fond Développement Agricole » 60% du coût d'investissement. (Puits ——Réseau)

L'eau doit financer l'eau

31

Efforts entrepris pour palier à la problématique

a) Options adoptées par les autorités

• Consolidation de la gestion de l'offre : eau renouvelable ressources non conventionnelle (lavage phosphate, golfs Marrakech, …)

Mais : présente des limites :

▪ B.V OER. Saturation taux mobilisation 94% (pertes mer = Ø).

▪ Incidence financière → Coût des infrastructures.

32

Perspectives :

À CT. Transfert bassins du Nord vers l'OER (principe de compensation).

À M & LT. Déssalement de l'eau de mer →cas : OCP - Jorf Lasfar - 2009-2010

• Gestion des ressources en eau en agissant sur la demande.

33

b) Mesures institutionnelles et économiques appliqués.

-CSEC - Consultatif - opérationnel approuve les PDAIREs (P.N.E à l'avenir)

-ABH : 7 opérationnelles, 2 en projets.

«espace de coordination et de concertation» : C.A - commission de planification.

-Lancement des PDAIREs à l'échelle du Bassin

-Mise en application des Principes

«Préleveur Payeur» - «Préleveur Pollueur»

34

- Énergie 1998
- Irrigation 2004 (GH - Grands Exploitants.
- Eau potable 2004-2005
- Pollution (texte 2006) lancé en 2007
- DPH (2003)

-Octroi des aides financières (Article 20, alinéa 4).

texte d'application non encore publié.

Souci ABH, préservation DPH et économie de l'eau → étude et réalisation des travaux (2008-2009 = 20 M DH en irrigation)

35

- Programmation et exécution de projet en partenariat : État - Région - ABH - ORMVAT - Usagers de l'eau - Utilisateur de produits agricoles.
- Reconversion de 1100 ha de l'aspercif au localisé dans le Doukkalas :

ABH = Étude + 20%
FDA = 60%)
Association d'agriculteurs = 20%
ORMVAD = Encadrement et sensibilisation

•El Aïchia (330 ha)
•Fariata (1085 ha)

36

- Subvention F.D.A pour l'économie de l'eau

Année	Taux de subvention	Plafond (DH/ha)	
		S. Bassin	A. Bassin
1994	30%	10.000	20.000
1995	40%	12.000	23.000
2001	60%	22.000	36.000

37

Le processus participatif INECO

Atelier 21 Mars 2008

•Contexte de rareté de la ressources en eau

•Augmentation de la demande (conflits inter-régions et inter-secteurs).

Déséquilibre Bilan-Ressources Déficit ~ -1200 Mm³/an

•Utilisation non rationnelle de l'eau (transport, mode d'irrigation, sous-valorisation de l'eau)

38

- Mode de financement ne garantissant pas la durabilité des projets (défaut de recouvrement des coûts …)

- Retard dans la promulgation des textes d'application de la loi sur l'eau et difficultés parfois de mise en œuvre de ceux publiés.

Contribue à des pertes importants d'eau (évaluées à près de 50% : 1675 Mm³/an perdus sur 3250 Mm³/an comme apport du Bassin)

39

À l'issue de l'atelier INECO

Unanimité : Gestion durable des Ressources en Eau dans le Bassin Hydraulique de l'Oum Er Rbia doit passer impérativement par :

« L'ECONOMIE & LA VALORISATION DE L'EAU »

=

Véritable gisement de l'avenir

40

Les Stakeholders ont donc recommandé d'œuvrer pour :

- L'amélioration de la connaissance des ressources en eau ;
- consolidation de la gestion de l'offre ;
- Promotion de la gestion de la demande en eau :
  - La réhabilitation et la modernisation des équipements ;
  - La réduction des pertes d'eau.

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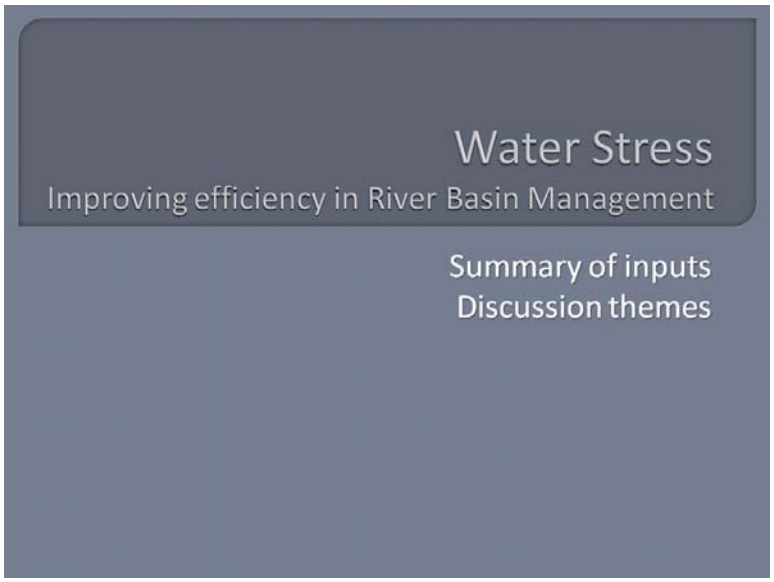
- Renforcement et actualisation du cadre institutionnel et juridique (textes qui réglementent l'aide de l'ABH en matière d'économie d'eau) ;
- Renforcement des associations d'usagers de l'eau (rôle d'encadrement des agriculteurs, de coordination avec les pouvoirs publics …) ;
- Mise en place d'un système de tarification rationnel qui incite à l'économie de l'eau. (rentabilité et durabilité des investissements, gestion de l'eau comme bien économique …) ;

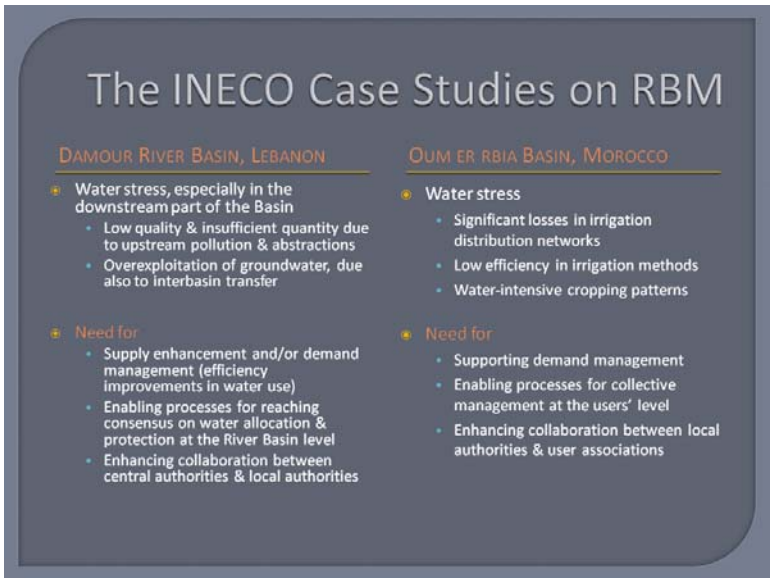
42

- Investigation sur le prix de revient du m^3 d'eau économisé et les retombées positives sur les agriculteurs (+ étude détaillée de la tarification) ;
- L'équité du partage des coûts dans la gestion et la maintenance des réseaux de transport d'eau ;
- Gouvernance des ressources en eau : favoriser la vision globale dans le traitement de la problématique d'économie de l'eau en intégrant dans le processus les politiciens, les chercheurs, les usagers de l'eau et le secteur privé.

43

3.6 Water Stress: Improving efficiency in River Basin Management – A summary of inputs from the Lebanon and Morocco Case Studies





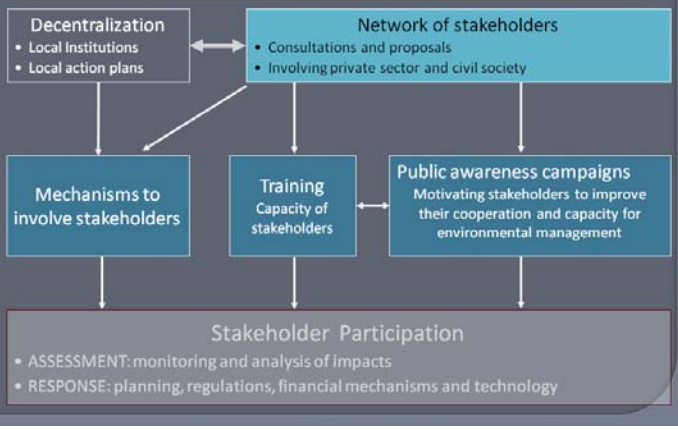
The Structural and the Non-structural approach

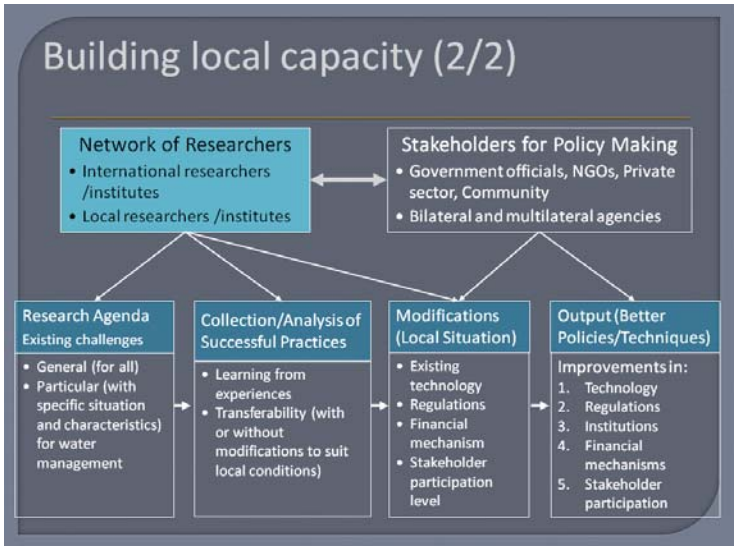
- Supply enhancement options
  - Much progress made in terms of infrastructure development
  - New dams or inter-basin transfers entail high costs
  - Despite technology progress, desalination is still an expensive solution & economically justifiable only for high income uses
- Demand management options
  - Meeting different needs with the appropriate quality of water
    - Can defer the need for additional infrastructure
  - Focus on improving efficiency in water use → saved water can be reallocated to other uses

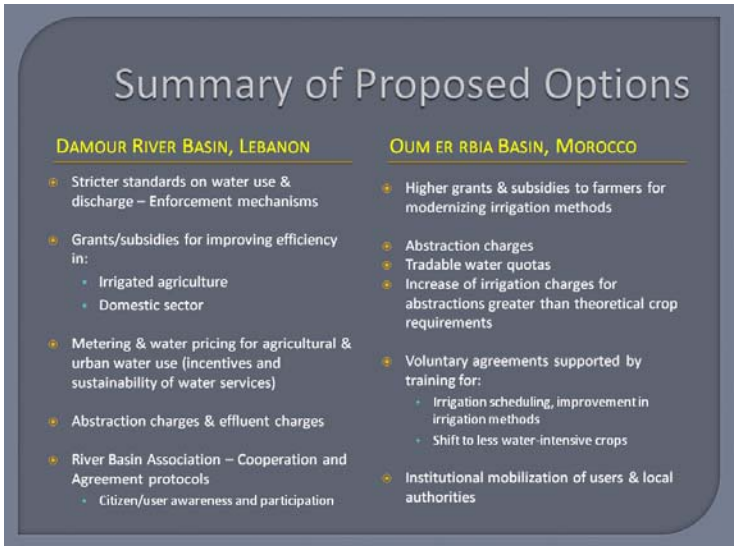
Hardware vs. Software

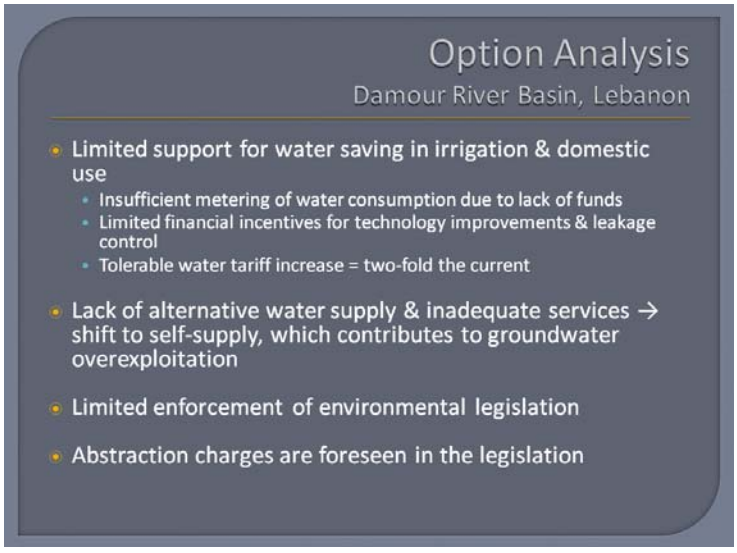
- "Hardware" (infrastructure) needs to be accompanied by "software":
  - Incentives for improving efficiency
  - Strengthening institutions so that they can manage services at the lowest level appropriate
- Capacity building
- Engaging communities in decision-making & improving societal awareness on water issues

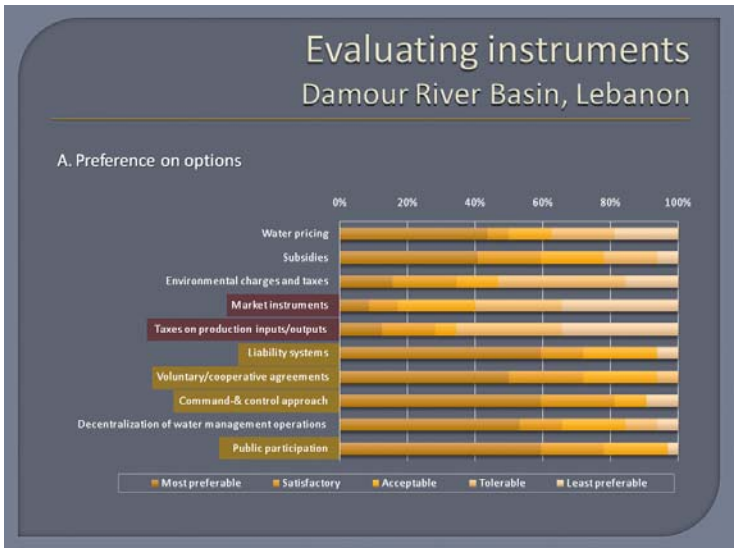
Building local capacity (1/2)

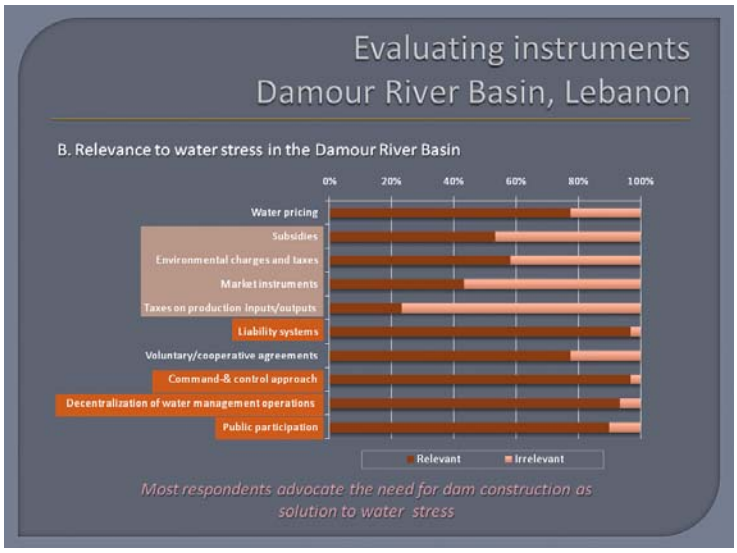


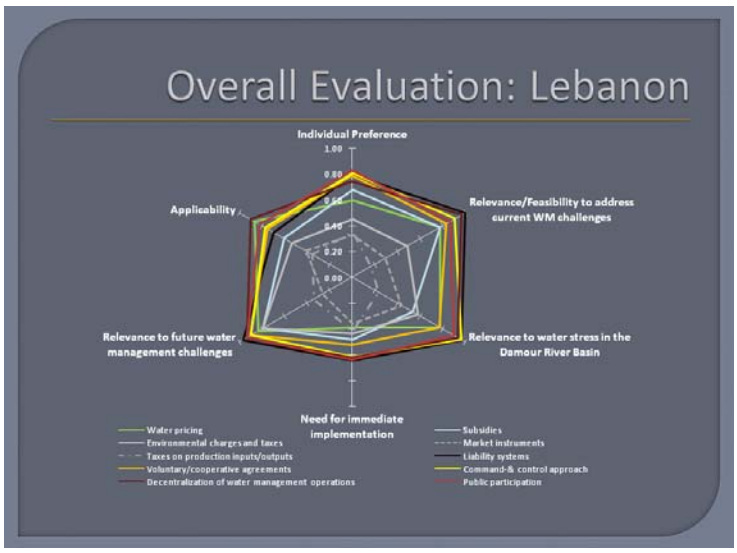

Building local capacity (2/2)
Network of Researchers
• International researchers /institutes
• Local researchers /institutes
Stakeholders for Policy Making
• Government officials, NGOs, Private sector, Community
• Bilateral and multilateral agencies
Research Agenda
Existing challenges
• General (for all)
• Particular (with specific situation and characteristics) for water management
Collection/Analysis of Successful Practices
• Learning from experiences
• Transferability (with or without modifications to suit local conditions)
Modifications (Local Situation)
• Existing technology
• Regulations
• Financial mechanism
• Stakeholder participation level
Output (Better Policies/Techniques)
Improvements in:
1. Technology
2. Regulations
3. Institutions
4. Financial mechanisms
5. Stakeholder participation


Summary of Proposed Options
DAMOUR RIVER BASIN, LEBANON
• Stricter standards on water use & discharge – Enforcement mechanisms
• Grants/subsidies for improving efficiency in:
  • Irrigated agriculture
  • Domestic sector
• Metering & water pricing for agricultural & urban water use (incentives and sustainability of water services)
• Abstraction charges & effluent charges
• River Basin Association – Cooperation and Agreement protocols
  • Citizen/user awareness and participation
OUM ER RBIA BASIN, MOROCCO
• Higher grants & subsidies to farmers for modernizing irrigation methods
• Abstraction charges
• Tradable water quotas
• Increase of irrigation charges for abstractions greater than theoretical crop requirements
• Voluntary agreements supported by training for:
  • Irrigation scheduling, improvement in irrigation methods
  • Shift to less water-intensive crops
• Institutional mobilization of users & local authorities


Option Analysis
Damour River Basin, Lebanon
• Limited support for water saving in irrigation & domestic use
  • Insufficient metering of water consumption due to lack of funds
  • Limited financial incentives for technology improvements & leakage control
  • Tolerable water tariff increase = two-fold the current
• Lack of alternative water supply & inadequate services → shift to self-supply, which contributes to groundwater overexploitation
• Limited enforcement of environmental legislation
• Abstraction charges are foreseen in the legislation


Evaluating instruments
Damour River Basin, Lebanon
A. Preference on options
0%
20%
40%
60%
80%
100%
Water pricing
Subsidies
Environmental charges and taxes
Market instruments
Taxes on production inputs/outputs
Liability systems
Voluntary/cooperative agreements
Command-& control approach
Decentralization of water management operations
Public participation
Most preferable
Satisfactory
Acceptable
Tolerable
Least preferable


Evaluating instruments
Damour River Basin, Lebanon
B. Relevance to water stress in the Damour River Basin
0%
20%
40%
60%
80%
100%
Water pricing
Subsidies
Environmental charges and taxes
Market instruments
Taxes on production inputs/outputs
Liability systems
Voluntary/cooperative agreements
Command-& control approach
Decentralization of water management operations
Public participation
Relevant
Irrelevant
Most respondents advocate the need for dam construction as solution to water stress


Overall Evaluation: Lebanon
Individual Preference
1.00
0.80
0.60
0.40
0.20
0.00
Relevance/Feasibility to address current WM challenges
Relevance to water stress in the Damour River Basin
Need for immediate implementation
Relevance to future water management challenges
Applicability
Water pricing
Subsidies
Environmental charges and taxes
Market instruments
Taxes on production inputs/outputs
Liability systems
Voluntary/cooperative agreements
Command-& control approach
Decentralization of water management operations
Public participation

The INECO Morocco workshop
Main actions agreed

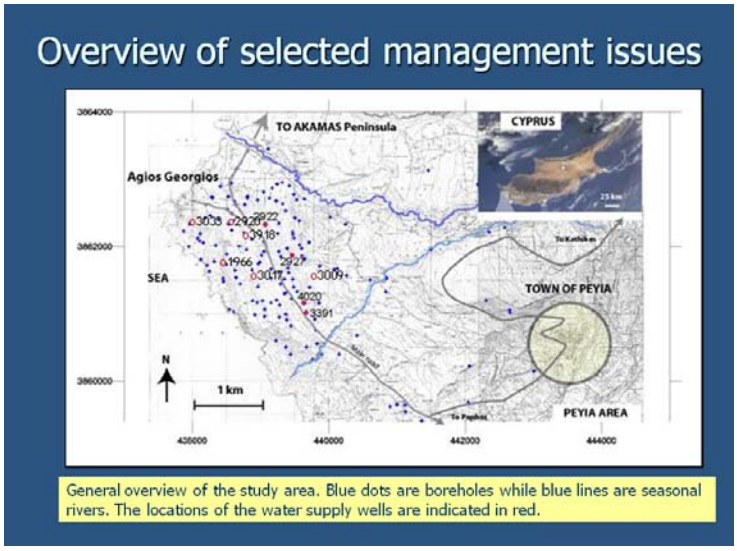
- Increase grants on installation of more efficient irrigation systems according to the example of other regions
  - State (60%), ABH resources (20%), users (20%)
- Explore potential of water reuse
- More equitable allocation of cost for the maintenance of irrigation networks
- Strengthening of the role of the ABH in water management, conflict resolution
- Strengthening of the role of user associations & legislative reform
- Better coordination & cooperation among water managers and users

Discussion Themes

- Supply enhancement ~ 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 incentive-based participatory mechanisms
  - Conflict resolution
  - Allocation of water between competitive uses/users
  - Public information organizations on local WM issues

3.7 Groundwater exploitation in Pegeia, Cyprus

Dr. I. Glekas, Aeoliki Ltd.



Overview of selected management issues

Pegeia aquifer

- **Brief description**
- **Area:** About 20 km². **The main aquifer measures only a few km².**
- **Thickness of aquifer:** 50 -300 m fractured carbonates (chalk and massive limestones)
- **Discharge(2005):** About 1.1 mio m³, 1 mio m³ for domestic water supply for Pegeia Community and tourist areas, and about 0.1 mio m³ for irrigation
- **Domestic W.S.(2007):** From four water supply wells water is extracted for more than 5000 houses and tourist units (End 2006 about 5000 water meters). The four W.S. boreholes are located within the main irrigated area. The one borehole hydr.nr. 4020 is in operation since 2004. Since June 2004 additional water for domestic purposes has been supplied from Asprogremmos treatment plant. Since July 2007 another three new borehole have been connected to the system. **Due to the growth of tourism in the Pegeia area, the demand on water has increased during the last years.**
- **Ground water monitoring:** The water table and salinity evolution have been monitored for several years in the Pegeia aquifer, but the monitoring network may have to be optimised.

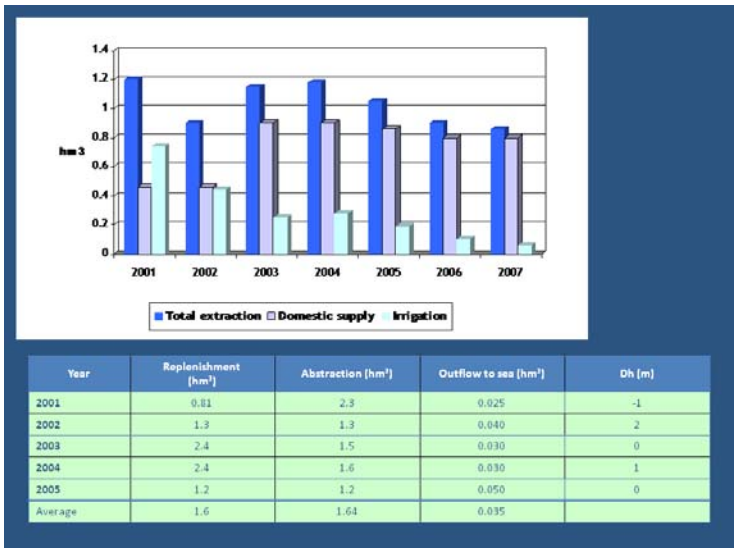
Overview of selected management issues

Pegeia aquifer

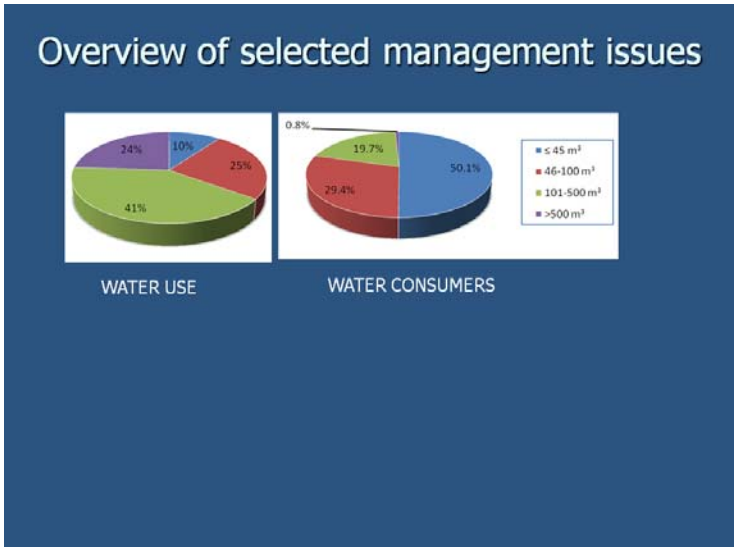
- **Sea intrusion:** Although the Pegeia coastal aquifer is not yet subject to dramatic seawater intrusion, degradation of the water quality due to excessive pumping has been observed in some locations.

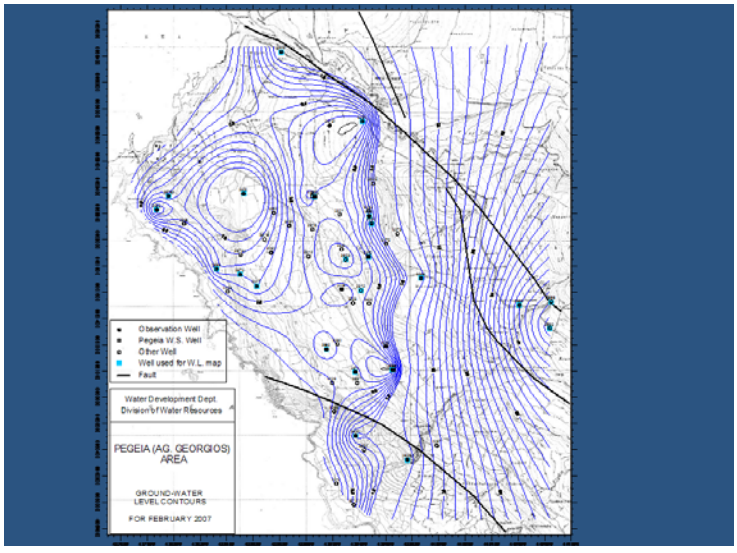
  A first protective measure that has been taken in the past few years has been to limit and decrease the extraction rates by forcing the farmers to use water from the Paphos Project (The coastal part of the aquifer area is included in the Paphos Irrigation Project).
- **Protection of aquifer:** Being a locally important aquifer, supplying water for the Pegeia Municipality and the expanding tourist area, it is a major issue to protect the ground water resources from the **seawater intrusion** and other (agriculture) **contamination**.
- **Measures have to be taken:**
  a) quality: Use of **small sewage treatment units** for every house or group of houses. The recycled water can be used for irrigation.
  Control of, in particular, **fertilizers** and other **pollutants** used in agriculture as well as avoiding pollution from **oil** and **petrol** used already in some pumping boreholes.
  b) quantity: Control of **losses** in the distribution system. Control of **water use**, especially during the summer period (many houses have swimming pools and use domestic water to fill the pools and replenish the water, which evaporates). A significant amount of domestic water is used by the tourist units.

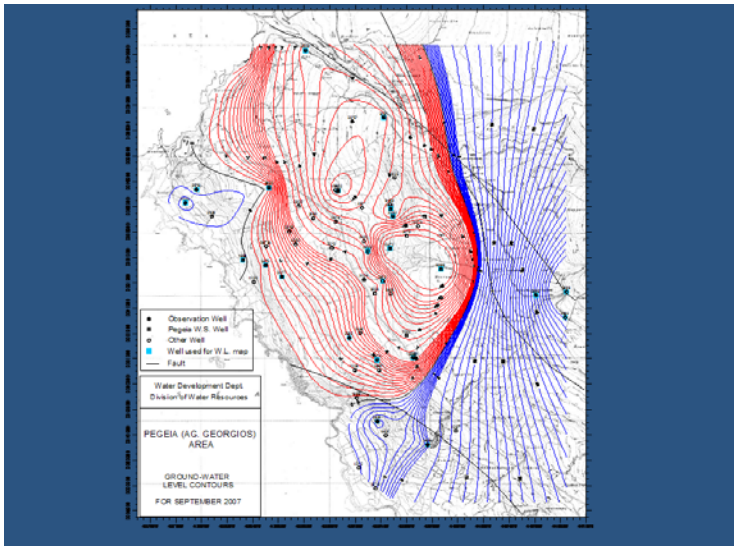
General data	**Groundwater vulnerability** Groundwater in the area was until 2005 in nearly equilibrium state, however the low rate of replenishment, the high extraction rates, the application of fertilizers, the increasing tourist development make the aquifer vulnerable to pollution due to sea intrusion and seepage of domestic wastewater.
	Water level decline (m) Until 2005, there has been increase of the water level.
	Sustainable and Developed groundwater yield (m³/yr) Extraction should not exceed 1 hm³/yr. The annual amount that can be extracted from boreholes is about 2 –2.4 hm³ but this should be considered as strategic reserves
	Change in groundwater quality characteristics NA
	Groundwater treatment requirements No treatment required at present, as quality meets drinking water quality standards
Sharing water	**Total groundwater abstraction / Groundwater recharge (%)** GW/Replenish=1.575/1.5=1.05 **or over 5%.** These are average numbers not on a year by year basis
	Total groundwater use (m³/yr) See figure 30, for the years 2001 - 2005
	Groundwater as a percentage of total use of drinking water in the region(%) 100%
Valuing water	**Range of cost of groundwater extraction (€€/m³)** 0.02 - 0.05 €€/m³
	Groundwater abstraction charges/levies Ground water abstraction charges are not practiced
Governing water	**Groundwater Extraction Monitoring** Monthly water level measurements – monthly abstraction measurements from water supply boreholes, water quality measurements twice a year (full ionic analysis and nitrates). It is absolutely necessary to monitor all boreholes in the area and to equip them with water metres
	Groundwater Extraction Permit issuing A permit is needed from the District Office to drill a well. No regulations exist with respect to depths to drill which aquifers to penetrate and from which aquifer to pump water. Following the drilling of a well no further control is exercised by the District Office.
	Participation in decision-making Until now no public participation was practiced for water management decisions in the area.



Year	Replenishment (hm³)	Abstraction (hm³)	Outflow to sea (hm³)	Dh (m)
2001	0.81	2.3	0.025	-1
2002	1.3	1.3	0.040	2
2003	2.4	1.5	0.030	0
2004	2.4	1.6	0.030	1
2005	1.2	1.2	0.050	0
Average	1.6	1.64	0.035	







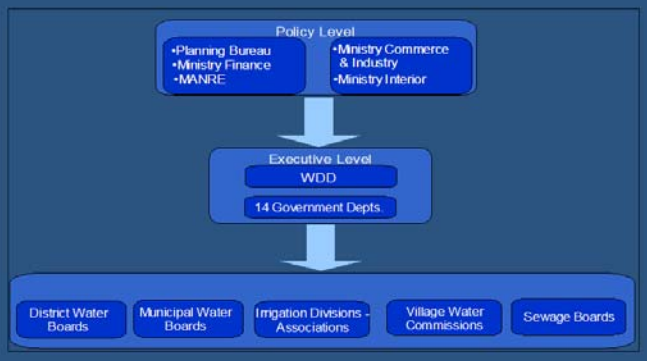
Overview of selected management issues

Stakeholder	Features of Stakeholder	Problems perceived	Capacity and motivation to solve identified problems	Possible actions to be undertaken by stakeholder
Pegeia Municipality	Management of domestic water supply	▪Meeting water demand for domestic purposes; ▪Lack in additional water supply sources;	▪Limited capabilities for exerting influence to the policy makers; ▪Positive attitute regarding the construction of desalination plants; ▪Negative attitude regarding restrictions in issuing building permits	▪Infrastructure improvement; ▪Raise awareness on water use and water conservation; ▪Coopperation with policy makers;
Water Development Department	Implementation of Government's water policy	▪Water scarcity problems; ▪Need for improvement of the water management practices; ▪Limited feedback from the end users on the water quantities required;	▪WDD has the capacity to influence the decision making process; ▪Within the framework of applying the WFD initiated and organised publioc information campaigns;	▪Infrastructure improvement; ▪Enhancement of the General Public information campaign on water use and conservation practices;
Farmers	Individuals;	▪Lack in additional water supply resources; ▪Cost of the water; ▪Water and climatic conditions (drought periods); ▪Banana plantations are not consolidered to be in the priorities of the policy makers;	▪Limited capabilities for exerting influence the decision making process;	▪Cooperation with other stakeholders;

Overview of selected management issues

Developers	Housing construction and real estate development companies	▪Lack in additional water supply resources; ▪Water scarcity problems might influence the developmnet in the future;	▪Capacity to exert influence the decision making process; ▪Negative attitude regarding restrictions in issuing building permits;	▪Cooperation with other stakeholders; ▪Mobilise political pressure;
Hotel Industry	Hotels and hotel apartments in the area	▪Lack in additional water supply resources; ▪Water scarcity problems influence hotel operations; ▪Cost of the water;	▪Capacity to exert influence on the decision making process; ▪Positive attitude regarding the installation of desalination plants; ▪Negative attitude regarding water restrictions; ▪Negative attitude regarding water tariff reformation;	▪Cooperation with other stakeholders; ▪Mobilise political pressure;
Locals	Individuals - Cypriots	▪Lack in additional water supply resources; ▪Water and climatic conditions (drought periods); ▪Water wastage by the swimming pools of foreigners;	▪Limited capabilities for exerting influence on the decision making process; ▪Positive attitude regarding the installation of desalination plants; ▪Negative attitude regarding water restrictions; ▪Negative attitude regarding water tariff reformation;	▪Cooperation with other stakeholders;
Locals - foreigners	Individuals - Foreigners (50% of Pegeia population are foreigners	▪Inefficient management of available water resources; ▪Pressures from rapid development; ▪Water and climatic conditions (drought periods); ▪Lack in information and transparency on water issues;	▪Limited capabilities for exerting influence on the policy makers;	▪Cooperation with other stakeholders;

Overview of selected management issues



Overview of selected management issues

The main obstacles encountered for better efficiency in water management are :

Fragmentation of responsibility

Lack of an umbrella law covering water

Relaxed supervision and control

Lack of effective water pricing

Sluggish enforcement of water legislation on the exscuse of socio-economic issues

Lack of information to interested parties

Overview of selected management issues

- Pegeia aquifer is a locally important aquifer, supplying water for the Pegeia Municipality and the expanding tourist area.
- It is a major issue to protect the ground water resources from the seawater intrusion and other (agriculture) contamination.
- Degradation of the water quality due to excessive pumping has been observed in some locations.
- Probably significant losses in the distribution system and over-consumption of water, especially during the summer period have to be identified, and the appropriate measures have to be taken.
- The water table and salinity evolution have been monitored for several years in the Pegeia aquifer, but the monitoring network may have to be optimised
- The building construction development in the area is booming and this is another pressure on water issues
- Improvement in the management of the aquifer and in the distribution of the domestic water is needed.

Current efforts for problem mitigation

- **Irrigation methods improvement**
  As a result of a successfully implemented program (subsidies, long-term low interest loans and effective extension/demonstration program), farmers shifted from flood-irrigation to micro-irrigation. Now days there are few margins for further improvement in water application technology.
- **Reduction of losses**
  The unaccounted water in the main urban domestic supply distribution networks is estimated to be 15 – 20% and about 20 – 30% in the rural communities. The measure is applied on a regional basis (on a water body level). Where applied so far, water consumption has been reduced substantially.
- **Water conservation measures**
  In order to ensure conservation and rational use of water, the WDD embarked on a Strategic Plan, providing financial incentives for the promotion of technological adjustments aiming to water conservation. These includes subsidies for borehole drilling, introduction of improved irrigation systems, or installation of reuse systems of the grey water in the lavatories and the irrigation of gardens of houses.

Current efforts for problem mitigation

- **Cost recovery**
  As a result of a successfully implemented program (subsidies, long-term low interest loans and effective extension/demonstration program), farmers shifted from flood-irrigation to micro-irrigation. Now days there are few margins for further improvement in water application technology.
- **Water supply restrictions**
  During drought periods, water supply restrictions are imposed on all sectors, leading to a rationalization of water consumption.
  However, these measures raised a number of objections from various social groups, and especially by agricultural organizations, hotel owners, who demanded that the tourist industry should bear either none or a very small restriction of water supply, and environmental organizations.

Current efforts for problem mitigation

- **Promotion of the use of surface water for irrigation purposes**
  Farmers were forced to use the water of the Pafos Irrigation Project instead the water from the aquifer
- **Provision of fresh water from Asprokremmos treatment plant**
  Since June 2004 additional water for domestic purposes has been supplied from Asprokremmos treatment plant.
- **Groundwater Extraction Monitoring**
  Monthly water level measurements – monthly abstraction measurements from water supply boreholes, water quality measurements twice a year (full ionic analysis and nitrates).
- **Waste Water Treatment Plant**
  Municipality of Pegeia together with the WDD has started the process for the design and construction of a sewerage collection network and a waste water treatment plant.
- **Desalination Plants**
  WDD has initiated the procedure for the construction of a desalination plant to cover the dri nking water needs of Pafos district
  Hotels and other tourist developments assess the possibility to construct their own desalination plant to cover their needs for drinking and irrigation water

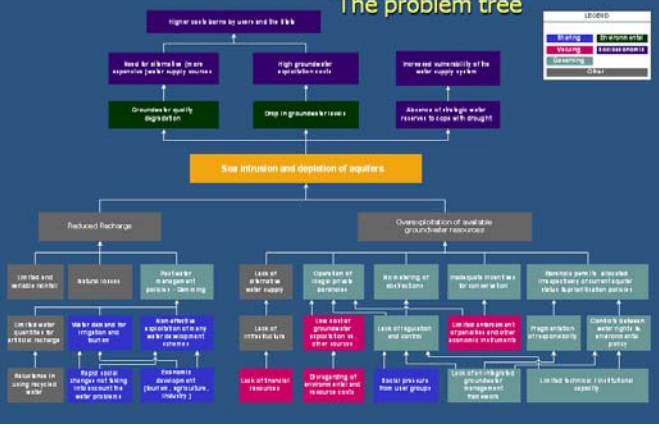
INECO Participatory Process

Date:	15 November 2007
Venue:	SPE Cultural Centre – Pegeia Pafos
Title:	INECO Cyprus Stakeholders Workshop 1 Pre-meeting
Number of Participants:	25
Date:	26 -27 October 2007
Venue:	Coral Bay Hotel – Pegeia Pafos
Title:	INECO Cyprus Stakeholders Workshop 1
Number of Participants:	50
Date:	November 2007 - May 2008
Venue:	Pegeia municipality boarders
Title:	Individual meeting and consultations with the stakeholders (Municipality, WDD , locals)
Number of Participants:	~ 150
Date:	15 May 2008
Venue:	SPE Cultural Centre – Pegeia Pafos
Title:	INECO Cyprus Stakeholders Workshop 2
Number of Participants:	23

Objective tree analysis Problem tree analysis

INECO Participatory Process

The problem tree

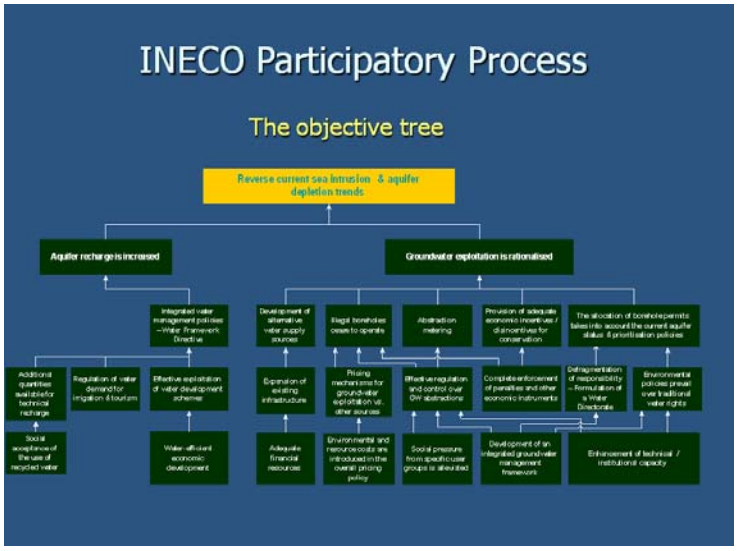


INECO Participatory Process

The stakeholders opinion

- Locally important aquifer (Pegeia Municipality and the expanding tourist area;
- Protection of the aquifer from the seawater intrusion and other (agriculture - sewage seepage) contamination;
- Excessive pumping has been observed in some locations;
- Significant losses in the distribution system and over-consumption of water, especially during the summer period have to be identified, and the appropriate measures have to be taken;
- The water table and salinity evolution have been monitored for several years in the Pegeia aquifer, but the monitoring network may have to be optimise;
- The existing and forseen building permits exceed the capacity to provide water to Pegeia and this is another pressure on the aquifer sustainable management;
- Impacts from agricultural practices (water quantities – nutrient pollution) ;
- Lack of water conservation culture among the Pegeia residents;
- Lack of information (… and transparency);

- Improvement in the management of the aquifer and in the distribution of the domestic water is needed.



INECO Participatory Process

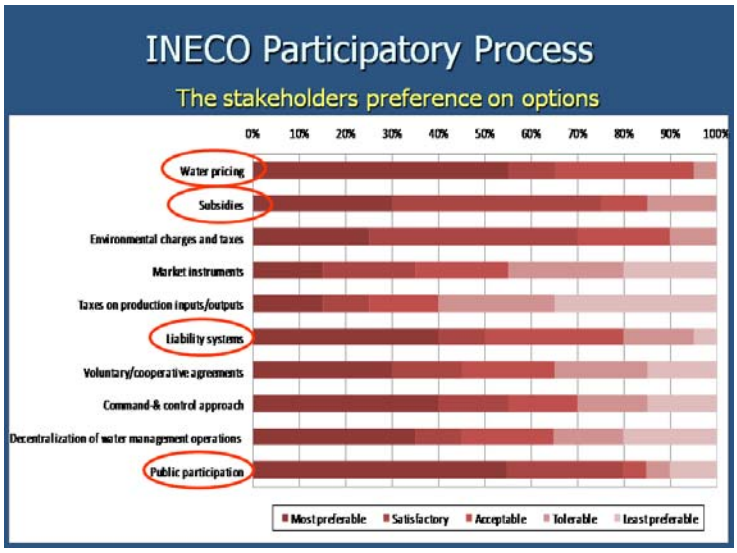
The stakeholders opinion

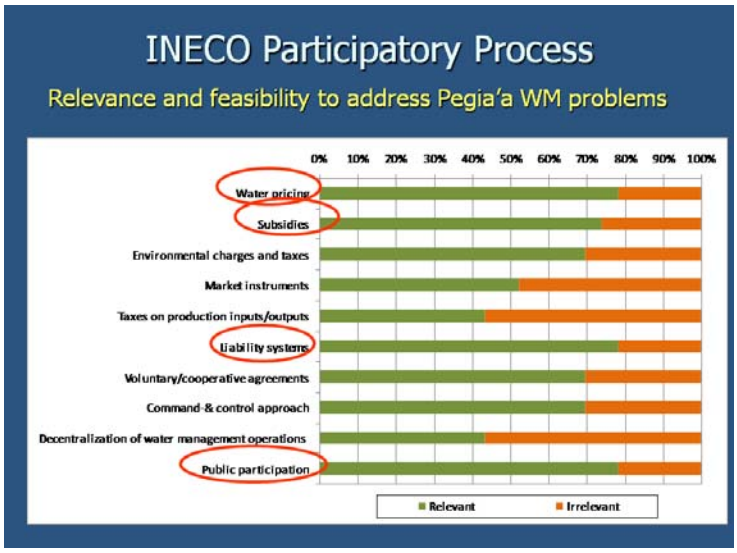
- Development of additional water supply sources
  - Technical issues (desalination plant, rain harvesting, reduce losses, use unexploited water resources of the area, use of small sewage treatment units, transfer of fresh water from a neighbouring country through a water pipeline);
- Improving freshwater efficiency
  - Cost recovery (water tariff reform);
  - Introduction of seasonal water rates;
  - Regular water audits for large consumers;
- Enhance water system efficiency (domestic – irrigation)
  - Financing (subsidies for water conservation measures);
  - Economic incentives (change of cropping patterns);
- Regulation of abstractions
  - Monitoring & control;
  - Penalties & fines;
  - Reduce groundwater abstractions for tourist units – desalination units for tourist units;
  - Economic incentives (subsidies for conservation) and disincentives (abstraction charges, penalties)

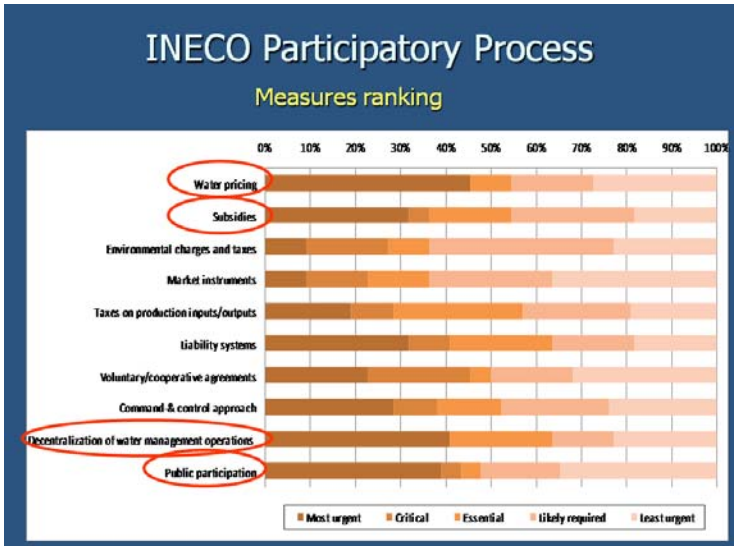
INECO Participatory Process

The stakeholders opinion

- Enhancing awareness
  - Regular awareness campaigns on water saving practices
  - Information disclosure (regular open meetings / hearings)
  - Citizens' jury and panels (identification of areas of disagreement or agreement)
  - Transparency in water issues
- Overall planning and integration
  - One body responsible for planning/authorization

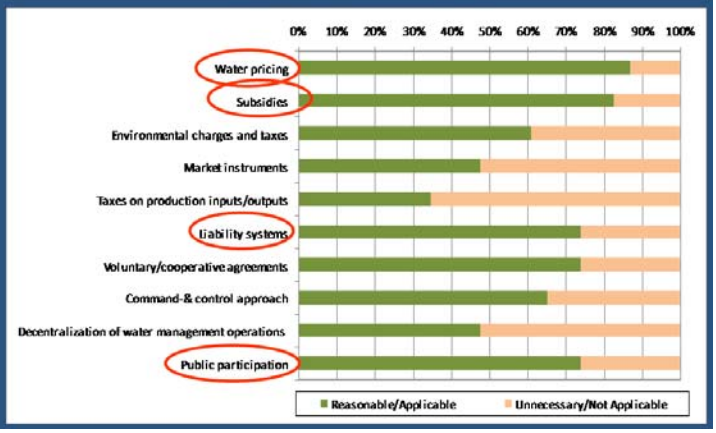

INECO Participatory Process
The stakeholders preference on options
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Water pricing
Subsidies
Environmental charges and taxes
Market instruments
Taxes on production inputs/outputs
Liability systems
Voluntary/cooperative agreements
Command-& control approach
Decentralization of water management operations
Public participation
Most preferable
Satisfactory
Acceptable
Tolerable
least preferable


INECO Participatory Process
Relevance and feasibility to address Pegia'a WM problems
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Water pricing
Subsidies
Environmental charges and taxes
Market instruments
Taxes on production inputs/outputs
Liability systems
Voluntary/cooperative agreements
Command-& control approach
Decentralization of water management operations
Public participation
Relevant
Irrelevant


INECO Participatory Process
Measures ranking
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Water pricing
Subsidies
Environmental charges and taxes
Market instruments
Taxes on production inputs/outputs
Liability systems
Voluntary/cooperative agreements
Command-& control approach
Decentralization of water management operations
Public participation
Most urgent
Critical
Essential
Likely required
least urgent

INECO Participatory Process

Measures General View



INECO Participatory Process

Measures Proposal
(based on stakeholders' consultation)

- **Water pricing**
- **Subsidies**
- **Liability systems**
- **Public participation**
- **Voluntary systems**

INECO Participatory Process

Water pricing

- Water for domestic supply (including tourism)
  - WDD provides bulk water supply to Town Water Boards – Municipal Authorities – Community Boards from Government Works (80% of total consumption) – Share of own sources from 1 – 30%
  - Pegeia : Own resources 60% - WDD 40%
  - Water for municipal supply (including industrial, commercial and tourist sectors) is sold at full cost; However in the last seven years the water tariff for the domkestic sector does not reflect the full cost as formed with the recent intoduction of the expensive desalination water (subsidy as high as 34%)
  - In 2004, the Government of the Republic of Cyprus proceeded in a major reform of the bulk domestic water tariffs. Currently the bulk domestic tariff for supply from the Government Water Works for the district of Pafos is equal to 0.56 €/m^3 .
  - The water tariff structure imposed by the Water Boards for all major urban areas is made of two parts : a fixed charge and a volumetric charge. Tariff rates are progressive : the volumetric charge increases as consumption increases
  - Rural water supply is parrtially subsidized for capital expenditures to a degree varying according to the population and other factors, varying from 83% for communities with < 100 people, to 50-75% for more
  - Tourism charges are different from domestic charges
  - Affordability indicator (water expenditure/average GDP) equal to 0.4%. In industrialised countries, water is considered "expensive" when it weights more than 1.5% of households' income.
  - 30% increase in the average volumetric price for domestic use is estimated to be sufficient to apply the full cost recovery principle. Affordability index will rise by almost 50% to reach 0.6% which is still less than half the "limit" of 1.5%.
  - Abstraction charges : Have not been applied in the past. However, it is considered as a potential measure that could be adopted for the river basin district of Cyprus : Member states need to ensure by 2010 that water pricing policies provide adequate incentives for users to use water resources efficiently and adequate contribution of the different water uses

INECO Participatory Process

Water pricing (continued)

- Water for agriculture
  - **Until 2003** : different tariffs on a local basis, according to the Irrigation Scheme, and the quality of services provided, ranging from 0.08 €/m^3 at the lowest to 0.12 €/m^3 .
    From 2004 : gradual increase of tariffs in order to reach by 2007 the uniform charge of 0.19 €/m^3. However, due to the persisting drought period of the last years, the Council of Ministers in 2007 postponed the final increase of 0.01 €/m^3 in order to alleviate the difficult condition that the farmers are experiencing.
  - Current irrigation water tariffs encourage cultivation of high water consuming crops. Increasing the tariffs to cover the full average unit costs would make many crops, such as citrus, unprofitable (direct effect). Furthermore, expensive surface water could lead to excessive use of local groundwater supplies. This would result to saline intrusion and further degradation of the aquifer reserves causing larger inequities between farmers depending on government and those on non-government schemes (indirect effect).
  - Parliament is reluctant to raise tariffs of irrigation water for political and economic reasons since this might discourage irrigated agriculture and lead further urbanization with all its associated social problems.

INECO Participatory Process

Subsidies

borehole drilling for garden irrigation(680 €);

Subsidy for borehole drilling for home gardens for households connected to the water distribution networks for all municipalities and villages (subject to well permit and inspection of site after permit and before drilling)

	1997-2002	2003	2004	2005	2006	2007
# installations	240	95	170	250	545	1058
Budget allocated (€)	70,000	30,000	55,000	85,000	215,000	620,000
Water savings (m^3)	300,000	100,000	200,000	300,000	700,000	1,300,000

INECO Participatory Process

Subsidies (continued)

installation of reuse systems of the grey water in the lavatories and the irrigation of gardens of houses (1,700 € for households and 60% of the cost for the rest of the cases);

The subsidy covers installation of a system for the treatment of grey water and its reuse in lavatories and garden irrigation of a household, school, playing grounds, swimming pools, gyms, hotels, industries, etc., connected with distribution networks of all municipalities and villages.

	1999-2002	2003	2004	2005	2006
# installations	20	15	20	10	35
Budget allocated (€)	25,000	20,000	35,000	20,000	60,000
Water savings (m^3)	650,000	450,000	600,000	400,000	1,350,000

INECO Participatory Process

Subsidies (continued)

the connection of borehole with lavatories(€680);

The subsidy covers connection of wells with home lavatories, schools, offices, shops, institutes etc. connected with distribution networks of all municipalities and villages for the purpose of conserving drinking water that is used for lavatories (subject to application, inspection and provision of technical advise by WDD).

	1997-2002	2003	2004	2005	2006	2007
# installations	70	20	50	60	175	535
Budget allocated (€)	30,000	20,000	35,000	40,000	110,000	365,000
Water savings (m^3)	300,000	100,000	200,000	300,000	700,000	1,200,000

INECO Participatory Process

Subsidies (continued)

introduction of hot water recirculators (290 €)

introduction of improved irrigation systems;

As a result of a successfully implemented program (subsidies, long-term low interest loans and effective extension/demonstration program), the flood-irrigated area declined from 13,400 ha in 1974 to 2,000 ha by 1995. Over the same period, micro-irrigation cover has increased from 2,700 ha to 35,600 ha. There are few margins for further improvement in water application technology.

The estimated potential water savings can reach 50% of drinking water demand.

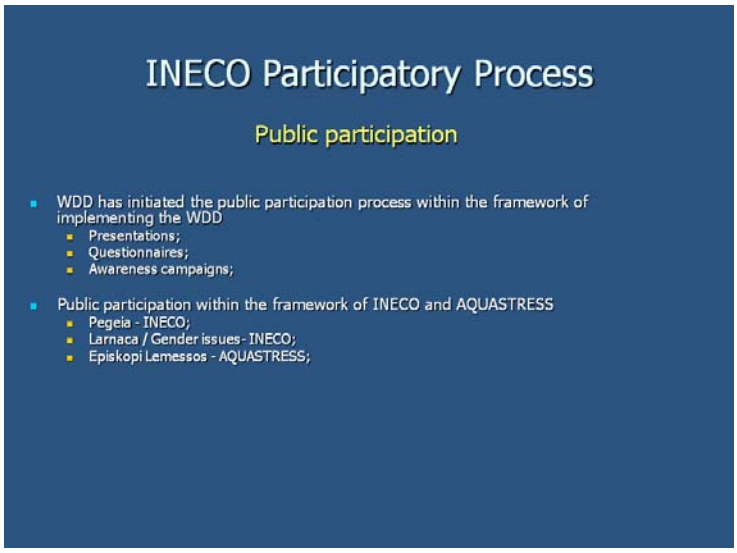
The annual budget allocated for these incentives is 2.0 mill € (1.5 mill € for subsidies and 0.5 mill € for accompanying awareness and promoting campaigns) for 2008 and 2.0 mill € (1.5 mill € for subsidies and 0.5 mill € for accompanying awareness and promoting campaigns) for 2009.

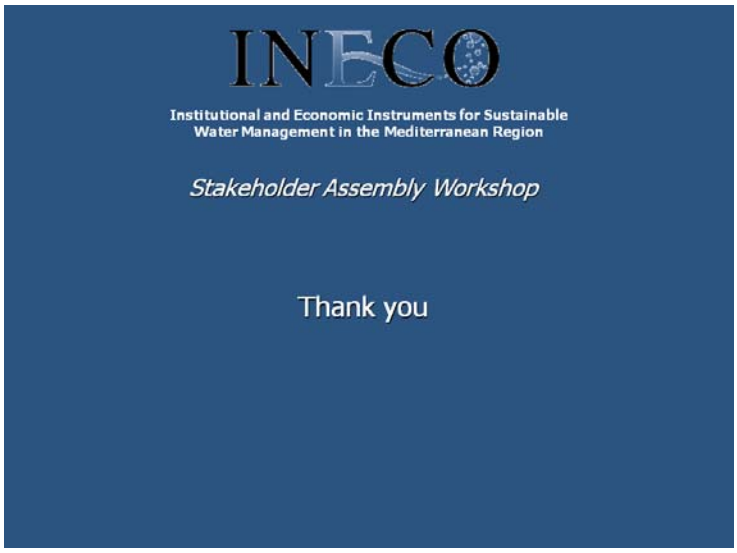
INECO Participatory Process

Liability systems

- Legislation measures for domestic water conservation ('hose ban')
  - Water Conservation (Special measures) Law of 1991 applied within Water Board areas, Municipalities and Village water supply areas :any person using water through a hose for washinf sidewalks or streets, verandas and vehicles is guilty of a criminal offence and could be imprisoned for up to 3 months and or be fined up to 1000 € or both. Policemen or other licenced persons (WDD personnel) having grounds to believe that a person is committing such an offence could issue a fine of up to 110 € in lieu of taking this person to court
  - The measure is applied sporadically especially during drought periods
- Legislation measures for groundwater conservation - Wells Law (Cap 351)
  - A permit is needed from the District Officer before a well or borehole is sunk or constructed;
  - Relaxed supervision and control, light penalties, issuing of covering permits and interference in the process by non-technical bodies has resulted in a large number of illegal drilling of wells

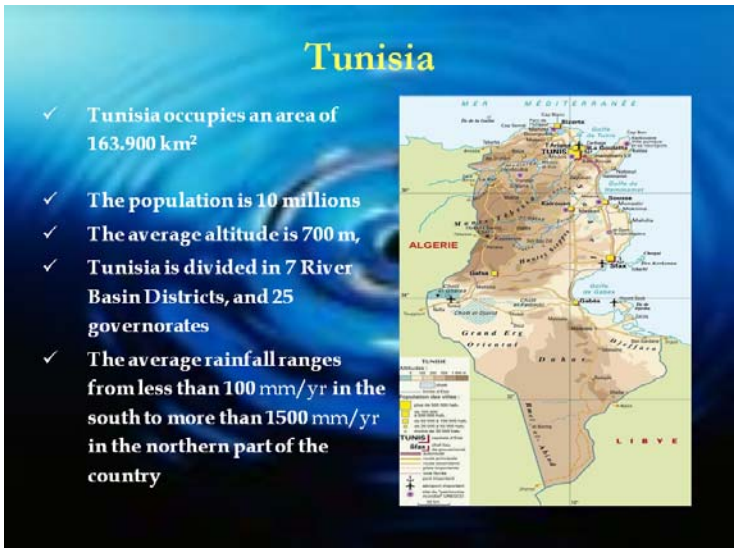
The relative sluggish enforcement of the water legislation on the excuse of socio-economic conditions is considered as one of the weak points of the National water situation


INECO Participatory Process
Public participation
WDD has initiated the public participation process within the framework of implementing the WDD
Presentations;
Questionnaires;
Awareness campaigns;
Public participation within the framework of INECO and AQUASTRESS
Pegeia - INECO;
Larnaca / Gender issues- INECO;
Episkopi Lemessos - AQUASTRESS;


INECO
Institutional and Economic Instruments for Sustainable Water Management in the Mediterranean Region
Stakeholder Assembly Workshop
Thank you

3.8 Groundwater overexploitation in Tunisia

Mr. A. Bouzid, CITET



Physical characteristics

Tunisia, being arid to semi-arid country, is facing water shortage of increasing severity, Water scarcity problems are expected to intensify, as a result of population growth, rising living standards and accelerated urbanisation. These drivers put significant pressure on available resources and on the agricultural sector, leading to a significant increase in water use and pollution loads.

Hydraulogical balance

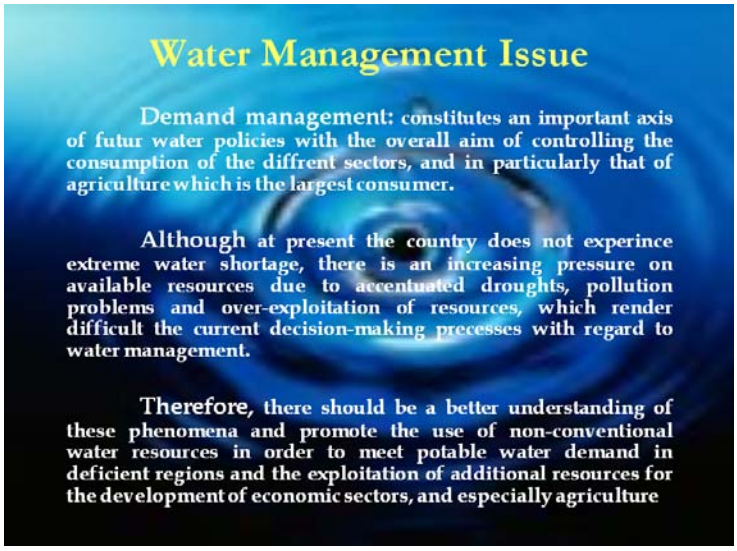
Natural water resources in Tunisia are relatively limited and equal to at 4.670 million m^3, of which 4.100 million m^3 are considered exploitable. The ratio of available water resources per capita had been estimated at 450 m^3 in 1996 and will decrease further to 315 m^3 in 2030. Thus, the country is considered one of the poorest countries in terms of natural water resources.

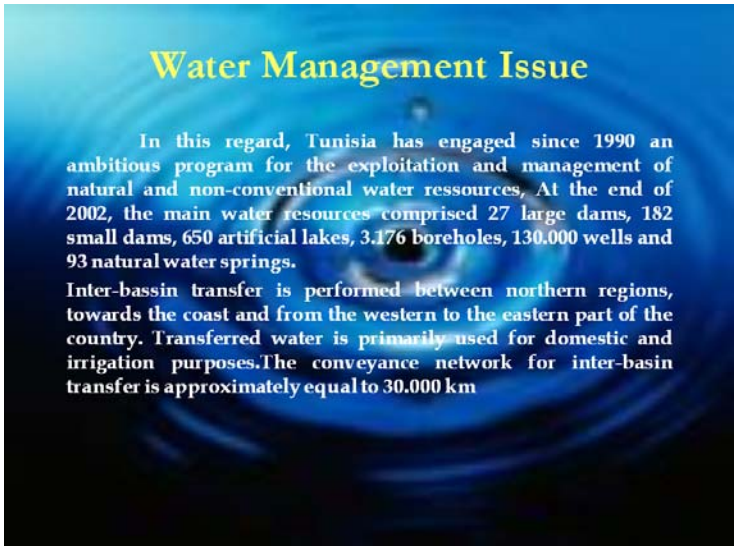
In 1996 total water demand was estimated at 2.528 million m3 and is expected to follow a tremendous and continuous growth. It is estimated that in 2010 exploitable resources will be equal to 4.600 million m3, whereas water demand is projected at 2.689 million m3.

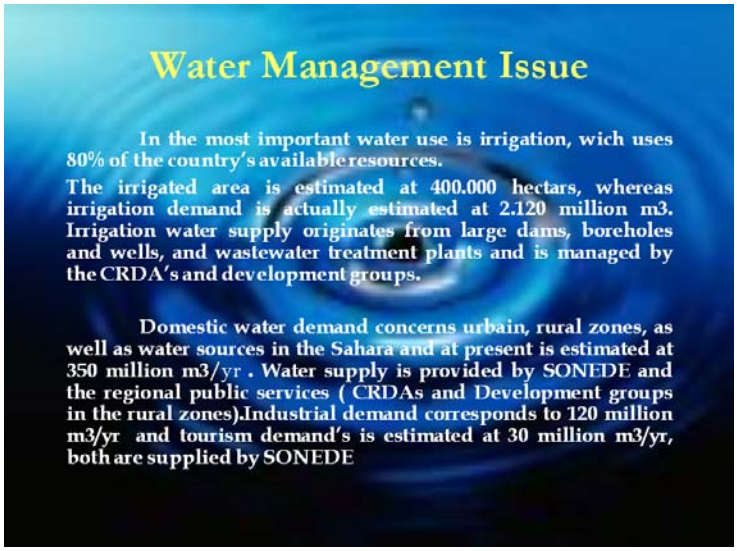
Water Management issue

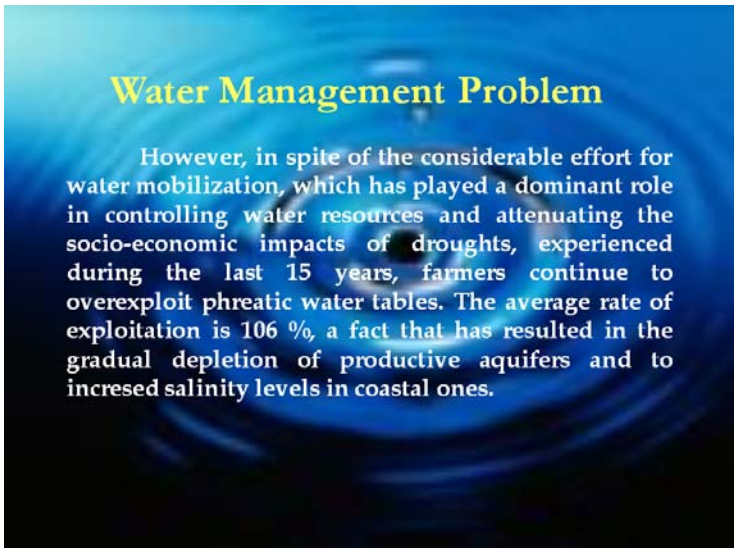
In the above perspective, policy makers have been compelled to develop additional resources and to take measures in order to preserve existing ones.

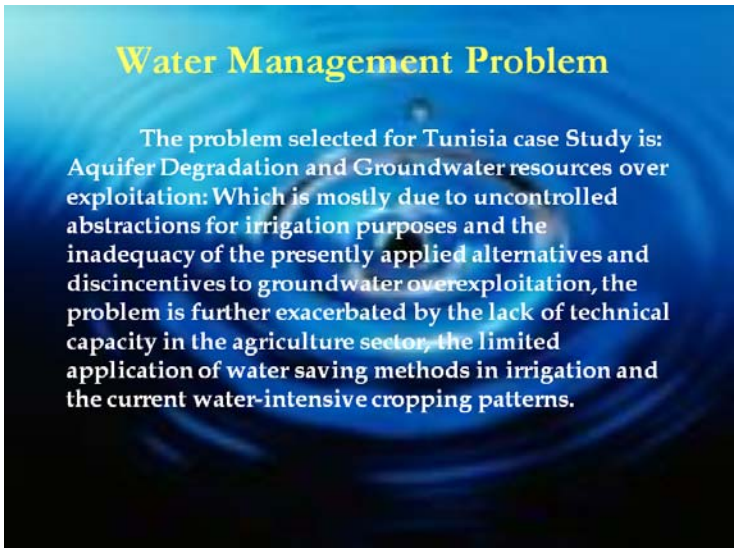
Currently the main components of the National Water Ressources Management strategy are surface water mobilization, soil and water conservation works, water harvesting, and use of non-conventional water resources, such as reuse of treated wastewater for crop irrigation and aquifer recharge.

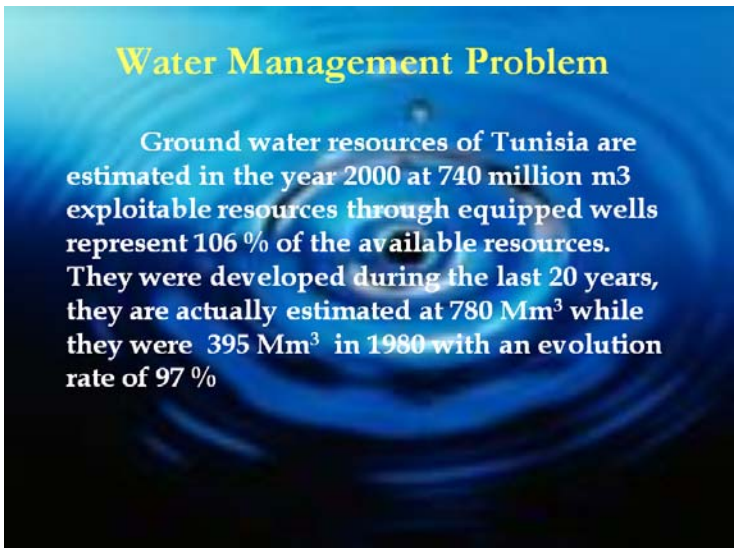

Water Management Issue
Demand management: constitutes an important axis of futur water policies with the overall aim of controlling the consumption of the diffrent sectors, and in particularly that of agriculture which is the largest consumer.
Although at present the country does not experince extreme water shortage, there is an increasing pressure on available resources due to accentuated droughts, pollution problems and over-exploitation of resources, which render difficult the current decision-making precesses with regard to water management.
Therefore, there should be a better understanding of these phenomena and promote the use of non-conventional water resources in order to meet potable water demand in deficient regions and the exploitation of additional resources for the development of economic sectors, and especially agriculture

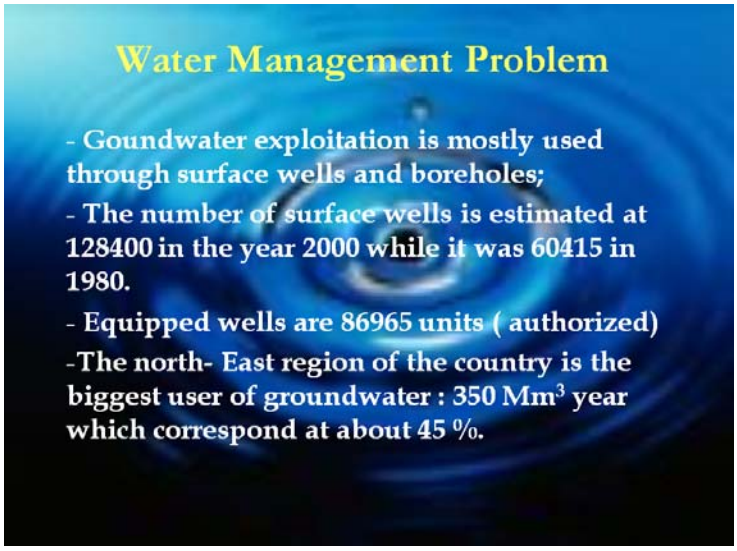

Water Management Issue
In this regard, Tunisia has engaged since 1990 an ambitious program for the exploitation and management of natural and non-conventional water ressources, At the end of 2002, the main water resources comprised 27 large dams, 182 small dams, 650 artificial lakes, 3.176 boreholes, 130.000 wells and 93 natural water springs.
Inter-bassin transfer is performed between northern regions, towards the coast and from the western to the eastern part of the country. Transferred water is primarily used for domestic and irrigation purposes.The conveyance network for inter-basin transfer is approximately equal to 30.000 km

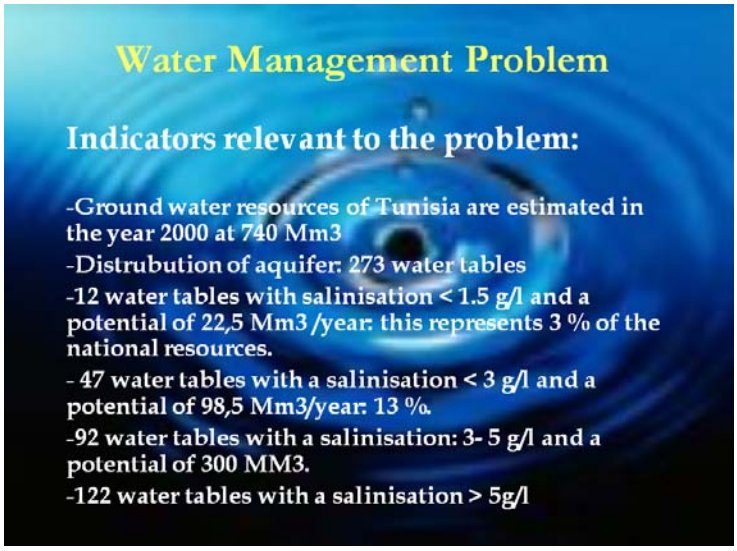

Water Management Issue
In the most important water use is irrigation, wich uses 80% of the country's available resources.
The irrigated area is estimated at 400.000 hectars, whereas irrigation demand is actually estimated at 2.120 million m3. Irrigation water supply originates from large dams, boreholes and wells, and wastewater treatment plants and is managed by the CRDA's and development groups.
Domestic water demand concerns urbain, rural zones, as well as water sources in the Sahara and at present is estimated at 350 million m3/yr . Water supply is provided by SONEDE and the regional public services (CRDAs and Development groups in the rural zones).Industrial demand corresponds to 120 million m3/yr and tourism demand's is estimated at 30 million m3/yr, both are supplied by SONEDE

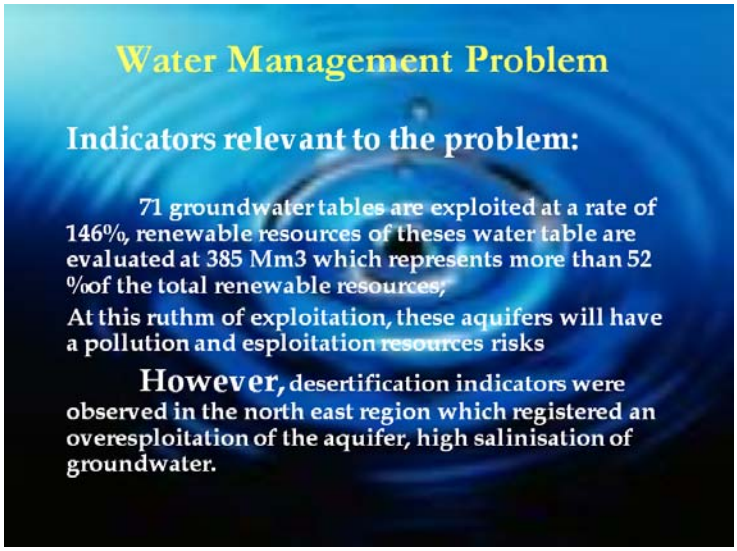

Water Management Problem
However, in spite of the considerable effort for water mobilization, which has played a dominant role in controlling water resources and attenuating the socio-economic impacts of droughts, experienced during the last 15 years, farmers continue to overexploit phreatic water tables. The average rate of exploitation is 106 %, a fact that has resulted in the gradual depletion of productive aquifers and to incresed salinity levels in coastal ones.

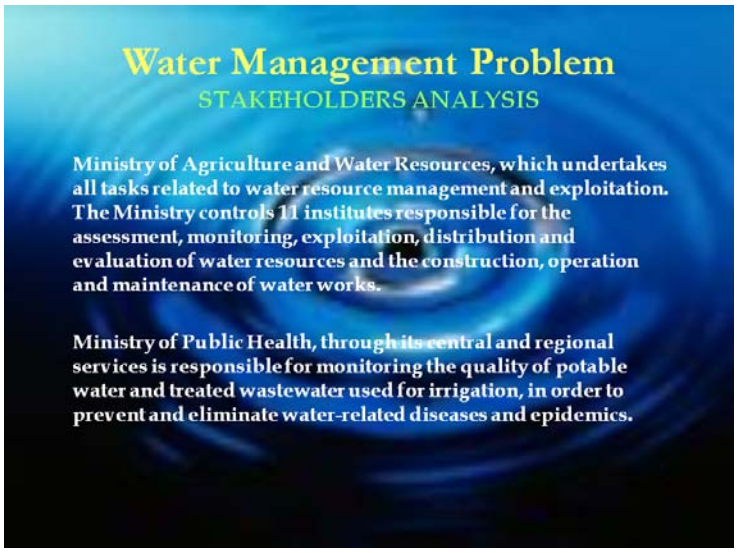

Water Management Problem
The problem selected for Tunisia case Study is: Aquifer Degradation and Groundwater resources over exploitation: Which is mostly due to uncontrolled abstractions for irrigation purposes and the inadequacy of the presently applied alternatives and discincentives to groundwater overexploitation, the problem is further exacerbated by the lack of technical capacity in the agriculture sector, the limited application of water saving methods in irrigation and the current water-intensive cropping patterns.

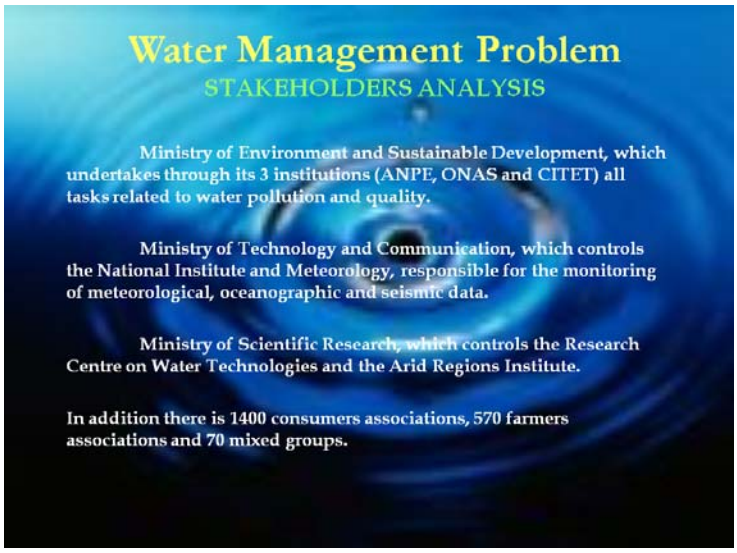

Water Management Problem
Ground water resources of Tunisia are estimated in the year 2000 at 740 million m3 exploitable resources through equipped wells represent 106 % of the available resources. They were developed during the last 20 years, they are actually estimated at 780 Mm3 while they were 395 Mm3 in 1980 with an evolution rate of 97 %

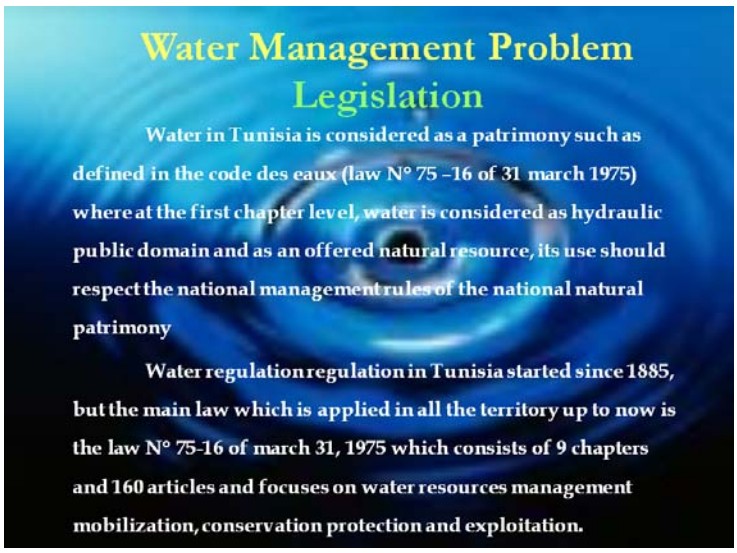

Water Management Problem
- Goundwater exploitation is mostly used through surface wells and boreholes;
- The number of surface wells is estimated at 128400 in the year 2000 while it was 60415 in 1980.
- Equipped wells are 86965 units (authorized)
-The north- East region of the country is the biggest user of groundwater : 350 Mm3 year which correspond at about 45 %.

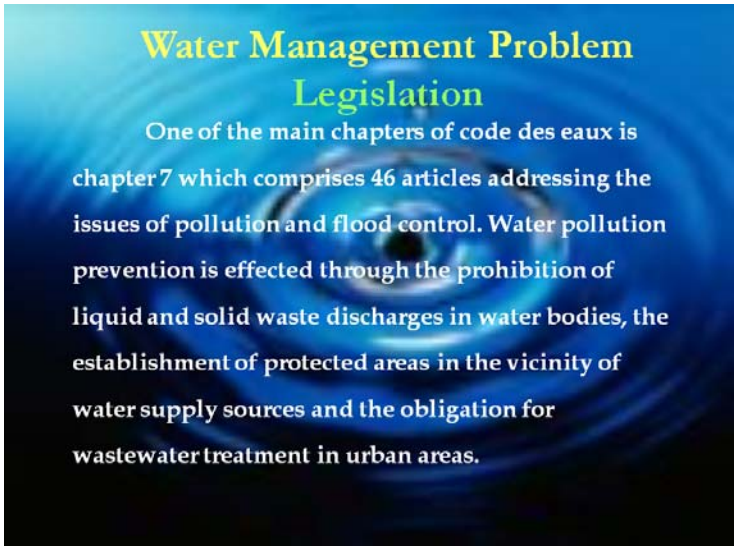

Water Management Problem
Indicators relevant to the problem:
-Ground water resources of Tunisia are estimated in the year 2000 at 740 Mm3
-Distrubution of aquifer: 273 water tables
-12 water tables with salinisation < 1.5 g/l and a potential of 22,5 Mm3 /year: this represents 3 % of the national resources.
- 47 water tables with a salinisation < 3 g/l and a potential of 98,5 Mm3/year: 13 %.
-92 water tables with a salinisation: 3- 5 g/l and a potential of 300 MM3.
-122 water tables with a salinisation > 5g/l

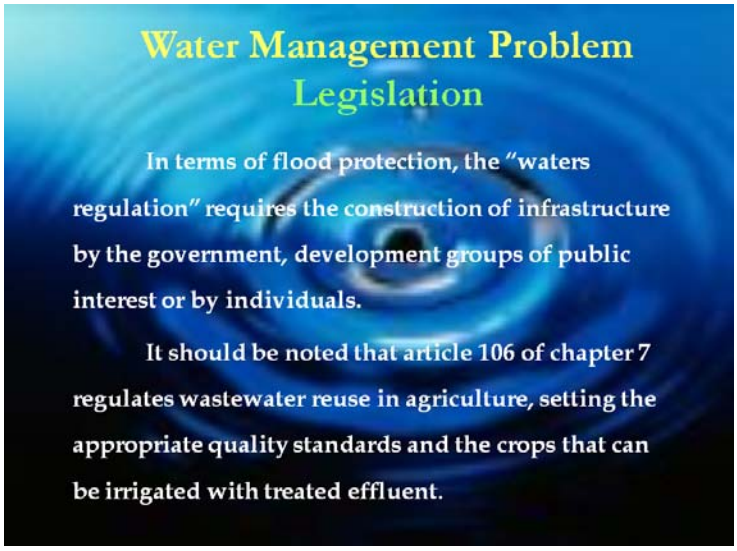

Water Management Problem
Indicators relevant to the problem:
71 groundwater tables are exploited at a rate of 146%, renewable resources of theses water table are evaluated at 385 Mm3 which represents more than 52 ‰of the total renewable resources;
At this ruthm of exploitation, these aquifers will have a pollution and esploitation resources risks
However, desertification indicators were observed in the north east region which registered an overesploitation of the aquifer, high salinisation of groundwater.

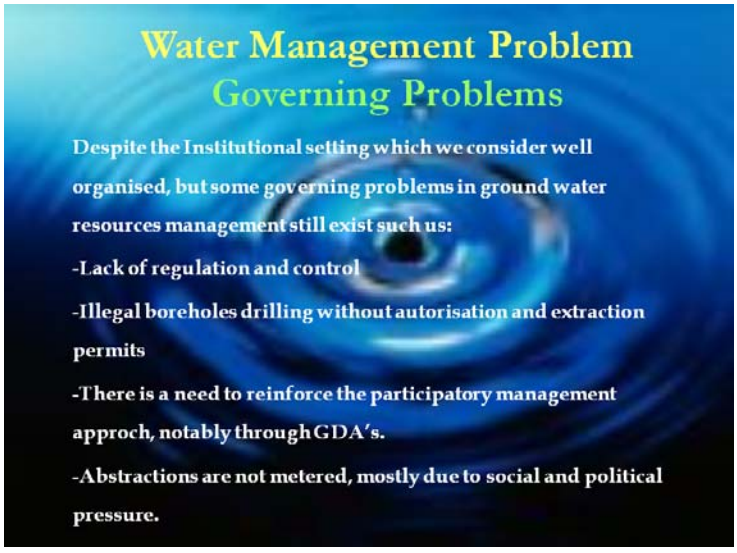

Water Management Problem
STAKEHOLDERS ANALYSIS
Ministry of Agriculture and Water Resources, which undertakes all tasks related to water resource management and exploitation. The Ministry controls 11 institutes responsible for the assessment, monitoring, exploitation, distribution and evaluation of water resources and the construction, operation and maintenance of water works.
Ministry of Public Health, through its central and regional services is responsible for monitoring the quality of potable water and treated wastewater used for irrigation, in order to prevent and eliminate water-related diseases and epidemics.

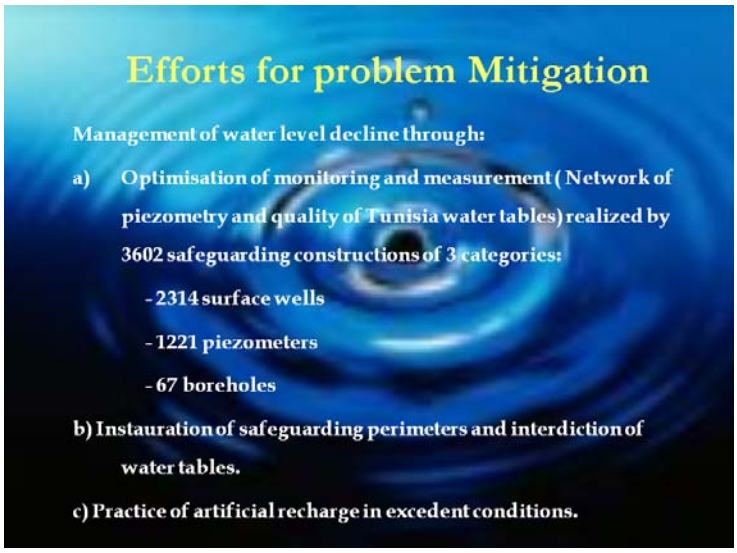

Water Management Problem
STAKEHOLDERS ANALYSIS
Ministry of Environment and Sustainable Development, which undertakes through its 3 institutions (ANPE, ONAS and CITET) all tasks related to water pollution and quality.
Ministry of Technology and Communication, which controls the National Institute and Meteorology, responsible for the monitoring of meteorological, oceanographic and seismic data.
Ministry of Scientific Research, which controls the Research Centre on Water Technologies and the Arid Regions Institute.
In addition there is 1400 consumers associations, 570 farmers associations and 70 mixed groups.


Water Management Problem
Legislation
Water in Tunisia is considered as a patrimony such as defined in the code des eaux (law N° 75 –16 of 31 march 1975) where at the first chapter level, water is considered as hydraulic public domain and as an offered natural resource, its use should respect the national management rules of the national natural patrimony
Water regulation regulation in Tunisia started since 1885, but the main law which is applied in all the territory up to now is the law N° 75-16 of march 31, 1975 which consists of 9 chapters and 160 articles and focuses on water resources management mobilization, conservation protection and exploitation.


Water Management Problem
Legislation
One of the main chapters of code des eaux is chapter 7 which comprises 46 articles addressing the issues of pollution and flood control. Water pollution prevention is effected through the prohibition of liquid and solid waste discharges in water bodies, the establishment of protected areas in the vicinity of water supply sources and the obligation for wastewater treatment in urban areas.


Water Management Problem
Legislation
In terms of flood protection, the "waters regulation" requires the construction of infrastructure by the government, development groups of public interest or by individuals.
It should be noted that article 106 of chapter 7 regulates wastewater reuse in agriculture, setting the appropriate quality standards and the crops that can be irrigated with treated effluent.


Water Management Problem
Governing Problems
Despite the Institutional setting which we consider well organised, but some governing problems in ground water resources management still exist such us:
-Lack of regulation and control
-Illegal boreholes drilling without autorisation and extraction permits
-There is a need to reinforce the participatory management approch, notably through GDA's.
-Abstractions are not metered, mostly due to social and political pressure.

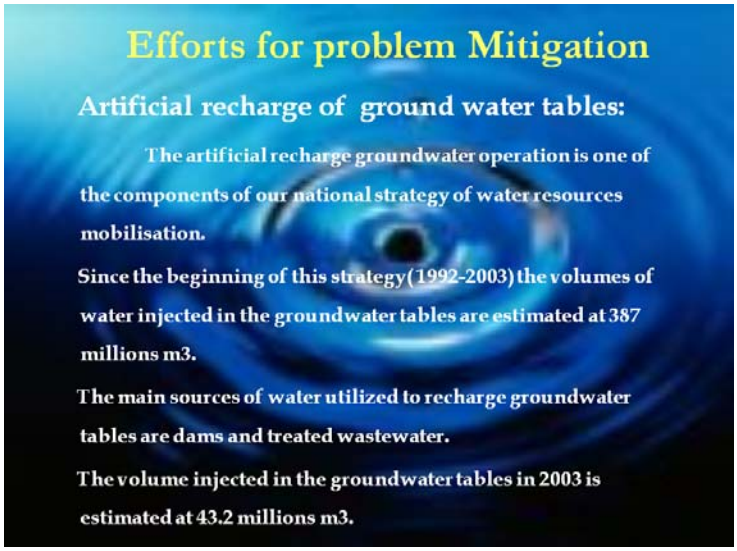

Efforts for problem Mitigation
Management of water level decline through:
a) Optimisation of monitoring and measurement (Network of piezometry and quality of Tunisia water tables) realized by 3602 safeguarding constructions of 3 categories:
- 2314 surface wells
- 1221 piezometers
- 67 boreholes
b) Instauration of safeguarding perimeters and interdiction of water tables.
c) Practice of artificial recharge in excedent conditions.


Efforts for problem Mitigation
Ground water Vulnerability :
The ministry of agriculture and hydraulic resources is aware of this problem and in order to reduce the effect of pollution by solid or liquid dismissals in the vulnerable ground water tables, some measures were taken into consideration notably:
- Safe guarding water ressources quality
- Establishing vulnerability maps of water tables to potential pollution sources.
- Survey of main hydrous pollution sources and putting in place a national network of safeguarding hydrous pollution.


Efforts for problem Mitigation
ANPE from the ministry of environment and sustainable Development is conducting actually a study about the vulnerability of most important aquifers of Tunisia.

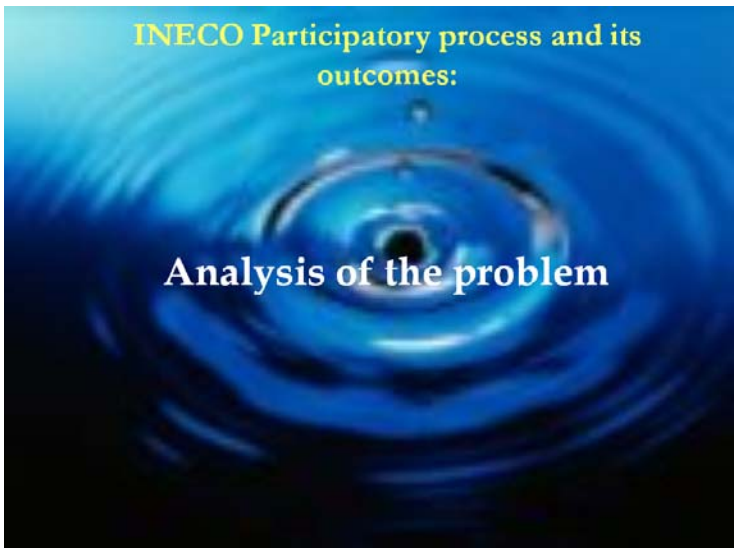

Efforts for problem Mitigation
Ground water saving:
Starting from the importance of water and its rareness in Tunisia, many measures of capacity reinforcement were taken. In fact, the national program of water saving in irrigation which benefited of many measures of support and important financial incitements, taken in conformity with the legal frame instaured since 1995, which foresees to grant an investment bonus for using water saving techniques in irrigation.
This bonus vary from 40 to 60% of the global cost of investment according to the agricultural exploitation size, the climatic zones and the crop nature, A 10 % reduction on the equipement value and the suppression of the added value tax (TVA) and the cosumtion rights are also foreseen by the national code of invedtment


Efforts for problem Mitigation
Waste water treatment and reuse:
Tunisia has sewerage network of 12771 km and 98 waste water treatment plants. The volume is estimated actually at 201 Mm3/year it will be 260 Mm3 in 2011 and 480 Mm3/year in 2030 which represents 10 % of the mobilized conventional resourcesActually, only 32 % of the available volume is reused in agriculture.


Efforts for problem Mitigation
Artificial recharge of ground water tables:
The artificial recharge groundwater operation is one of the components of our national strategy of water resources mobilisation.
Since the beginning of this strategy(1992-2003) the volumes of water injected in the groundwater tables are estimated at 387 millions m3.
The main sources of water utilized to recharge groundwater tables are dams and treated wastewater.
The volume injected in the groundwater tables in 2003 is estimated at 43.2 millions m3.


Efforts for problem Mitigation
Groundwater extraction monitoring :
Some measures were put in place aiming to reinforce groundwater extraction monitoring such us:
-Means and instruments were provided to stakeholders for better water resources management.
-Instauration and putting in place a planning and hydraulic equipement bureau at the ministry of agriculture and hydraulic resources
-Evaluation of resources monitoring (networks optimization, improvement of telemeasurement system, GIS...)
-Execution of water tables strategy (data base GIS and numeric models, prototype of integrated management of phreatic water tables...)
-Pilot project of associative management of water demand for irrigation (participatory management approch)
-Control of the hydric pollution and treated wastewater reuse....

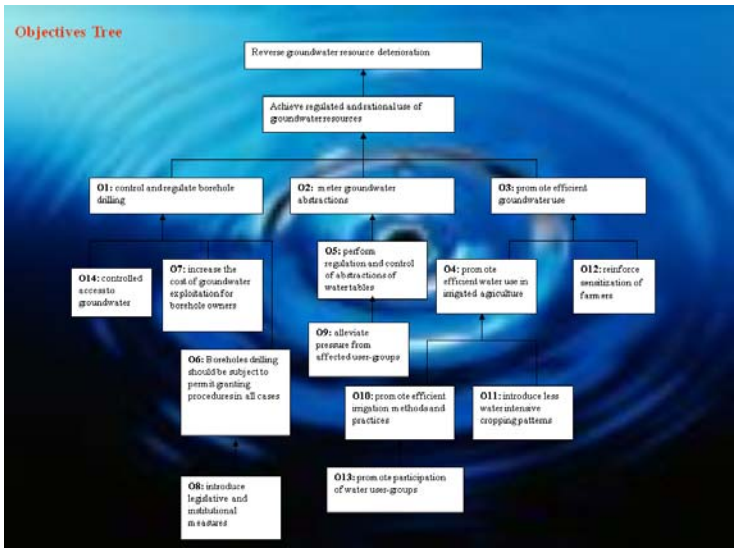

Efforts for problem Mitigation
Sustainable and Developed Grounwater Yield :
Aiming to attain the objectives of sustainable and developed ground water yields, many measures are undertaken such as:
a) The implementation of reviewed and detailed water researches work plans an the basis of recent studies » water saving 200 (1995) and water sector (1999)
b) Elaboration, adoption and implementation of water resource management programs.
c) Putting in place a national network of safeguarding and monitoring groundwater resources.


INECO Participatory process and its outcomes:
Analysis of the problem


Causes and effects of deterioration of available groundwater resources in Tunisia
Higher cost of agricultural products
Change in the cropping system
Increase in rural unemployment and migration to urban areas
Need to develop more expensive water supply sources
Desertification Appearance
Farmers grow poorer
Lac of strategic reserves to cope with drought events
Drying up of wells and boreholes groundwater quality degradation and increased salinity levels
Deterioration of the available groundwater resource
Overexploitation of groundwater resource
Illegal borehole drilling and operation
No metering of groundwater abstractions
Irrational management of groundwater use
Easy access to groundwater
Competitive cost for groundwater exploitation vs. other sources
Boreholes are not subject to authorisation unless the perimeter is prohibited or a loan for equipment is requested
Lack of regulation and control for water tables
Low valorisation of water in irrigated agriculture
Lack of sensitization of farmers
Lack of legislation and institutional measures
Social pressure from sensitive/affected user-groups
Efficiency of irrigation methods and practices is not sufficient
Water and intensive cropping patterns
Lack of participation of water user-groups


INECO Participatory process and its outcomes:
- Analysis of the problem
According to the problem tree the main (primary) cause of aquifer degradation is the overexploitation, wich is a result of:
- The operation of illegal (unauthorized) boreholes, whose operation is not monitored;
- The current irrigation practices and agriculture development patterns (low efficiency of irrigation methods, selection of low-value, water intensive crops
- The lack of meetering in groundwater abstractions.


INECO Participatory process and its outcomes:
Key possible objectives



INECO Participatory process and its outcomes:

- 2 key objectives are distinguished:

a) Reversing the availability of groundwater resources.

b) Rationalizing groundwater use through :

- Control and regulation over borehole drilling.
- Metering and regulation of groundwater abstractions
- Promotion of efficient groundwater use, especially in irrigated agriculture.

INECO Participatory process and its outcomes:

- Alternative options:

A set of proposed institutional and economic instruments (options) for the Tunisia Case study. Was drawn on the basis of the identified deficiencies and on international experience. Six categories of options were formulated for aquifer degradation:

-Category A: Options to control groundwater abstractions;

-Category B: options to enhance efficiency in irrigation water allocation and use, and thus reduce groundwater abstractions

-Category C: options to enhance the use of treated wastewater for crop irrigation.

-Category D: options to promote aquifer recharge with trated wastewater

-Category E: options to strengthen the socio-economic and institutional environment (enhance coordination and integration of policies and among institutions involved, develop collective management systems and enhance public involvement)

-Category F: options to improve the knowledge base on groundwater


INECO Participatory process and its outcomes:
Evaluation of options by local stakeholders :
questionaire INECO.pdf

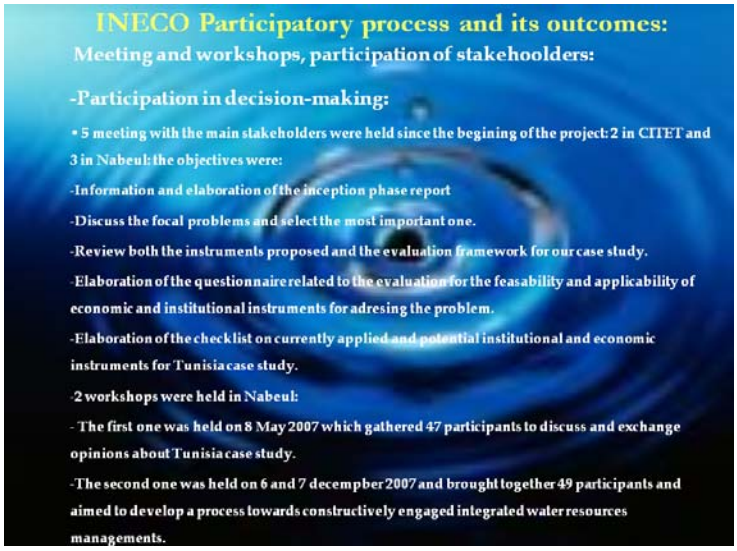

INECO Participatory process and its outcomes:
- Analysis of suggested options:
Control of groundwater abstractions:
- Groundwater abstractions (Public and private) are monitored by the CRDA at the regional level.
- Inventory of groundwater abstractions points exist by ground and undergound water table.
- Groundwater abstractions authorisations are offred by CRDA if less than 50 m of depth if more than 50 m of depth, authorisations are offred by the ministry of agriculture.
- There is no limits of depth unless groundwater resources are limited .


INECO Participatory process and its outcomes:
Enhance efficiency in irrigation water allocation and use:
- Many forms of assistance for those who use water saving techniques.
- 70 % of public irrigated shemes are equiped with water saving equipements
- Strategic crops are compensated up to 1500 m3 of water per HA is provided free of charge. Prices of cereal are in continuous increase.
- Information and sensitization compains are reinforced.
After 2010, a decrease in irrigation water consumption will be observed as a result of practiced water saving (through the incitement of water saving techniques, tarrif rationalization, hydraulic networks efficiency improvement, incitement of less water consumer crop varieties....) or by reallocation of distributed volumes according to the resource valorisation degree by the different sectors of water use.


INECO Participatory process and its outcomes:
Increase the use of treated waste water for crop irrigation:
- The course to TWW constitutes an important to satisfy some of the needs of agriculture, Industry and Tourism sectors when conventional can not respond to all demands.
-Considering the urban development and the territory management, the volume of TWW will be estimated in 2030 at 480 Mm3/ year which represents 10 % of the total mobilized resources, and will allow the irrigation of 100.000 HA. This reuse can not be possible only if specific and benefical tratment for the environment and the national economy is undertaken.
-To insure the collectivity sanitation, the safeguard of environment equilibrium, the exploitation of these resources should be operated according to specific legislation besed essentially on the result of studies and extensive research in this domain.


INECO Participatory process and its outcomes:
Promote aquifer recharge with treated waste water :
- Artificial recharge with TWW did not developed and it's estimated actually at 1% of the total water used for recharge of aquifers.
-The quality of TWW should be improved by a tertiary treatment to avoid all risks of contamination.


INECO Participatory process and its outcomes:
Stengthen the socio-economic and institutional environment:
-Participation in decision-making:
•There is a need to reinforce the responsabilization and the participation of all users and the different local stakeholders, notably through the agriculture development groups (GDA's) in matter of water management and to really implicate them in the dicision making process, the rehabilitation and in the maintenance of hydraulic infrastructures.
•Reinforce sensitization, education and capacity building of all users.
•Foresee the development of institutional instruments for wide coordination between concerned organisms.
-Water demand:
Water demand is growing, and there's a need to manage cerefully this grouth.
-Tarrif regulation: Provision of potable water and water for irrigation of strategic crops should be respected. In this regard tarrif regulation and water pricing is an important issue.
- Legislative measures inciting the creation of agriculture development groups need to be improved.

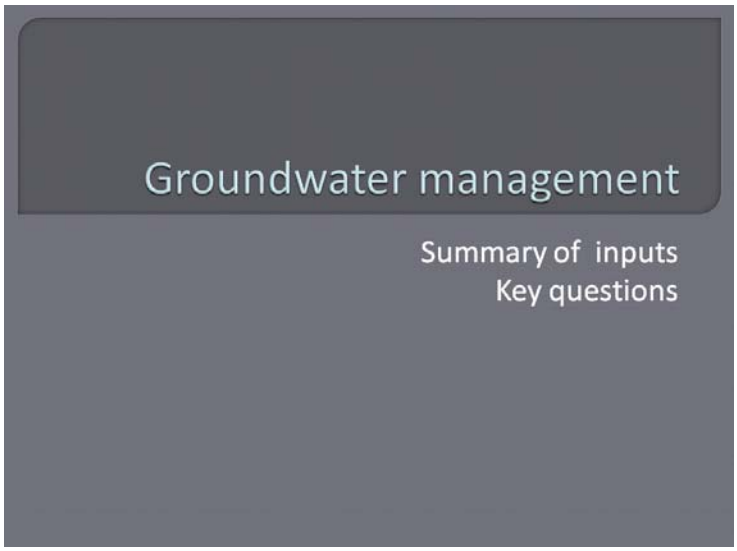

INECO Participatory process and its outcomes:
Meeting and workshops, participation of stakehoolders:
-Participation in decision-making:
• 5 meeting with the main stakeholders were held since the begining of the project: 2 in CITET and 3 in Nabeul: the objectives were:
-Information and elaboration of the inception phase report
-Discuss the focal problems and select the most important one.
-Review both the instruments proposed and the evaluation framework for our case study.
-Elaboration of the questionnaire related to the evaluation for the feasability and applicability of economic and institutional instruments for adresing the problem.
-Elaboration of the checklist on currently applied and potential institutional and economic instruments for Tunisia case study.
-2 workshops were held in Nabeul:
- The first one was held on 8 May 2007 which gathered 47 participants to discuss and exchange opinions about Tunisia case study.
-The second one was held on 6 and 7 decempber 2007 and brought together 49 participants and aimed to develop a process towards constructively engaged integrated water resources managements.

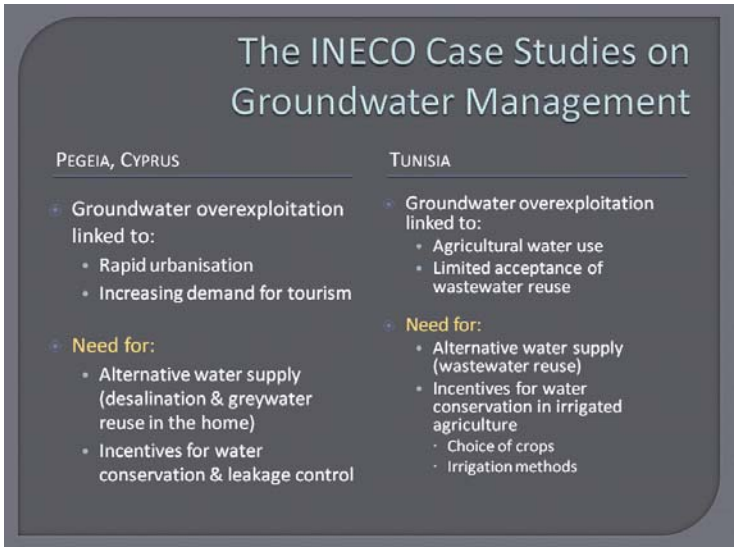

Proposal For improved water management:
1- Management and recharge of aquifers:
- Manage water tables in a shared process.
- Instal meters on wells in order to measure the quantity of water extracted.
- Take profit from surface water to recharge aquifers in the winter season.
- Establish a management organism of recharge devices
2- Improve TWW quality:
-Practice a more efficient control of industrials dismissals.
-Develop institutional measures for a large coordination between various stakeholders.
-Reinforce capacity building and sensitization of users for a rational control of TWW reuse .
3- Surface water Management and water saving control.
-Better management of water values for a maximal exploitation.
-Equip public irrigated shemes with an appropriated water saving equipments.
-Up-grading, consolidation, and reinforcement of GDA means.


Proposal For improved water management:
4- Other proposals
- Unify the tarrif of irrigation water
-Continue the mobilization of water ressources not mobilized yet.
-Reinforce soil and water conservation works.
-More preoccupation of piloting irrigation and water valorization on the economic level.
-Draw farmers interest vis à vis of collective management.
-Better manage droughts and floods
-Bringing scientific research results closer to GDA's
-Apply the agriculture map.

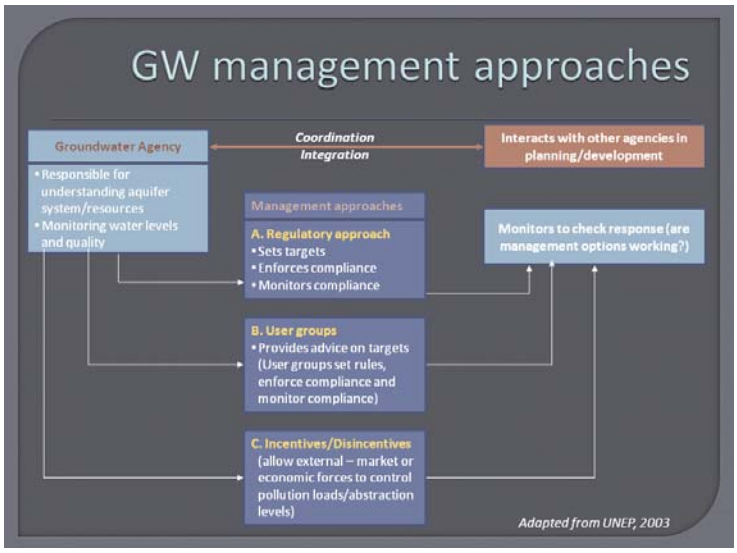

THANK YOU FOR YOUR
ATTENTION

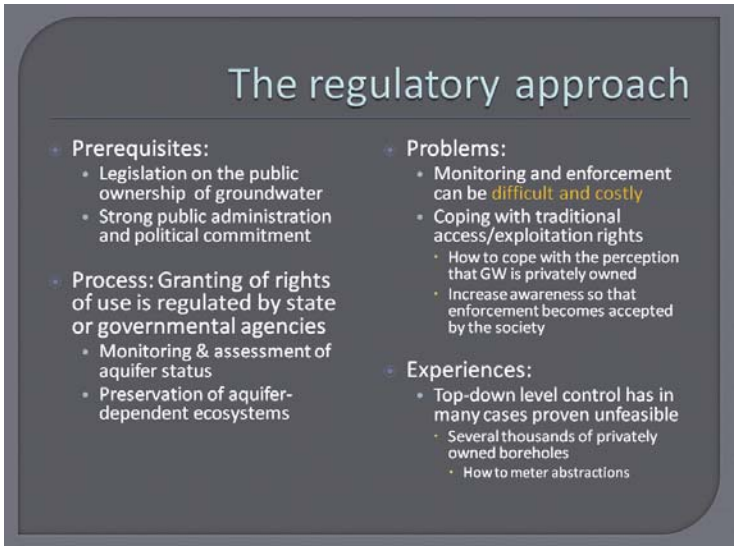
3.9 Groundwater management – A summary of inputs from the Cyprus and Tunisia Case Studies






Mitigating GW overexploitation
Policy Goals
Enhance supply
Doing more with more raw water
• Who bears the cost?
Increase productivity
Doing more with the same raw water
• Public subsidies vs. economic efficiency for low-value uses
Phase out some uses
Doing less with the same raw water
• Often socially & politically undesirable
• Enforcement?


GW management approaches
Groundwater Agency
• Responsible for understanding aquifer system/resources
• Monitoring water levels and quality
Coordination
Integration
Interacts with other agencies in planning/development
Management approaches
A. Regulatory approach
• Sets targets
• Enforces compliance
• Monitors compliance
Monitors to check response (are management options working?)
B. User groups
• Provides advice on targets (User groups set rules, enforce compliance and monitor compliance)
C. Incentives/Disincentives
(allow external – market or economic forces to control pollution loads/abstraction levels)
Adapted from UNEP, 2003


The regulatory approach
Prerequisites:
Legislation on the public ownership of groundwater
Strong public administration and political commitment
Process: Granting of rights of use is regulated by state or governmental agencies
Monitoring & assessment of aquifer status
Preservation of aquifer-dependent ecosystems
Problems:
Monitoring and enforcement can be difficult and costly
Coping with traditional access/exploitation rights
How to cope with the perception that GW is privately owned
Increase awareness so that enforcement becomes accepted by the society
Experiences:
Top-down level control has in many cases proven unfeasible
Several thousands of privately owned boreholes
How to meter abstractions

Collective management systems & Economic/regulatory instruments

- Establishment of collective management systems (bottom-up approach)
  - GW is perceived as a common property
  - Individual rights assigned on a customary base and enforced through mutual control
  - Associations ensure the allocation rights and the settlement of disputes
- Incentives/dicincentives and mixed economic/regulatory instruments
  - Abstraction charges (environmental taxation), possibly internalising part of resource costs (→ increase the cost borne by users)
  - Introduction of alternative supply sources (e.g. reclaimed water) in irrigation (→ price should be lower than GW extraction cost)
  - Voluntary agreeements to reduce groundwater abstractions
    - Compensation for loss of income
    - Subsidies/training support to install water saving equipment

Summary of suggested options

PEGEIA, CYPRUS

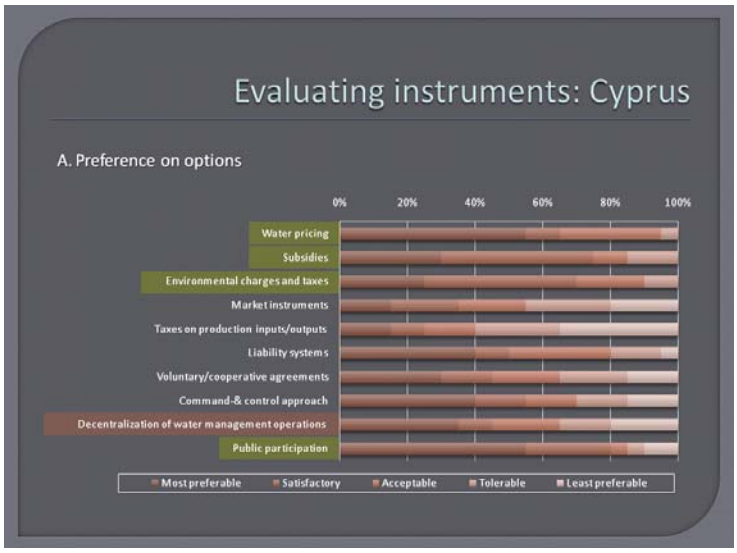
- Subsidies & mandates for the installation of efficient water fixtures and appliances, esp. for new buildings
- Disincentives for excessive water use
  - Increase of water rates, especially for large residential consumers/hotels to cause shift to other supply sources
  - Application of seasonal water rates
- Groundwater abstraction charges internalizing resource costs
- Government subsidies for leakage reduction and control programmes
- Compulsory water audits for the large consumers
- Awareness & participation

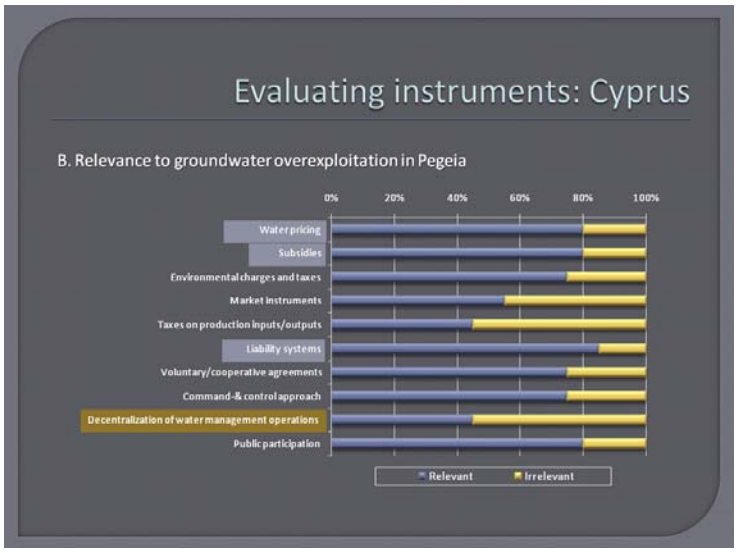
TUNISIA

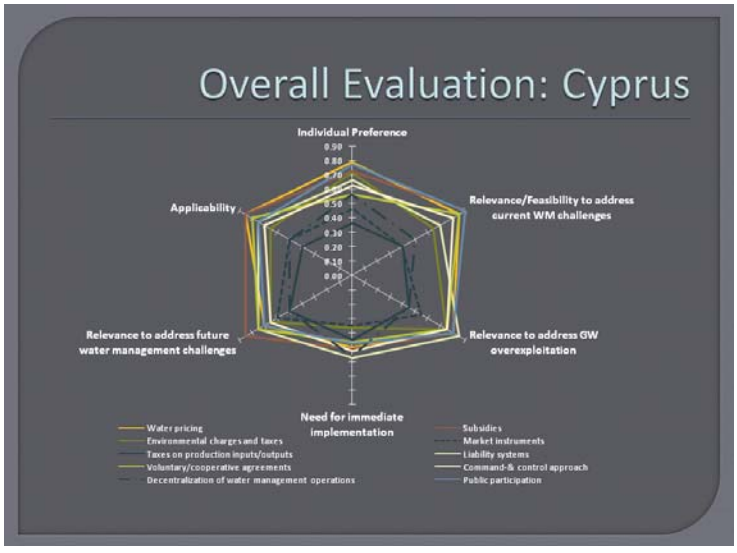
- Abstraction permits & enforcement
- Voluntary programmes for water saving/reduction in groundwater use targeted to farmers
- Pricing incentives
  - Lower price for treated wastewater than surface water and groundwater pumping costs
  - Abstraction charges for groundwater (public & private boreholes)
- Decentralization of activities in GW management – collective management schemes
- Awareness campaigning

Option Analysis: Cyprus

- Subsidies are in place for water saving in the domestic sector
  - Borehole drilling in urban areas for garden irrigation/toilet usage
  - Installation of greywater systems in homes/public buildings
- Voluntary agreements with farmers are available for vulnerable zones (Nitrates Directive)
  - Compensation is offered for the loss of production as a result of restrictions in fertilizer use
  - Limited potential for further improving irrigation efficiency
- The monitoring of groundwater extraction is limited to public water supply boreholes
- Abstraction charges are considered a potential instrument
  - Suggested process
    - Registration of public water suppliers (municipalities, irrigation divisions/associations), industrial plants, self-supplied farmers
    - Monitoring and registration of abstracted quantities
    - Setting of charge basis


Evaluating instruments: Cyprus
A. Preference on options
0%
20%
40%
60%
80%
100%
Water pricing
Subsidies
Environmental charges and taxes
Market instruments
Taxes on production inputs/outputs
Liability systems
Voluntary/cooperative agreements
Command-& control approach
Decentralization of water management operations
Public participation
Most preferable
Satisfactory
Acceptable
Tolerable
Least preferable


Evaluating instruments: Cyprus
B. Relevance to groundwater overexploitation in Pegeia
0%
20%
40%
60%
80%
100%
Water pricing
Subsidies
Environmental charges and taxes
Market instruments
Taxes on production inputs/outputs
Liability systems
Voluntary/cooperative agreements
Command-& control approach
Decentralization of water management operations
Public participation
Relevant
Irrelevant

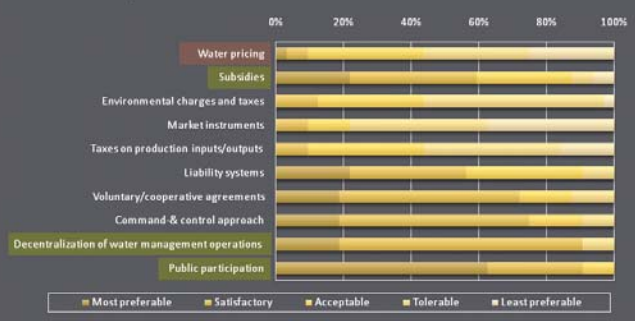

Overall Evaluation: Cyprus
Individual Preference
Relevance/Feasibility to address current WM challenges
Relevance to address GW overexploitation
Need for immediate implementation
Relevance to address future water management challenges
Applicability
Water pricing
Subsidies
Environmental charges and taxes
Market instruments
Taxes on production inputs/outputs
Liability systems
Voluntary/cooperative agreements
Command-& control approach
Decentralization of water management operations
Public participation

Option Analysis: Tunisia

- Increasing productivity in irrigated agriculture
  - Governmental support for cereals due to the prevailing global economic conditions and increased demand
  - Financial obstacles towards the adoption of efficient irrigation systems (soft loans are available but progress remains slow)
- Subsidies for wastewater reuse
  - Wastewater price 0.02 TD/m³ vs. 0.05 TD/m³ for Groundwater and 0.1 TD/m³ for Surface water
  - The State finances water reuse projects
  - However most farmers are not willing to use treated wastewater
    - Low quality of reclaimed water
    - Limited acceptance/lower prices of produce in the market
- Monitoring of groundwater abstractions
  - Monitorable by the Regional Department for Agricultural Development (CRDA)
  - No specific service to undertake the task
  - Compliance to permits checked mostly immediately after borehole drilling

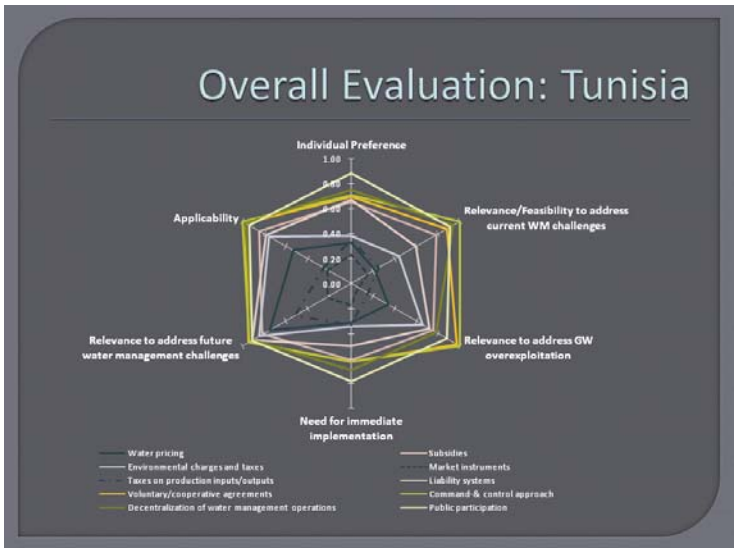
Evaluating instruments: Tunisia

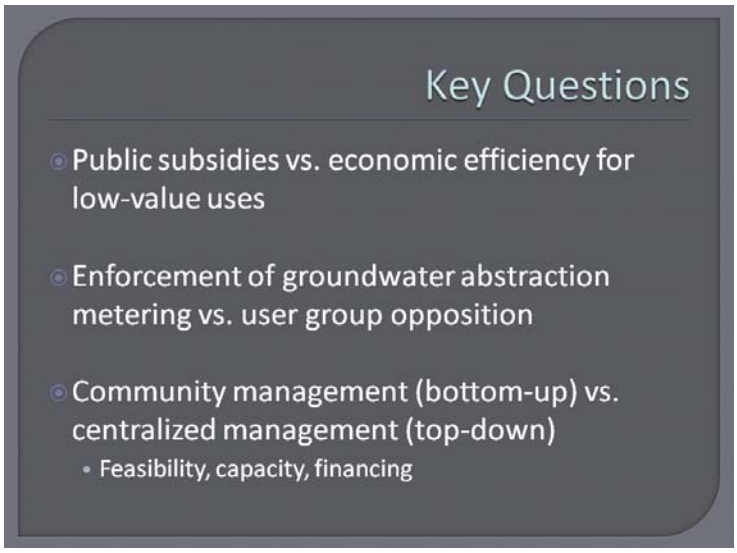
A. Preference on options



Evaluating instruments: Tunisia

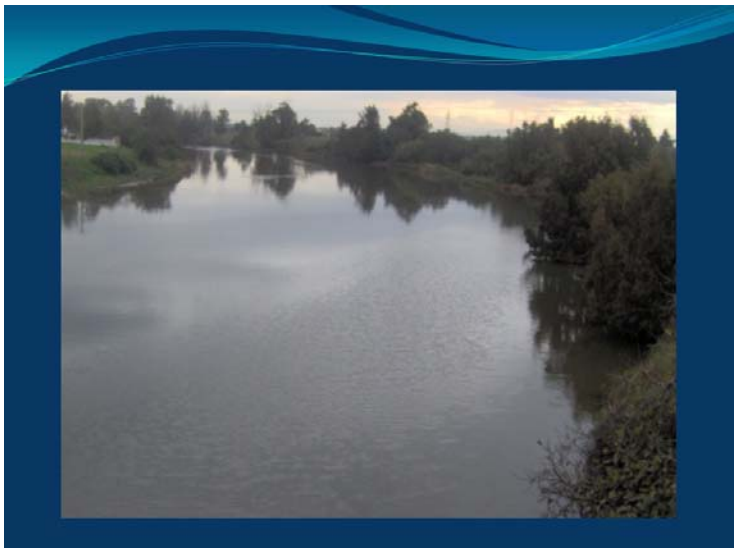
B. Relevance to groundwater overexploitation in Tunisia


Overall Evaluation: Tunisia
Individual Preference
Relevance/Feasibility to address current WM challenges
Relevance to address GW overexploitation
Need for immediate implementation
Relevance to address future water management challenges
Applicability
Water pricing
Environmental charges and taxes
Taxes on production inputs/outputs
Voluntary/cooperative agreements
Decentralization of water management operations
Subsidies
Market instruments
Liability systems
Command & control approach
Public participation


Key Questions
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

3.10 Pollution of the Seybouse River, Algeria

Mr. A. Bouchedja, Agence de Bassin Hydrographique de Constantinois-Seybouse-Mellegue



IDENTIFICATION DU PROBLEME

La mission d'identification a permis d'élaborer :

- Un diagnostic détaillé de la situation de la gestion de l'eau dans le bassin .Celui ci se base sur une analyse des données physiques de l'eau dans le bassin et porte notamment sur les principales contraintes pesant sur cette gestion.
- Une analyse des problèmes et des besoins en matière de gestion intégrée des ressources en eau du bassin.

DANGERS MENAÇANT LE COURS DE LA SEYBOUSE

- Le bassin de la Seybouse est confronté à la pollution urbaine industrielle et agricole.Cette pollution émane des différentes villes ,usines et zones agricoles situées sur ses deux rives . La pollution atteint un degré élevé.

4,5 millions de m3 sont rejetés annuellement dans la rivière , sur lesquels 3 millions de m3 sont des huiles usagées

- Le traitement de la Seybouse est un bel exemple de gestion intégrée , puisque il inclurait des volets de protection de ressources superficielles et souterraines ,de rationalisation d' usages domestiques , agricoles et industriels , mais aussi de lutte contre la pollution et de protection de l' environnement .

L'enjeu hydraulique pour la région est extrêmement important. Il conditionne l'existence économique et sociale même du bassin

L 'eau de l'oued Seybouse est de plus en plus polluée :
Elle se dégrade du fait :
- De l 'urbanisation,
-De l'industrialisation
- Du développement agricole,

- L'Oued Seybouse ,considéré comme un oued particulièrement stratégique de la région, la Seybouse est depuis une dizaine d'années confrontée à une pollution de plus en plus importante ,comme en témoignent les résultats d' analyses effectuées sur à la fois sur l' oued lui-même et sur les forages de la région .

Malheureusement , les informations disponibles ne permettent pas d' identifier précisément les raisons de cette pollution , ni les points précis où elle est générée , ni même l' ensemble des polluants rejetés

LES AGGLOMERATIONS

Annaba : 280.000 hab
Guelma 140.000 hab
Sidi Amar :50.000 hab
El Bouni :40.000 hab

LES INDUSTRIES DANS LE BASSIN

- 86 unités industrielles importantes
- Huit seulement ont leur propre station d' épuration .

LES PERIMETRES D' IRRIGATION

- Deux grands périmètres d' irrigation :
  Guelma Bouchegouf (12900Ha)
  Bounamoussa (4500 Ha)

Principales unités industrielles du bassin de la Seybouse

Les industries particulièrement polluantes :

- *SNS : El Hadjar*
  Engrais phosphatés : (Annaba)
- *Levurerie Bouchegouf: Rejets d 'eau noire (déversement dans l 'oued Mellah -affluent de la seybouse)*
- *Carrelage à Guelma (rejets d 'eaux minéralisées)*
- *Sucrerie Guelma : eaux riches en matières organiques en suspension*
- *Onalait : (Oued Meboudja en confluence avec la Seybouse)*

Principales
Industries polluantes
dans la Wilaya de
Annaba

1 ENCG
3 EMIB
5 ASMIDAL
6 FERROVIAL
7 SONACOME
9 ISPAT
11 PROSIDER
21 SNS

La situation dans les années 90

- Ressources limitées
- Croissance rapide :besoins de plus en plus importants , à la fois domestiques , agricoles et industriels .
- Diminution de la pluviométrie
- Rendements de réseaux faibles .
- Pollution des cours d' eau , résultat d' une urbanisation croissante ,d' une agriculture qui devient dynamique et d'une industrialisation galopante (non réglementée) .
- En terme de valeur économique de l' eau , l' eau est encore souvent perçue comme un don de Dieu .
- Peu d' études économiques , le coût de l' eau reste une notion très vague .
- Les divers modes de gestion de l' eau (régies communales , entreprises régionales et de wilaya) ont d' autant moins facilité cette approche économique , que l' on est souvent passé rapidement d' un mode à l' autre, sans consolidation des résultats.

- Deux échelons territoriaux principaux sont en place : le niveau national et niveau de wilaya .
- Seule l' Agence Nationale des Ressources Hydrauliques (ANRH) s' appuie sur la notion de région
- Les départements de plus en plus petits font que la gestion de la ressource n' est plus adaptée au cadre administratif existant .
- Peu d' information du public et peu de concertation

Quelques indicateurs pertinents de pollution

- Actuellement le réseau de surveillance de la qualité des eaux de surface dans le bassin de la Seybouse, comprend quatre stations de mesures suivies par l'Agence Nationale des Ressources Hydrauliques (Direction Régionale de Constantine). Les mesures sont théoriquement réalisées douze fois par an.
- Les mesures concernent les paramètres suivants: Température, pH, Conductivité électrique, Oxygène dissous, Turbidité, Matières en suspension, Résidu sec, Calcium, Magnésium, Sodium, Potassium, Chlorures, Sulfates, Carbonates, Bicarbonates, Demande Chimique en Oxygène (DCO), Manganèse, Fer, Matières Organiques, Phosphates (PO_4), Ammonium (NH_4), Nitrates (NO_3) , Nitrites (NO_2), Demande Biologique en Oxygène à cinq jours (DBO_5)
- Nous avons choisi une présentation par histogramme des paramètres de pollution par point de prélèvement représentant chacun des paramètres suivants: Nitrates, Nitrites, Phosphates, Ammonium, Demande Chimique en Oxygène, sur la base d'une moyenne d'observations, entre 2004 et 2006.

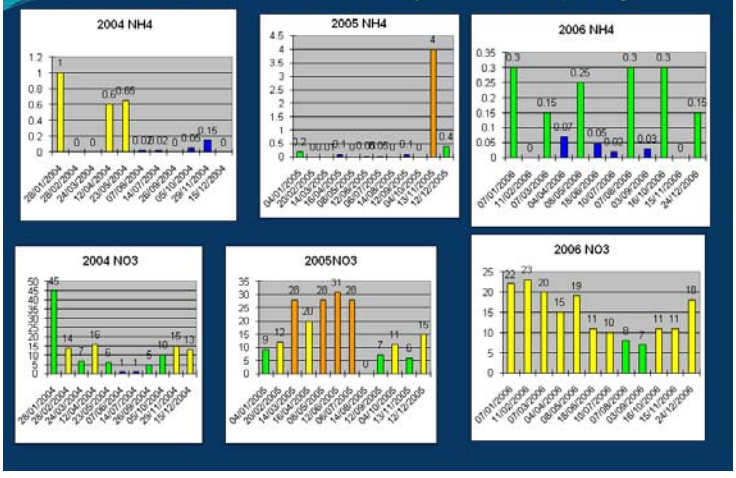
GRILLE DE QUALITE GLOBALE

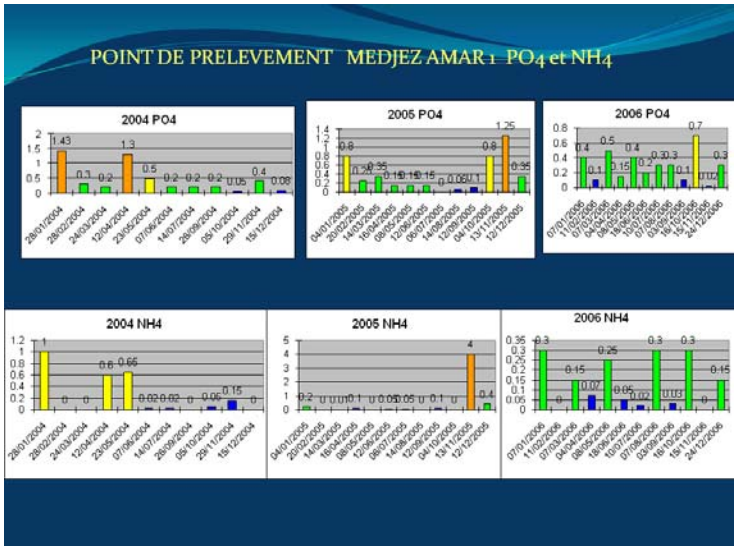
La classe de qualité la plus défavorable dans chacun des paramètres détermine la classe de qualité globale du point considéré.

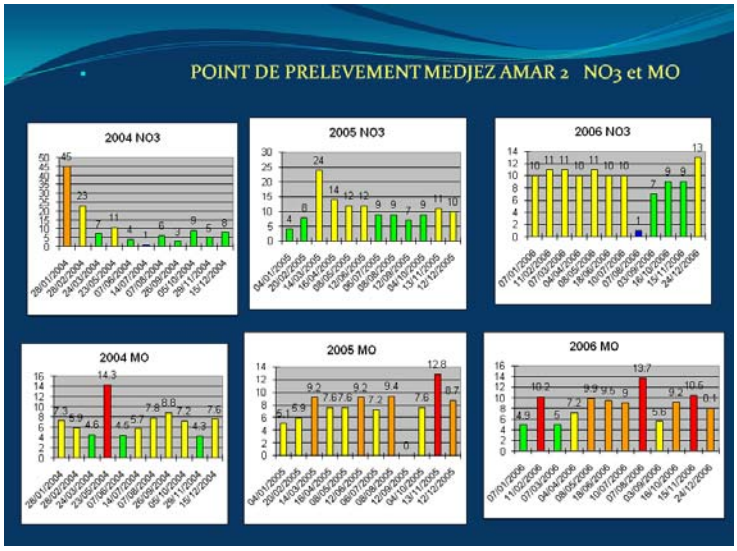
Points de prélèvement d'aval en amont

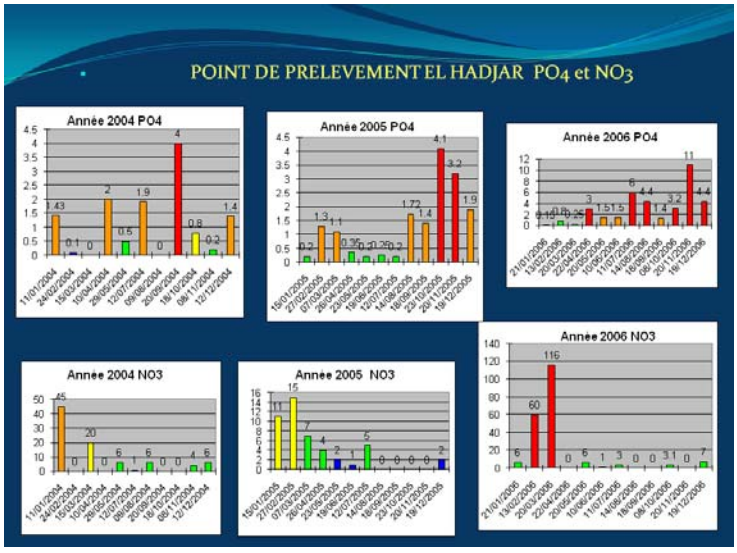
- Medjez Amar 2 St. 14 03 situé sur Oued seybouse, dans la wilaya de Guelma
- Segmen Amar 1 St. 14 06 situé sur Oued Seybouse, dans la wilaya de Annaba
- El Hadjar St. 14 06 situé sur Oued Meboudja, dans la wilaya de Annaba

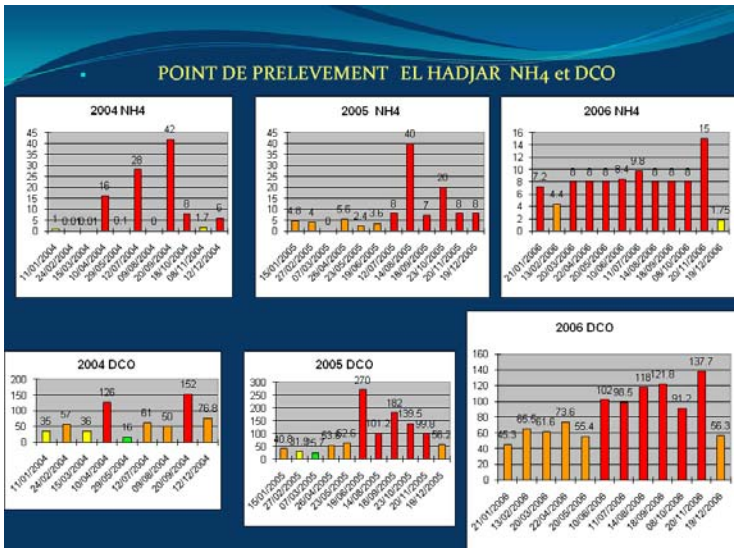
POINT DE PRELEVEMENT Medjez Ammar 1 NH_4 et NO_3

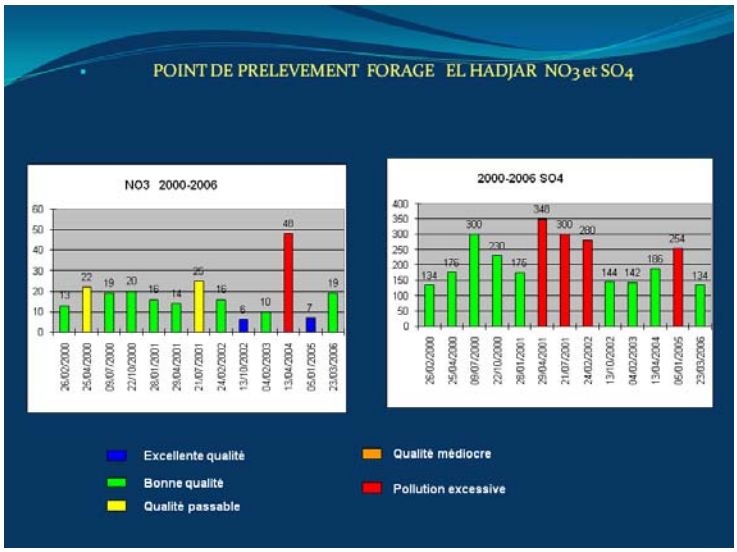



POINT DE PRELEVEMENT MEDJEZ AMAR 1 PO4 et NH4
2004 PO4
2005 PO4
2006 PO4
2004 NH4
2005 NH4
2006 NH4


POINT DE PRELEVEMENT MEDJEZ AMAR 2 NO3 et MO
2004 NO3
2005 NO3
2006 NO3
2004 MO
2005 MO
2006 MO


POINT DE PRELEVEMENT EL HADJAR PO4 et NO3
Année 2004 PO4
Année 2005 PO4
Année 2006 PO4
Année 2004 NO3
Année 2005 NO3
Année 2006 NO3


POINT DE PRELEVEMENT EL HADJAR NH4 et DCO
2004 NH4
2005 NH4
2006 NH4
2004 DCO
2005 DCO
2006 DCO


POINT DE PRELEVEMENT FORAGE EL HADJAR NO3 et SO4
NO3 2000-2006
2000-2006 SO4
Excellente qualité
Bonne qualité
Qualité passable
Qualité médiocre
Pollution excessive


Une étude faite en 1994 (thèse du Docteur Djabri – Université de Annaba) avait déjà montré des taux élevés en :
Nitrates (4mgl)
Fer (entre 2 et 6 mg/l)
Manganèse
Phosphates (0.5 mg/l)
Ammonium
supérieurs aux valeurs limites!!!!

Une récente étude(1993) fait apparaitre le résultats suivants :

Ammonium : Les concentrations sont supérieures aux normes admises (0.5 mg/l). Teneur faible à Guelma ; En allant vers Annaba , les concentrations augmentent (> 20 mg/l)

Provenance : rejets urbains des villes de Guelma , Boumahra , Bouchegouf , Drean . Les fortes concentrations se situent dans la zone de Annaba .

Nitrites : Concentrations élevées (6 mg /l). Les concentrations les + importantes secteur sud de Guelma ,Bouchegouf , Sidi Salem / rejets urbains importants (Guelma et Bouchegouf)

Nitrates: Les fortes concentrations se situent dans le secteur de Bouchegouf et sont probablement liées à l' utilisation massive d' engrais .

L' analyse des eaux de rejet a montré de fortes concentrations en sodium, particulièrement au niveau de la levurerie de Bouchegouf

Tableau Récapitulatif de la classe de Qualité

Nom de la Station	Année 2004	Année 2005	Année 2006
M'djez Amar I - O.Cherf			
H. Debagh - Guelma			
Segmen Amar - Mirebek			
El Hadjar- O.Meboudja			

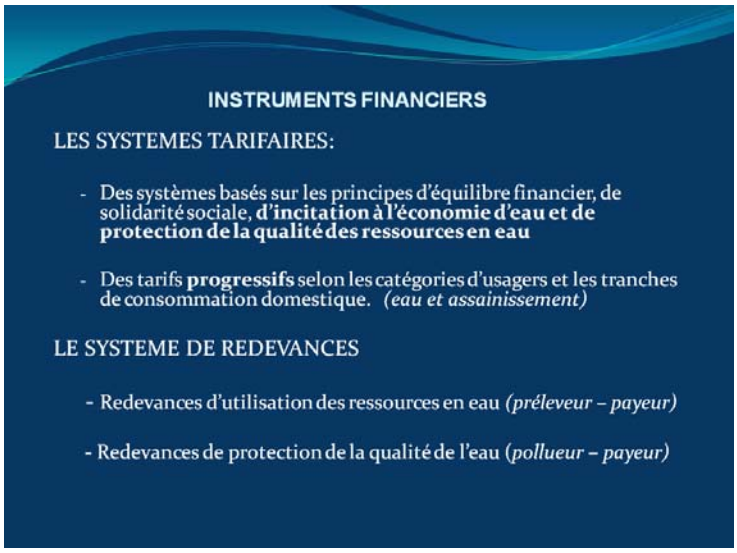
Excellente qualité
Bonne qualité
Qualité passable
Qualité médiocre
Pollution excessive

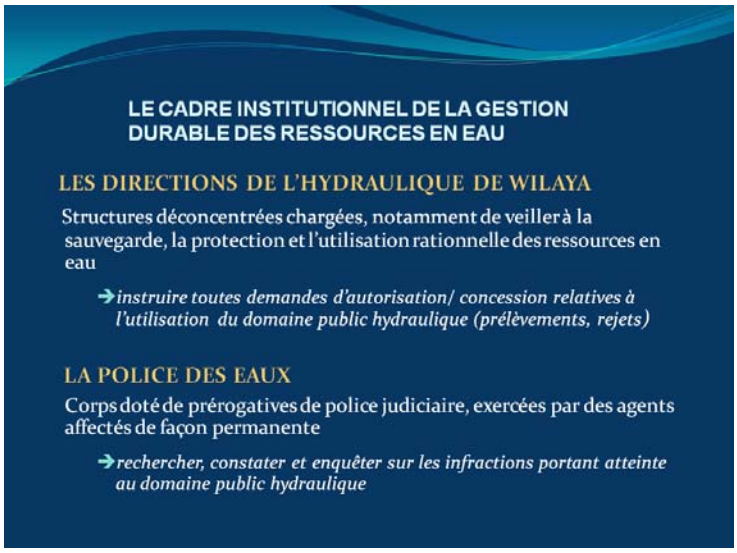
REGLES ET INSTRUMENTS
DE PROTECTION QUALITATIVE

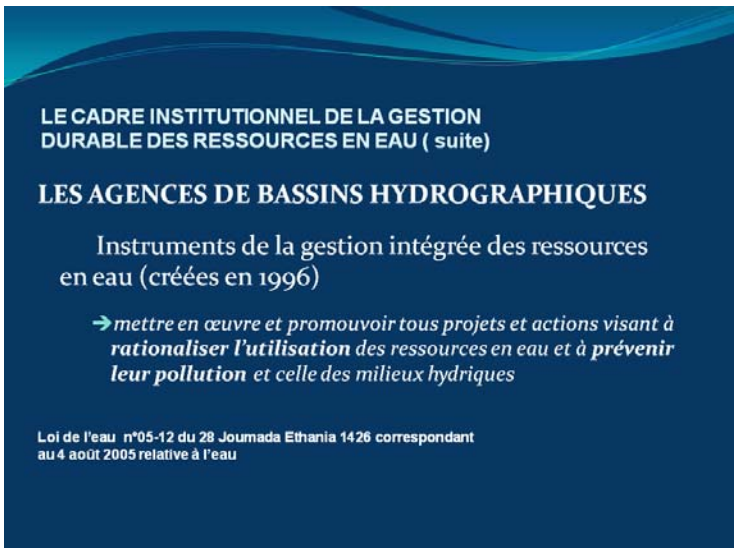
- AUTORISATIONS DE REJET, DE DEVERSEMENT OU DE DEPÔTS DE MATIERES NON TOXIQUES
- NORMES DE REJETS *(obligation de prétraitement des effluents industriels avec mesures conservatoires)*

INSTRUMENTS:

- PERIMETRES DE PROTECTION QUALITATIVE autour des infrastructures ou des ressources vulnérables *(immédiate / rapprochée / éloignée)*
- PLANS DE RESTAURATION ET DE PROTECTION DE LA QUALITE DES EAUX *(retenues, lacs, oueds et étangs menacés d'eutrophisation)*


INSTRUMENTS FINANCIERS
LES SYSTEMES TARIFAIRES:
- Des systèmes basés sur les principes d'équilibre financier, de solidarité sociale, d'incitation à l'économie d'eau et de protection de la qualité des ressources en eau
- Des tarifs progressifs selon les catégories d'usagers et les tranches de consommation domestique. (eau et assainissement)
LE SYSTEME DE REDEVANCES
- Redevances d'utilisation des ressources en eau (préleveur – payeur)
- Redevances de protection de la qualité de l'eau (pollueur – payeur)


LE CADRE INSTITUTIONNEL DE LA GESTION DURABLE DES RESSOURCES EN EAU
LES DIRECTIONS DE L'HYDRAULIQUE DE WILAYA
Structures déconcentrées chargées, notamment de veiller à la sauvegarde, la protection et l'utilisation rationnelle des ressources en eau
→instruire toutes demandes d'autorisation/ concession relatives à l'utilisation du domaine public hydraulique (prélèvements, rejets)
LA POLICE DES EAUX
Corps doté de prérogatives de police judiciaire, exercées par des agents affectés de façon permanente
→rechercher, constater et enquêter sur les infractions portant atteinte au domaine public hydraulique


LE CADRE INSTITUTIONNEL DE LA GESTION DURABLE DES RESSOURCES EN EAU (suite)
LES AGENCES DE BASSINS HYDROGRAPHIQUES
Instruments de la gestion intégrée des ressources en eau (créées en 1996)
→mettre en œuvre et promouvoir tous projets et actions visant à rationaliser l'utilisation des ressources en eau et à prévenir leur pollution et celle des milieux hydriques
Loi de l'eau n°05-12 du 28 Joumada Ethania 1426 correspondant au 4 août 2005 relative à l'eau

Mais est – ce suffisant ?

- *Que faire pour aider à la réduction des pollutions industrielles ?*
- *Comment réduire les pollutions agricoles ?*
- *Comment réduire les dépôts de déchets solides?*
- *Comment sensibiliser et convaincre ?*
- *Quels sont les outils à mettre en place pour des actions réellement efficaces et durables ?*

- *Il y a une réelle prise de conscience du fait que la pollution de l'Oued Seybouse peut devenir un problème sérieux .*
- *Le programme de stations d'épuration récemment lancé devrait pouvoir atténuer le problème , au moins dans sa partie de pollution domestique .*
- *Les associations se sont mobilisées . Le travail fait par l'ANPEP (Association Nationale pour la Protection de l'Environnement et la lutte contre la Pollution) est de ce fait exemplaire : caravane de sensibilisation , films , dépliants de sensibilisation, conférences....*

STATIONS D' EPURATION

- Pas de stations d' épuration traitant les effluents domestiques . Cinq unités sont en cours de construction, sur le programme du Ministère des Ressources en Eau ,et traiteront 130.000m3/jour à l' horizon 2010.
- Deux autres sont programmées à Annaba (580.000 eq.hab:145.000 m3/j) et Oued Zenati(140.000 eq.hab :35.000 m3/j) respectivement pour 2008 et 2010 . Elles traiteront ensemble 180.000 m3/jour
- *Une troisième extension des Salines est prévue à l' horizon 2017/ prise en charge de el Hadjar et sidi Amar : 210.000 eq hab soit environ 53 000 m3/j.*

Plusieurs actions ont été ou seront menées

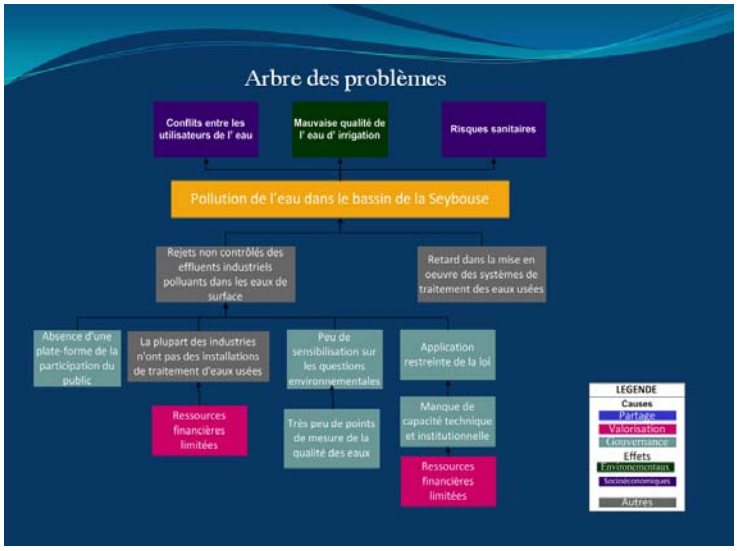
- *Action de sensibilisation , un atelier a été organisé le 28 avril 2008 et a regroupé les industriels de la région mais aussi des élus locaux*
  - *Acquisition de données sur le bassin , par un projet d'étude sur les rejets industriels et domestiques du bassin (en cours)*
  - *Relations avec l' Université en proposant des travaux de recherche adaptés à ce problème particulier , en relation avec les conclusions de l'atelier du 19 janvier 2008*
  - *Connaissances économiques et financières, notamment sur les possibilités de participation aux investissements de dépollution*
  - *Implication des différentes structures chargées de l'hydraulique et de l'environnement de la région.*
  - *Activation du rôle des associations de protection de l'environnement*

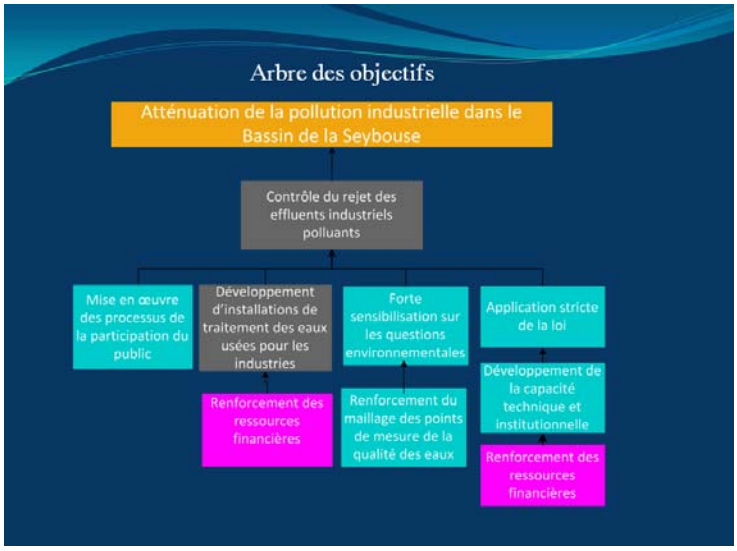
Synthèse du questionnaire de l'atelier de Annaba

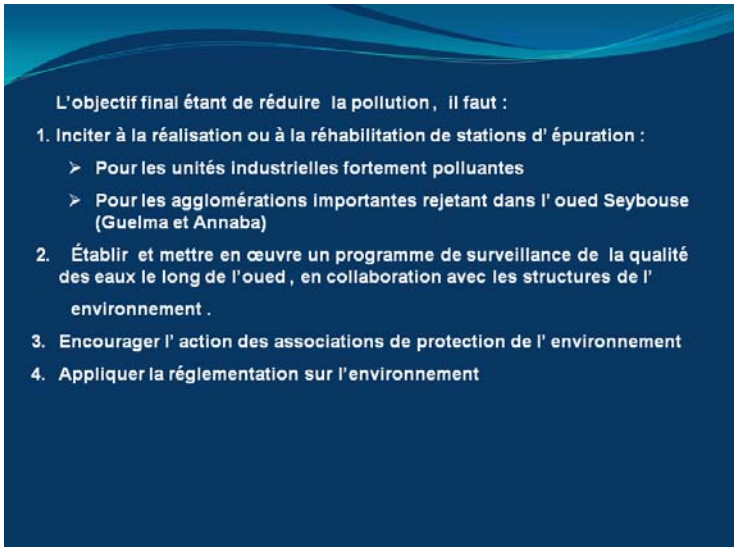
les participants à l'atelier de Annaba ont été destinataires d'un questionnaire concernant leur vision pour réduire la pollution de l'oued Seybouse

Il en ressort que sur 42 réponses reçues:

38 sont résidents permanents dans la région
18 sont concernés directement par la pollution de la Seybouse
26 pensent que la pollution de l'eau est très importante et qu'il faut agir immédiatement
30 pensent que les industries (y compris les petits fabricants) sont la cause principale de la pollution de l'eau.
17 disent que c'est un danger pour la santé humaine
14 pensent que la pollution affecte directement leurs activités quotidiennes
12 pensent que la législation n'est pas appliquée
27 pensent que les unités industrielles contribuent le plus à la pollution de l'eau
24 pensent que l'introduction des redevances proportionnelle aux quantités rejetées est souhaitable .
30 sont favorables à l'implication de la population pour garantir les intérêts de tous.


Arbre des problèmes
Conflits entre les utilisateurs de l' eau
Mauvaise qualité de l' eau d' irrigation
Risques sanitaires
Pollution de l'eau dans le bassin de la Seybouse
Rejets non contrôlés des effluents industriels polluants dans les eaux de surface
Retard dans la mise en oeuvre des systèmes de traitement des eaux usées
Absence d'une plate-forme de la participation du public
La plupart des industries n'ont pas des installations de traitement d'eaux usées
Peu de sensibilisation sur les questions environnementales
Application restreinte de la loi
Ressources financières limitées
Très peu de points de mesure de la qualité des eaux
Manque de capacité technique et institutionnelle
Ressources financières limitées
LEGENDE
Causes
Partage
Valorisation
Gouvernance
Effets
Environnementaux
Socioéconomiques
Autres

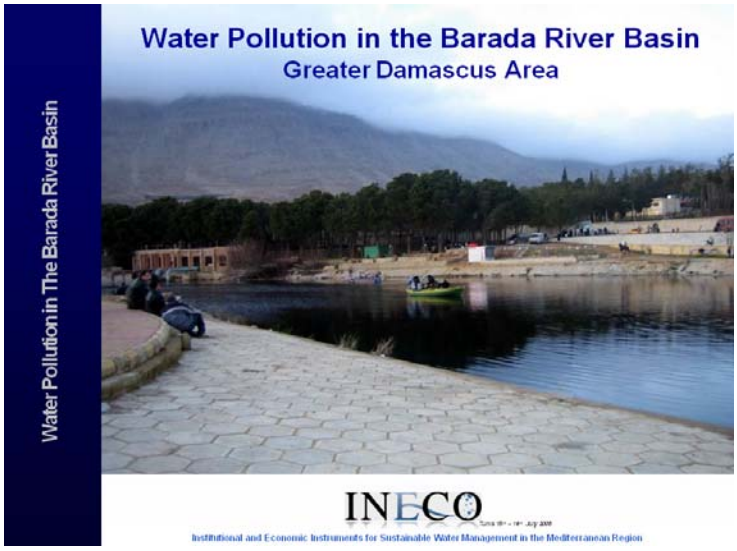

Arbre des objectifs
Atténuation de la pollution industrielle dans le Bassin de la Seybouse
Contrôle du rejet des effluents industriels polluants
Mise en œuvre des processus de la participation du public
Développement d'installations de traitement des eaux usées pour les industries
Forte sensibilisation sur les questions environnementales
Application stricte de la loi
Développement de la capacité technique et institutionnelle
Renforcement des ressources financières
Renforcement du maillage des points de mesure de la qualité des eaux
Renforcement des ressources financières

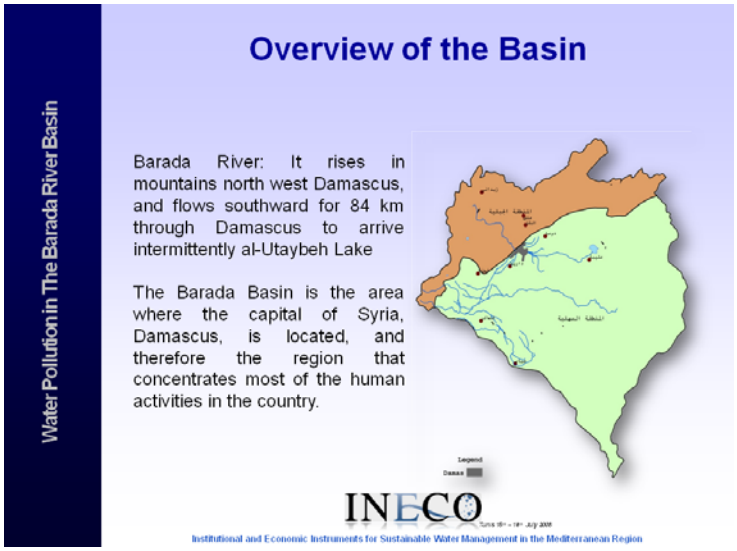

L'objectif final étant de réduire la pollution, il faut :
1. Inciter à la réalisation ou à la réhabilitation de stations d' épuration :
➢ Pour les unités industrielles fortement polluantes
➢ Pour les agglomérations importantes rejetant dans l' oued Seybouse (Guelma et Annaba)
2. Établir et mettre en œuvre un programme de surveillance de la qualité des eaux le long de l'oued, en collaboration avec les structures de l' environnement.
3. Encourager l' action des associations de protection de l' environnement
4. Appliquer la réglementation sur l'environnement


Merci de votre attention

3.11 Pollution of the Barada River (Greater Damascus Area), Syria

Mr. M. Haddad, Studies and Integration Consulting

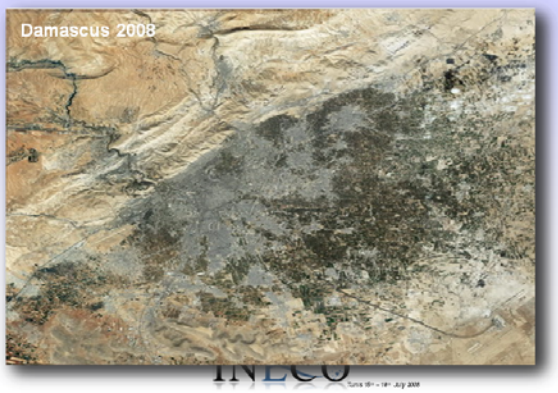




Water Pollution in The Barada River Basin

Overview of the Basin

The total population of the basin is about 5 million with 2.4 increasing rate. The demand for water, water sanitary services and new wastewater treatment facilities will be increase also.



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Water Pollution in The Barada River Basin

Water Pollution in the Barada River Basin

The discharge of high loads of domestic waste and wastewater.

One drainage pipe pours water in the river 1200 m from the Barada Spring, Zabadani Area, Feb 2008

A branch of the river and seemed completely dry, which accumulate dirt, Sep 2007

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Water Pollution in The Barada River Basin

Water Pollution in the Barada River Basin

The discharge of high loads of industrial waste and wastewater.

Polluted water in the tanneries area Mar 2008

Polluted water in the Marble Factories area Mar 2008

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Water Pollution in The Barada River Basin

Water Pollution in the Barada River Basin

Excessive and irregular using of fertilizer and pesticides by farmers.
Using wastewater for irrigation.

Al Ghouta
Mar 2008

Barada Valley
Feb 2008

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Water Pollution in The Barada River Basin

Water Pollution in the Barada River Basin

The drawing of water from Barada and Fijeh springs for Damascus drinking water supply, by many wells has been digging by government around the springs, in addition to many illegal wells belonged farmers, house owners, factories and touristic establishments, caused drying of the Barada spring lake,

Barada Spring lake, the lake is fully dry, Feb 2008

Al Fijeh Spring
Feb 2008

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Water Pollution in The Barada River Basin

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Water Pollution in The Barada River Basin

Water Pollution in the Barada River Basin

Water Pollution in The Barada River Basin

Indicators Relevant to the Problem

Water Quantity

Drought lakes formed by these springs, and that's creating agricultural, environmental, tourism problems in addition to depletion of underground water around basin.

The river drying pushes some farmers to break the sewage network pipes and irrigate their lands with wastewater, that's led to many other problem with the agriculture producing, environmental problems and pollution of groundwater.

The main activities of the people in Barada Basin (Damascus countryside) are agriculture and touristic activities, the losing of their water resources pushes them to migration from the countryside to Damascus city, thereby reducing the green areas and increasing demand for drinking water and other services in Damascus City.

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Water Pollution in The Barada River Basin

Indicators Relevant to the Problem

Water Quantity

The unfair uses of water resources cause the dry of land, and the degradation of soil quality in many areas due to erosion, which reduced the fertility and productivity, which led to the destruction of vegetation and green spaces and forest degradation, and thus decline in biodiversity of land and water in fresh vegetable and animal assets.

Digging illegal wells randomly, affects ecologically a quantity of water levels in groundwater where this will lead to a decrease in the amount of water, declining water quality and pollution.

In many areas, the river bed turning to area for waste disposal due to drought, which led to the spread of insects and pollution of these areas.

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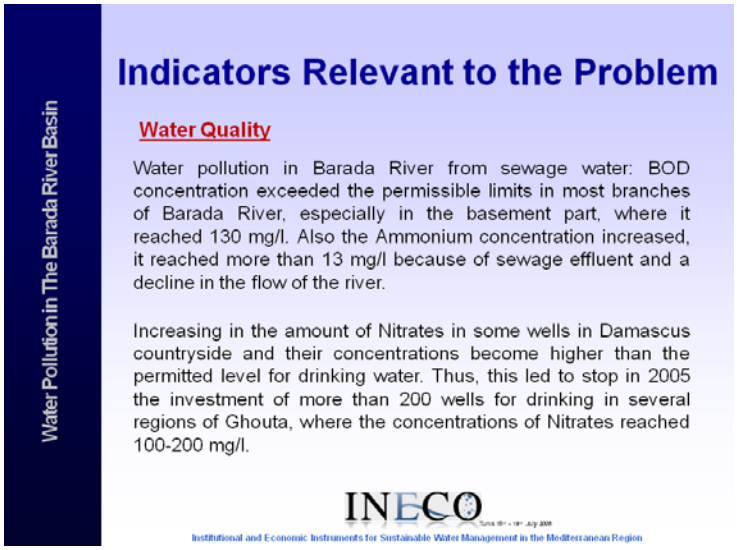
Water Pollution in The Barada River Basin
Indicators Relevant to the Problem
Water Quality
Water pollution in Barada River from sewage water: BOD concentration exceeded the permissible limits in most branches of Barada River, especially in the basement part, where it reached 130 mg/l. Also the Ammonium concentration increased, it reached more than 13 mg/l because of sewage effluent and a decline in the flow of the river.
Increasing in the amount of Nitrates in some wells in Damascus countryside and their concentrations become higher than the permitted level for drinking water. Thus, this led to stop in 2005 the investment of more than 200 wells for drinking in several regions of Ghouta, where the concentrations of Nitrates reached 100-200 mg/l.
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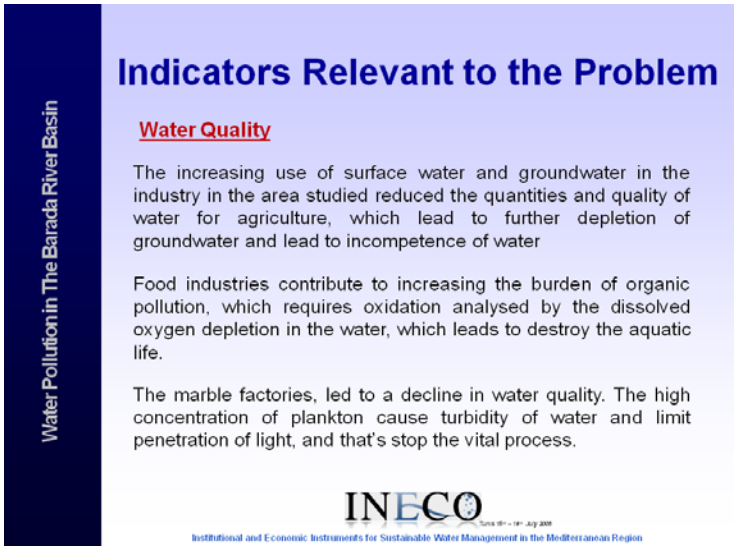
Water Pollution in The Barada River Basin
Indicators Relevant to the Problem
Water Quality
The increasing use of surface water and groundwater in the industry in the area studied reduced the quantities and quality of water for agriculture, which lead to further depletion of groundwater and lead to incompetence of water
Food industries contribute to increasing the burden of organic pollution, which requires oxidation analysed by the dissolved oxygen depletion in the water, which leads to destroy the aquatic life.
The marble factories, led to a decline in water quality. The high concentration of plankton cause turbidity of water and limit penetration of light, and that's stop the vital process.
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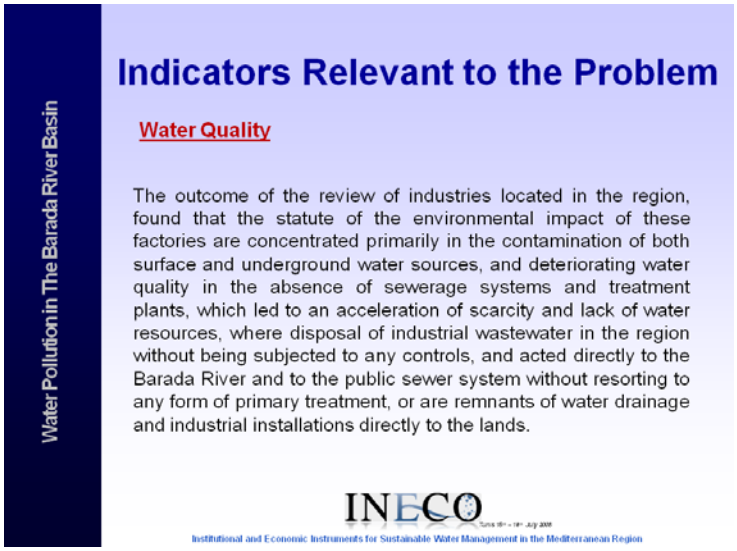
Water Pollution in The Barada River Basin
Indicators Relevant to the Problem
Water Quality
The outcome of the review of industries located in the region, found that the statute of the environmental impact of these factories are concentrated primarily in the contamination of both surface and underground water sources, and deteriorating water quality in the absence of sewerage systems and treatment plants, which led to an acceleration of scarcity and lack of water resources, where disposal of industrial wastewater in the region without being subjected to any controls, and acted directly to the Barada River and to the public sewer system without resorting to any form of primary treatment, or are remnants of water drainage and industrial installations directly to the lands.
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Water Pollution in The Barada River Basin

Water Sector

The Ministry of Irrigation and its directorates are responsible for administrating developing water resources, regular monitoring of surface and ground water quality and ensuring the availability of water resources for irrigation purposes. The ministry of irrigation is also responsible for controlling drilled wells, and for licensing future wells.

The Ministry of Agriculture and Agrarian reform is responsible for the economic uses of water for agriculture purposes. This include the provision of modern techniques for water savings, and cultivating crops with lower water demands.

The Ministry of Housing and Utilities is responsible for the drinking water distribution networks in urban and rural areas and for domestic waste water treatment.

The Ministry of Local Administration and Environment is responsible for monitoring and controlling water quality, and for issuing national standards for the protection of water resources.

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Institutional and Economic Instruments for Sustainable Water Management in the Mediterranean Region

Water Pollution in The Barada River Basin

Overview of the Institutional and Economic Settings in Syria

Governorates play an important role as offering services, especially for small local authorities, which do not have the necessary technical competence of their own. In each Governorate there is a *water authority*, which carries out water services in the whole governorate. Public companies under these authorities have been set up in cities, which have wastewater treatment plants. The number of these companies is increasing in line with the increase of the number of treatment plants.

The previous 4 ministries with ministry of health involved in carrying out chemical and biological analysis of ground and surface water resources in favor of the interest of these ministries.

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Institutional and Economic Instruments for Sustainable Water Management in the Mediterranean Region

Water Pollution in The Barada River Basin

Overview of the institutional and economic settings in Syria

The Tariff system:

	2001 – 2007		1/11/2007			
Sector	Previous Water Consumption Layer (m^3)	Previous Tariff Rate S.P./m3	Consumed water (m^3)	Tariff S.P./m^3	Sewage Rate as % from water tariff	Sewage Minimum and Maximum Tariff (S.P.)
Household	1-20	3=(0.04E)	1–15	2.5=(0.03E)	5%	
Household	21-30	4.5=(0.06E)	16–25	7=(0.09E)	10%	Min. 30=(0.42E)
Household	31-60	13.5=(0.19E)	26 – 40	15=(0.21E)	15%	Max. 530 = (7.46E)
Household	Over 60	19=(0.26E)	41-60	22=(0.3E)	20%	
Household			Over 61	30=(0.42E)		
Governmental agencies		8.5=(0.11E)		14=(0.19E)	55%	Min. 38=(0.53E) Max. Unlimited
Industrial, commercial and tourism sectors		22=(0.3E)		30=(0.42E)	40%	Min. 38 (0.53E) Max. Unlimited

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Institutional and Economic Instruments for Sustainable Water Management in the Mediterranean Region

Water Pollution in The Barada River Basin

Overview of the Institutional and Economic Settings in Syria

For Domestic Sector, and according to "Damascus City Water Establishment", the contributions of billing system cover 90% of operating costs. For Damascus countryside the numbers is around 40% of operating costs.

The cost of cubic metre of waste water processor is about 9 LS/m^3 (0.12 Euro).

Funding is obtained (the difference) from the public debt fund (Ministry of Finance).

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Water Pollution in The Barada River Basin

Overview of the Institutional and Economic Settings in Syria

For agriculture sector, the revenues are very limited; the farmers should pay a fix amount of money for each hectare every year, with disregarding to the kind of crops.

But in practice that's not happened, the farmers used to bring water from the river or from their own wells without pay anything, and the water price does not include in the agriculture products.

The role of beneficiary associations is completely absent,

The new water law focus in activation of this role, but that still not apply. The Water Users Associations are the ideal instrument to participate in the management of irrigation and water sector.

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Water Pollution in The Barada River Basin

Overview of the Institutional and Economic Settings in Syria

For legal industry establishments, they should pay 30 S.P. for each m^3, and 40% of their total bill for wastewater treatment.

Many illegal industrial workshops in the basin, most of them are using water from the household network and pay only the minimum tariff, and some of them use the river water.

According to the industry wastewater, nothing can recover the cost. The main wastewater treatment plant in Adra City, is just ready to deal with household wastewater, not industrial wastewater. For many times the work of this plant stop completely because the waste and wastewater of industry.

Also, there no distinction between the type or method of industries. i.e. Coca-Cola factories, cement...

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Water Pollution in The Barada River Basin

Other Water Management Problems

Lack of integration of functions between authorities.

Deficient application of economic instruments.

Lack of efficient monitoring systems.

Negligence of the role of beneficiaries in water management

Multiplicity of authorities and overlaps in the allocation of responsibilities among the different parties.

Lack of communication and data exchange between policy and decision makers.

Failure of the present policy to achieve capacity building in the water sector.

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Water Pollution in The Barada River Basin

Stakeholders

Ministries and Governorates Authorities:
Ministry of Irrigation, Ministry of Agriculture, Ministry of Housing, Ministry of Local Administration and Environment, Ministry of Industry, Ministry of Tourism, Ministry of Finance, State Planning Commission, Ministry of Health.
Damascus Governorate, Damascus Countryside Governorate.

Other Scientific Bodies:
General Board for Water Resources (New), Higher Institute for Water Management (New), Atomic Energy Commission of Syria, Supreme Council of Sciences.

NGO's:
Syrian Environment Association, Damascus Friends Association, Sustainable Development Association, Women Union.

Beneficiaries:
Farmers, Industries, Chambers of Commerce, Industries and Tourism, Mayors of Municipalities.

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Institutional and Economic Instruments for Sustainable Water Management in the Mediterranean Region

Water Pollution in The Barada River Basin

List of New Laws Related to Water Sector

Reference	Content	Implementation Status
Establishment of the Higher Institute for Water Management Legislative decree No. 27 for the year 2007. Dated: 13/4/2007	The tasks of HIWM: • Undertaking research and scientific experiments. • Designing and implementing training programs. • Reforming technical resources in the ministries involved in water management. • Providing of technical and scientific assistance. • Cooperating with local, Arab and foreign societies for water-related research and studies, training, post-graduate studies and exchange of information and experience. • Providing PhD studies and degrees in the field of water management.	New decree, HIWM is currently being launched.
Water legislation Law No. 31 for the year 2005. Dated: 16/11/2005	• Definition and arrangement of all rights on water resources. • Regulation of the use of State water networks and infrastructure. • Procedures for the licensing of well and borehole drilling and the exploitation of pumping equipment. • Penalties for destruction, sabotage, dissents and water theft. • Implementation of water police (a committee for identifying law offences). • Organization of water assessments and surveys by the State. • Establishment of Water Users Associations.	It is considered comprehensive, but not fully effected because the Government granted a "grace" period to industries and the owners of illegal wells and boreholes to comply with the law.

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Institutional and Economic Instruments for Sustainable Water Management in the Mediterranean Region

Water Pollution in The Barada River Basin

List of New Laws Related to Water Sector

Reference	Content	Implementation Status
Establishment of the "General Board for Water Resources" Legislative decree No. 90 for the year 2005 Dated: 29/9/2005	• Management, development and protection of water resources in all river basins of the Syria. • Supervision of investments and control of water resources and water infrastructure in all river basins. • Formulation of strategies for executing the adopted water policy, for ensuring the comprehensive and sustainable development of water resources. • Identification of ways of further exploiting water resources, under the coordination of specialized Ministries and other institutions. • Formulation of mechanisms and options for exploiting water resources in a way that protects all river basins, with the coordination/collaboration with other, relevant Ministries. • Exploitation, maintenance and development of projects and water infrastructure, definition of standards for assessments, implementation and supervision of commissioning and operation of facilities. • Training and education of technical staff within and outside the country, in cooperation and coordination with various scientific boards to achieve the targets of the HIWM. • Proposal of relevant legislation needed for the implementation of HIWM tasks, etc.	
The Environment Law No. 50 for the year 2003.	• Identified the standards and the maximum limits of Pollution Parameters for discharge in the water environment	

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Water Pollution in The Barada River Basin

Current Efforts for Improve Water Management

The Syrian government is working on several important projects in order to improve the water quality of Barada Basin

The new legislation requires that tanning manufactures move from the river vicinity to the new industrial area of Adra (in northern Damascus). But...

Discussion is going on to find a good incentives to move many workshops and factories to the Adra Industrial City.

The State, with support from different International Agencies has undertaken a good initiative for monitoring water resources in the region, (Surface and groundwater quality), a good database for automatic water analysis is launched under the responsibility of Ministry of Irrigation.

A plan to develop Adra wastewater treatment plant in order to make it ready to deal with industrial wastewater, and improve the out of this treatment plant..

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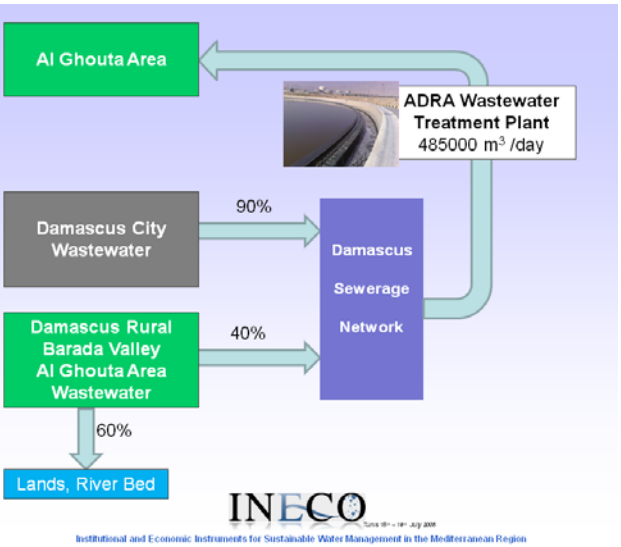
Water Pollution in The Barada River Basin



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Water Pollution in The Barada River Basin

Currently Applied Institutional and Economic Instruments

A program for construction 30 small wastewater treatment plants in Damascus rural (around the river basin), in order to assure a clean flow of the water In the riverbed and treat all the wastewater before arriving to the river.

The government took decisions to push the farmers to use the modern technologies for irrigation.

Non-interest loan for the farmers to move into modern irrigation technologies.

The Environmental Law and Water Law are very important steps to draw the legal framework for all other efforts.

The new water tariff is also good step to push people to save water.

The government try to activate the Water Users Associations, the new water law open the road to establish such associations but till now there role is completely absent.

The 10th five years plan (2006-2010) draw a good short and long term road map to achieve IWRM.

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Institutional and Economic Instruments for Sustainable Water Management in the Mediterranean Region

Water Pollution in The Barada River Basin

Currently Applied Institutional and Economic Instruments

The Establishment of the "Higher Institute for Water Management" is a very important step in order to undertaking research and scientific experiments, designing and implementing training programs, reforming technical resources in the ministries involved in water management, providing of technical and scientific assistance, post-graduate studies and exchange of information and experiences. Providing PhD studies and degrees in the field of water management.

Many awareness campaigns had took place in order to increase the awareness of farmers for many subjects, such as: modern irrigation methods, the dangers of using polluted water, nitrates effects, the excessive application of fertilizers and pesticides…

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Water Pollution in The Barada River Basin

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Water Pollution in The Barada River Basin
INECO Participatory process and outcomes
The INECO Workshop in Syria was held at September 10th 2007 with 54 participants from various ministerial departments, governmental agencies, regional authorities and NGOs.
The workshop aimed at strengthening the alliance between the INECO Project Team and Local Stakeholders, by providing a platform for constructively engaged dialogue on the mitigation of water pollution of the Barada River.
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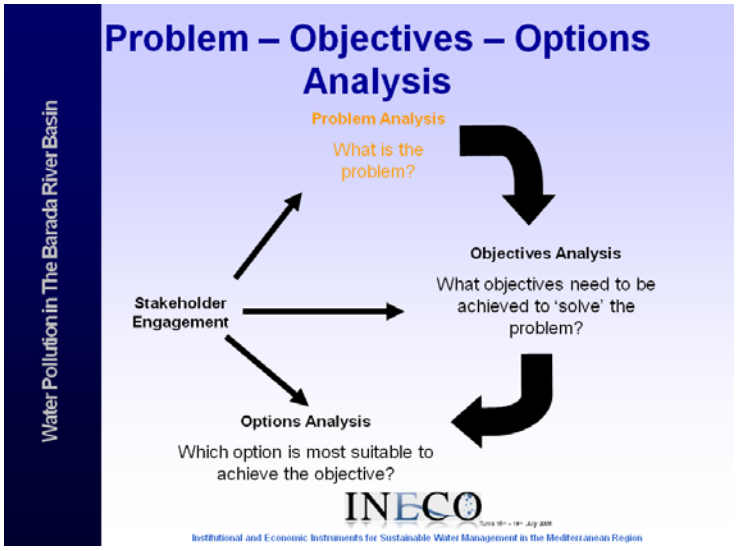
Water Pollution in The Barada River Basin
Problem – Objectives – Options Analysis
Problem Analysis
What is the problem?
Objectives Analysis
What objectives need to be achieved to 'solve' the problem?
Stakeholder Engagement
Options Analysis
Which option is most suitable to achieve the objective?
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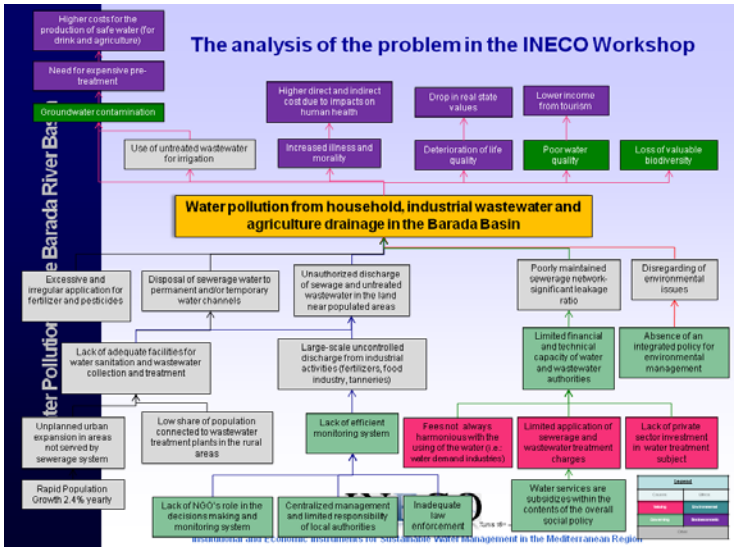
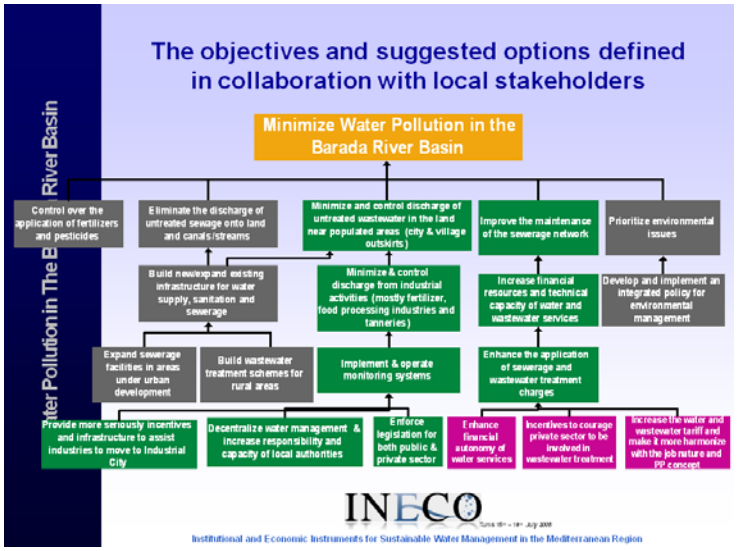

The analysis of the problem in the INECO Workshop
Higher costs for the production of safe water (for drink and agriculture)
Need for expensive pre-treatment
Groundwater contamination
Higher direct and indirect cost due to impacts on human health
Drop in real state values
Lower income from tourism
Use of untreated wastewater for irrigation
Increased illness and morality
Deterioration of life quality
Poor water quality
Loss of valuable biodiversity
Water pollution from household, industrial wastewater and agriculture drainage in the Barada Basin
Excessive and irregular application for fertilizer and pesticides
Disposal of sewerage water to permanent and/or temporary water channels
Unauthorized discharge of sewage and untreated wastewater in the land near populated areas
Poorly maintained sewerage network-significant leakage ratio
Disregarding of environmental issues
Lack of adequate facilities for water sanitation and wastewater collection and treatment
Large-scale uncontrolled discharge from industrial activities (fertilizers, food industry, tanneries)
Limited financial and technical capacity of water and wastewater authorities
Absence of an integrated policy for environmental management
Unplanned urban expansion in areas not served by sewerage system
Low share of population connected to wastewater treatment plants in the rural areas
Lack of efficient monitoring system
Fees not always harmonious with the using of the water (i.e.: water demand industries)
Limited application of sewerage and wastewater treatment charges
Lack of private sector investment in water treatment subject
Rapid Population Growth 2.4% yearly
Lack of NGO's role in the decision-making and monitoring system
Centralized management and limited responsibility of local authorities
Inadequate law enforcement
Water services are subsidizes within the contents of the overall social policy


Water Pollution in The Barada River Basin
The objectives and suggested options defined in collaboration with local stakeholders
Minimize Water Pollution in the Barada River Basin
Control over the application of fertilizers and pesticides
Eliminate the discharge of untreated sewage onto land and canals/streams
Minimize and control discharge of untreated wastewater in the land near populated areas (city & village outskirts)
Improve the maintenance of the sewerage network
Prioritize environmental issues
Build new/expand existing infrastructure for water supply, sanitation and sewerage
Minimize & control discharge from industrial activities (mostly fertilizer, food processing industries and tanneries)
Increase financial resources and technical capacity of water and wastewater services
Develop and implement an integrated policy for environmental management
Expand sewerage facilities in areas under urban development
Build wastewater treatment schemes for rural areas
Implement & operate monitoring systems
Enhance the application of sewerage and wastewater treatment charges
Provide more seriously incentives and infrastructure to assist industries to move to Industrial City
Decentralize water management & increase responsibility and capacity of local authorities
Enforce legislation for both public & private sector
Enhance financial autonomy of water services
Incentives to courage private sector to be involved in wastewater treatment
Increase the water and wastewater tariff and make it more harmonize with the job nature and PP concept
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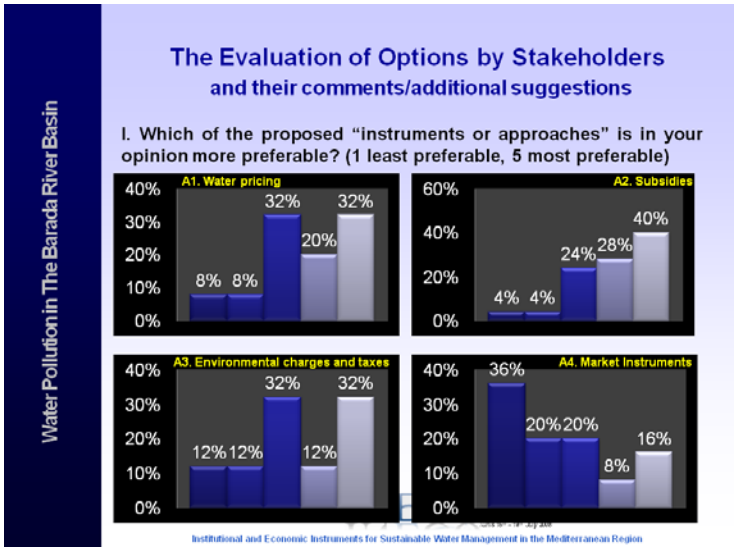
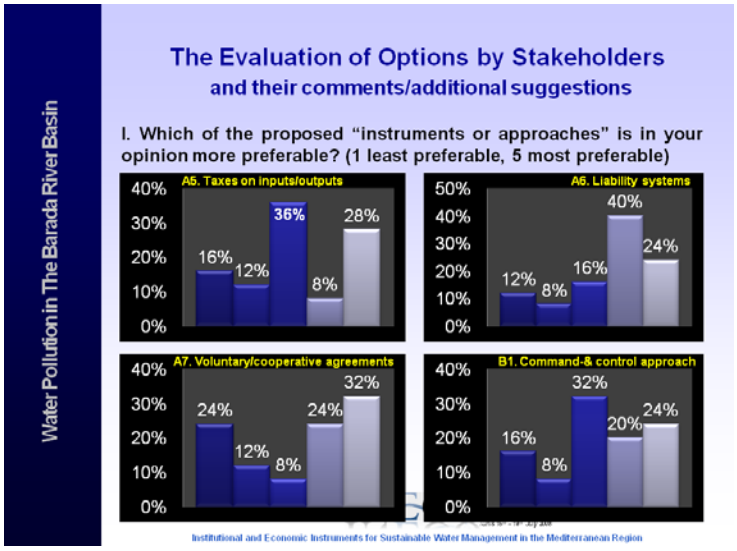
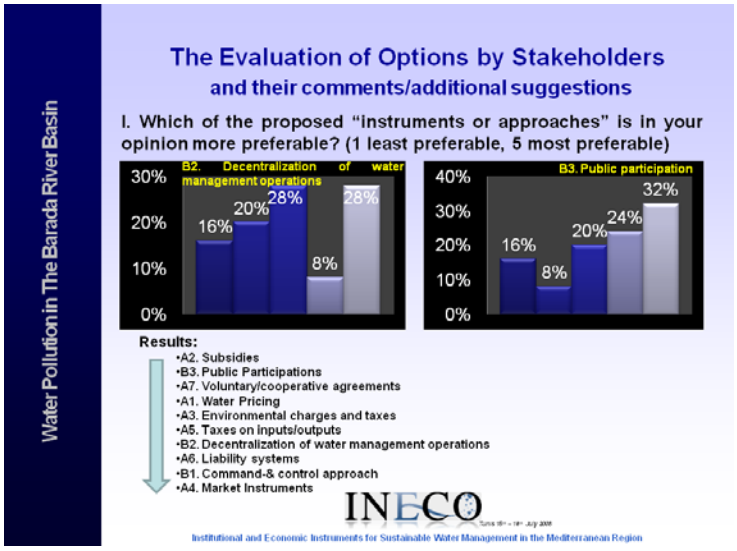

Water Pollution in The Barada River Basin
The Evaluation of Options by Stakeholders and their comments/additional suggestions
I. Which of the proposed "instruments or approaches" is in your opinion more preferable? (1 least preferable, 5 most preferable)
A1. Water pricing
8% 8% 32% 20% 32%
A2. Subsidies
4% 4% 24% 28% 40%
A3. Environmental charges and taxes
12% 12% 32% 12% 32%
A4. Market Instruments
36% 20% 20% 8% 16%
Institutional and Economic Instruments for Sustainable Water Management in the Mediterranean Region


Water Pollution in The Barada River Basin
The Evaluation of Options by Stakeholders and their comments/additional suggestions
I. Which of the proposed "instruments or approaches" is in your opinion more preferable? (1 least preferable, 5 most preferable)
A5. Taxes on inputs/outputs
16% 12% 36% 8% 28%
A6. Liability systems
12% 8% 16% 40% 24%
A7. Voluntary/cooperative agreements
24% 12% 8% 24% 32%
B1. Command-& control approach
16% 8% 32% 20% 24%
Institutional and Economic Instruments for Sustainable Water Management in the Mediterranean Region


Water Pollution in The Barada River Basin
The Evaluation of Options by Stakeholders
and their comments/additional suggestions
I. Which of the proposed "instruments or approaches" is in your opinion more preferable? (1 least preferable, 5 most preferable)
B2. Decentralization of water management operations
30%
20%
10%
0%
16%
20%
28%
8%
28%
B3. Public participation
40%
30%
20%
10%
0%
16%
8%
20%
24%
32%
Results:
•A2. Subsidies
•B3. Public Participations
•A7. Voluntary/cooperative agreements
•A1. Water Pricing
•A3. Environmental charges and taxes
•A5. Taxes on inputs/outputs
•B2. Decentralization of water management operations
•A6. Liability systems
•B1. Command-& control approach
•A4. Market Instruments
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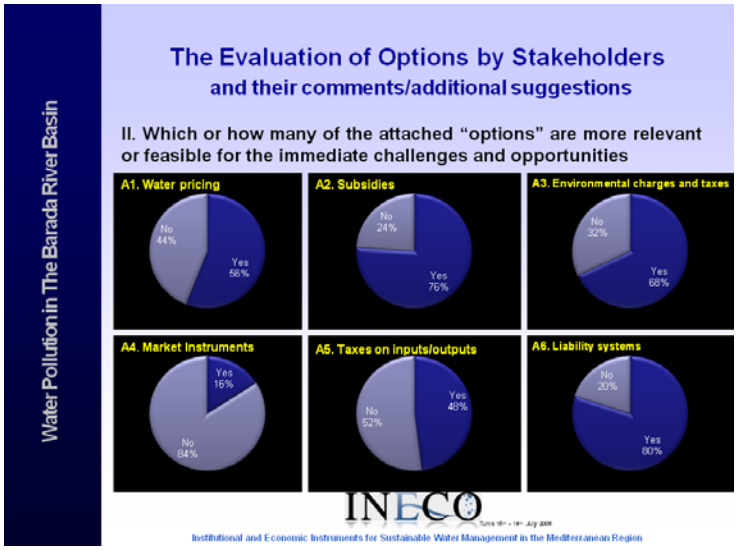
Water Pollution in The Barada River Basin
The Evaluation of Options by Stakeholders
and their comments/additional suggestions
II. Which or how many of the attached "options" are more relevant or feasible for the immediate challenges and opportunities
A1. Water pricing
No 44%
Yes 56%
A2. Subsidies
No 24%
Yes 76%
A3. Environmental charges and taxes
No 32%
Yes 68%
A4. Market Instruments
Yes 16%
No 84%
A5. Taxes on inputs/outputs
Yes 48%
No 52%
A6. Liability systems
No 20%
Yes 80%
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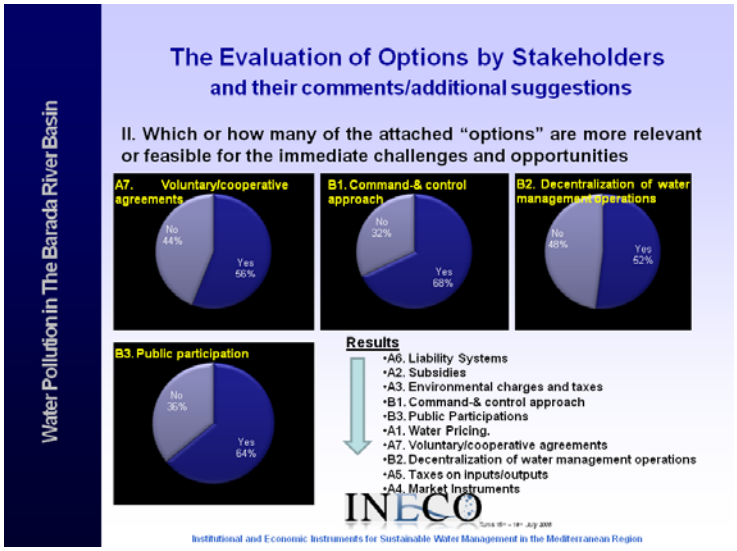
Water Pollution in The Barada River Basin
The Evaluation of Options by Stakeholders
and their comments/additional suggestions
II. Which or how many of the attached "options" are more relevant or feasible for the immediate challenges and opportunities
A7. Voluntary/cooperative agreements
No 44%
Yes 56%
B1. Command-& control approach
No 32%
Yes 68%
B2. Decentralization of water management operations
No 48%
Yes 52%
B3. Public participation
No 36%
Yes 64%
Results
•A6. Liability Systems
•A2. Subsidies
•A3. Environmental charges and taxes
•B1. Command-& control approach
•B3. Public Participations
•A1. Water Pricing.
•A7. Voluntary/cooperative agreements
•B2. Decentralization of water management operations
•A5. Taxes on inputs/outputs
•A4. Market Instruments
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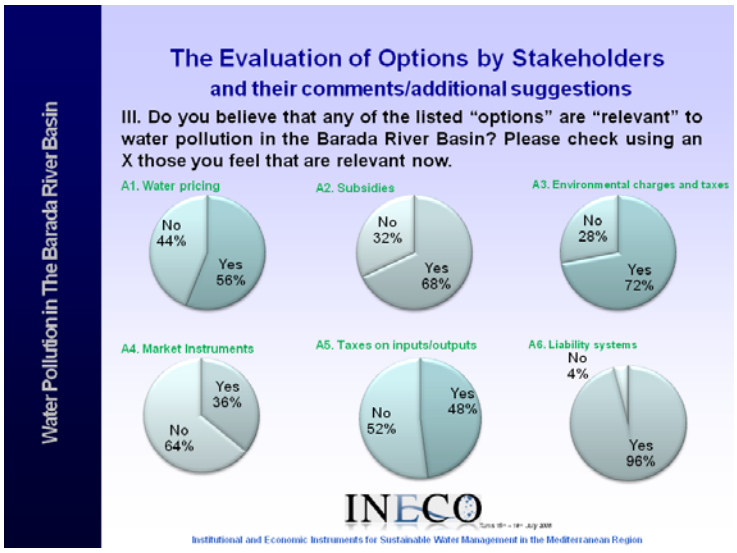
Water Pollution in The Barada River Basin
The Evaluation of Options by Stakeholders
and their comments/additional suggestions
III. Do you believe that any of the listed "options" are "relevant" to water pollution in the Barada River Basin? Please check using an X those you feel that are relevant now.
A1. Water pricing
No 44%
Yes 56%
A2. Subsidies
No 32%
Yes 68%
A3. Environmental charges and taxes
No 28%
Yes 72%
A4. Market Instruments
Yes 36%
No 64%
A5. Taxes on inputs/outputs
Yes 48%
No 52%
A6. Liability systems
No 4%
Yes 96%
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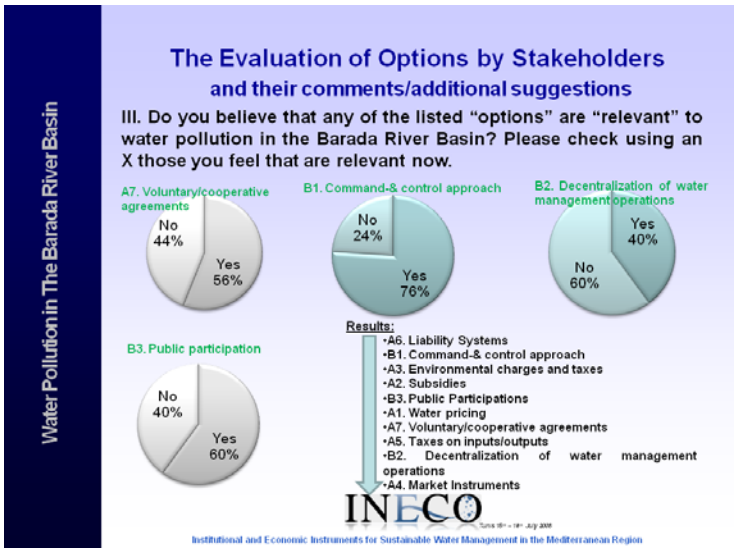
Institutional and Economic Instruments for Sustainable Water Management in the Mediterranean Region


Water Pollution in The Barada River Basin
The Evaluation of Options by Stakeholders
and their comments/additional suggestions
III. Do you believe that any of the listed "options" are "relevant" to water pollution in the Barada River Basin? Please check using an X those you feel that are relevant now.
A7. Voluntary/cooperative agreements
No 44%
Yes 56%
B1. Command-& control approach
No 24%
Yes 76%
B2. Decentralization of water management operations
Yes 40%
No 60%
B3. Public participation
No 40%
Yes 60%
Results:
•A6. Liability Systems
•B1. Command-& control approach
•A3. Environmental charges and taxes
•A2. Subsidies
•B3. Public Participations
•A1. Water pricing
•A7. Voluntary/cooperative agreements
•A5. Taxes on inputs/outputs
•B2. Decentralization of water management operations
•A4. Market Instruments
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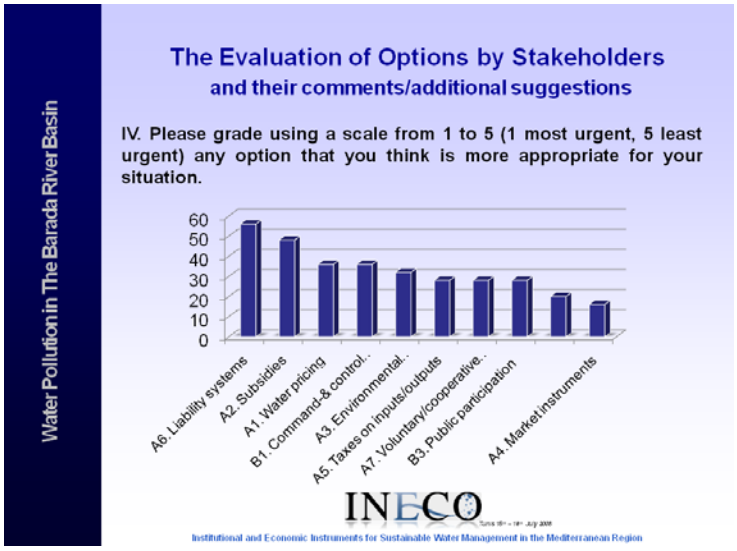
Water Pollution in The Barada River Basin
The Evaluation of Options by Stakeholders
and their comments/additional suggestions
IV. Please grade using a scale from 1 to 5 (1 most urgent, 5 least urgent) any option that you think is more appropriate for your situation.
60
50
40
30
20
10
0
A6. Liability systems
A2. Subsidies
A1. Water pricing
B1. Command-& control..
A3. Environmental..
A5. Taxes on inputs/outputs
A7. Voluntary/cooperative..
B3. Public participation
A4. Market instruments
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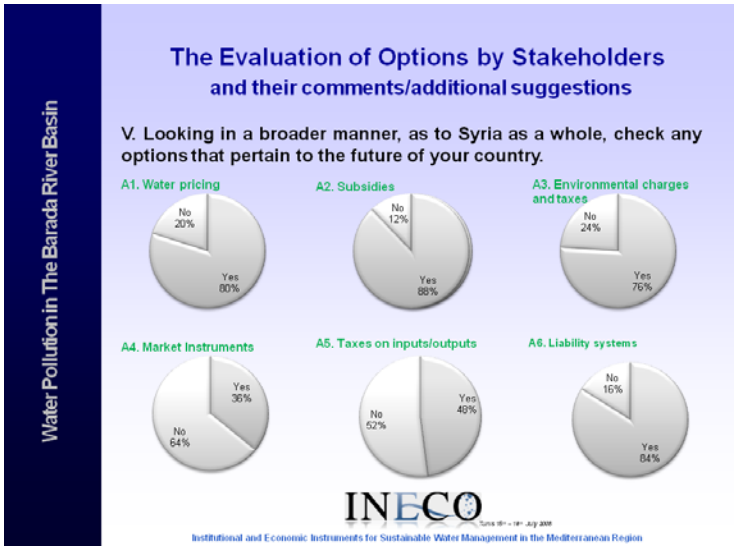
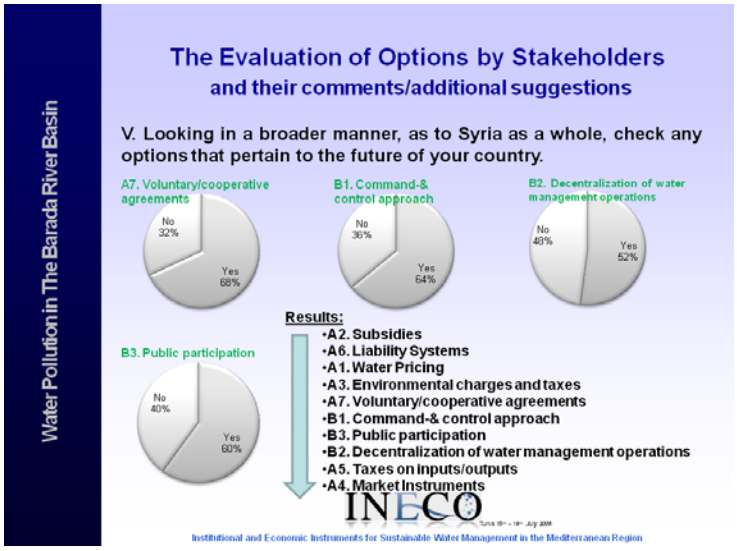

Water Pollution in The Barada River Basin
The Evaluation of Options by Stakeholders
and their comments/additional suggestions
V. Looking in a broader manner, as to Syria as a whole, check any options that pertain to the future of your country.
A1. Water pricing
No 20%
Yes 80%
A2. Subsidies
No 12%
Yes 88%
A3. Environmental charges and taxes
No 24%
Yes 76%
A4. Market Instruments
Yes 36%
No 64%
A5. Taxes on inputs/outputs
No 52%
Yes 48%
A6. Liability systems
No 16%
Yes 84%
INECO
Institutional and Economic Instruments for Sustainable Water Management in the Mediterranean Region


Water Pollution in The Barada River Basin
The Evaluation of Options by Stakeholders
and their comments/additional suggestions
V. Looking in a broader manner, as to Syria as a whole, check any options that pertain to the future of your country.
A7. Voluntary/cooperative agreements
No 32%
Yes 68%
B1. Command-& control approach
No 36%
Yes 64%
B2. Decentralization of water management operations
No 48%
Yes 52%
B3. Public participation
No 40%
Yes 60%
Results:
•A2. Subsidies
•A6. Liability Systems
•A1. Water Pricing
•A3. Environmental charges and taxes
•A7. Voluntary/cooperative agreements
•B1. Command-& control approach
•B3. Public participation
•B2. Decentralization of water management operations
•A5. Taxes on inputs/outputs
•A4. Market Instruments
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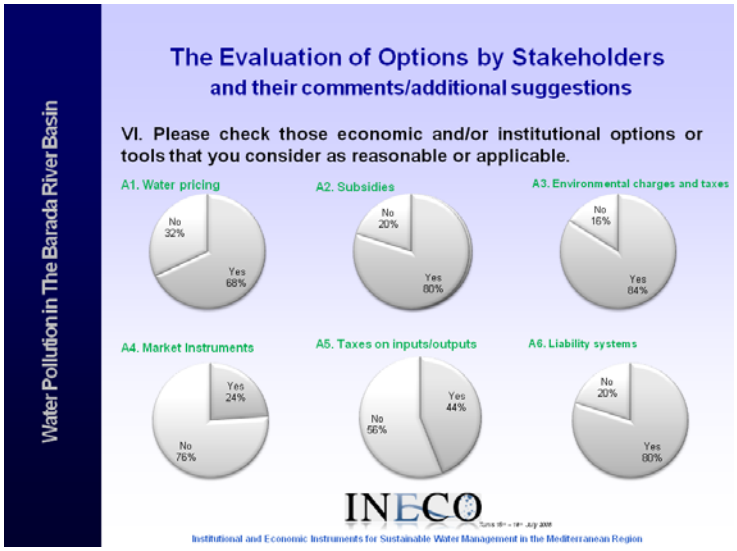
Institutional and Economic Instruments for Sustainable Water Management in the Mediterranean Region


Water Pollution in The Barada River Basin
The Evaluation of Options by Stakeholders
and their comments/additional suggestions
VI. Please check those economic and/or institutional options or tools that you consider as reasonable or applicable.
A1. Water pricing
No 32%
Yes 68%
A2. Subsidies
No 20%
Yes 80%
A3. Environmental charges and taxes
No 16%
Yes 84%
A4. Market Instruments
Yes 24%
No 76%
A5. Taxes on inputs/outputs
Yes 44%
No 56%
A6. Liability systems
No 20%
Yes 80%
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Water Pollution in The Barada River Basin

The Evaluation of Options by Stakeholders and their comments/additional suggestions

VI. Please check those economic and/or institutional options or tools that you consider as reasonable or applicable.

A7. Voluntary / cooperative agreements

B1. Command-& control approach

B2. Decentralization of water management operations

B3. Public participation

Results:

- A3. Environmental charges and taxes
- A6. Liability Systems
- A2. Subsidies
- A1. Water Pricing
- B1. Command-& control approach
- B3. Public Participations
- B2. Decentralization of water management operations
- A5. Taxes on inputs/outputs
- A7. Voluntary / cooperative agreements
- A4. Market Instruments

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Water Pollution in The Barada River Basin

Analysis of the Results

According to analyzing of stakeholders:

Topic	A1	A2	A3	A4	A5	A6	A7	B1	B2	B3
Instruments more preferable	7	10	6	1	5	3	8	2	4	9
More relevant or feasible for the immediate challenges and opportunities	5	9	8	1	2	10	4	7	3	6
Relevant to water pollution in the Barada River Basin	5	7	8	1	3	10	4	9	2	6
More appropriate for our situation.	8	9	6	1	5	10	4	7	2	3
Options that pertain to the future of Syria	8	10	7	1	2	9	6	5	3	4
Instruments consider as reasonable or applicable	7	8	10	1	3	9	2	6	4	5
Total	40	53	45	6	20	51	28	36	18	33

A2. Subsidies.
A6. Liability Systems.
A3. Environmental charges and taxes.
A1. Water Pricing.
B1. Command-& control approach.
B3. Public Participations.
A7. Voluntary / cooperative agreements.
A5. Taxes on inputs/outputs.
B2. Decentralization of water management operations.
A4. Market Instruments.

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Water Pollution in The Barada River Basin

Proposals for Improving the Water Management in Barada River Basin

Subsidies:

To create more incentives to courage industrials to move to Industrial City.

Assuring water, electricity, and wastewater treatment in good prices in the industrial city.

Encourage businesses to invest in water-efficient equipment to help reduce their water use and improve water quality.

Good incentives for the modern irrigation companies, and find a way to facilitate the technology transfer in this field, in addition to courage these companies to organize many awareness campaign in order to assuring the knowledge transfer to the farmers.

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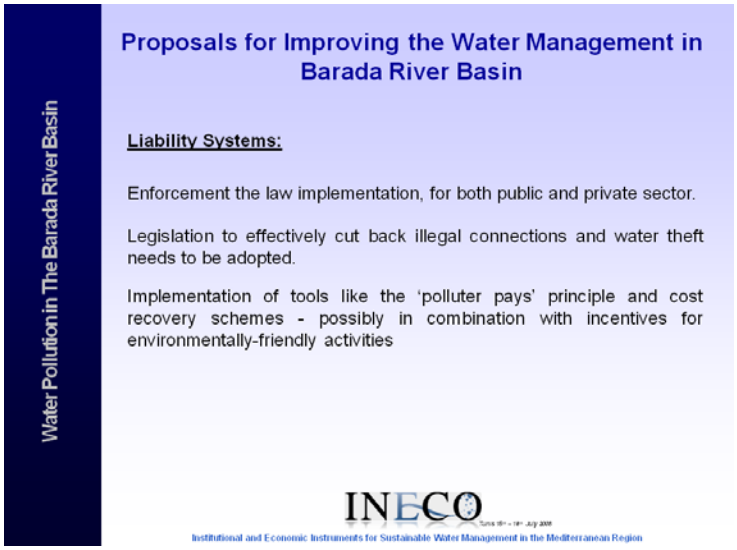
Water Pollution in The Barada River Basin
Proposals for Improving the Water Management in Barada River Basin
Liability Systems:
Enforcement the law implementation, for both public and private sector.
Legislation to effectively cut back illegal connections and water theft needs to be adopted.
Implementation of tools like the 'polluter pays' principle and cost recovery schemes - possibly in combination with incentives for environmentally-friendly activities
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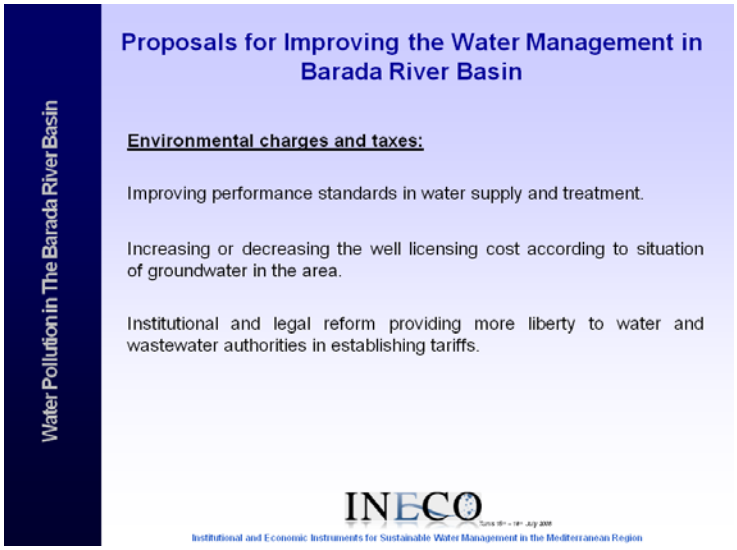
Water Pollution in The Barada River Basin
Proposals for Improving the Water Management in Barada River Basin
Environmental charges and taxes:
Improving performance standards in water supply and treatment.
Increasing or decreasing the well licensing cost according to situation of groundwater in the area.
Institutional and legal reform providing more liberty to water and wastewater authorities in establishing tariffs.
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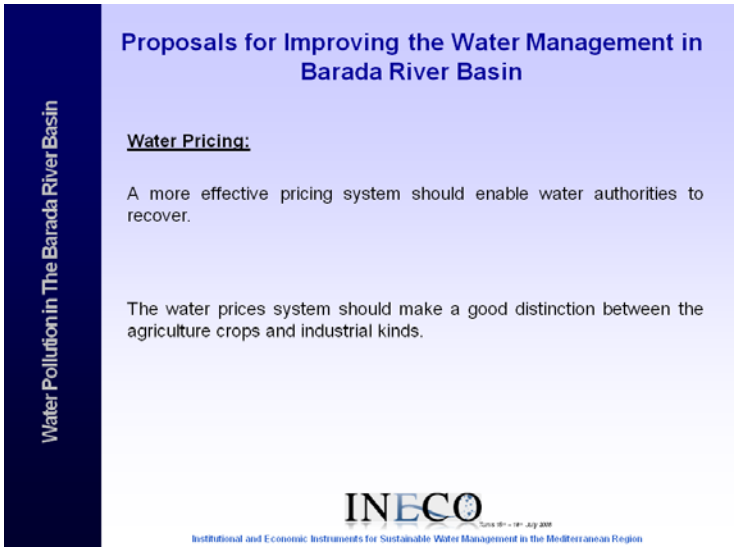
Water Pollution in The Barada River Basin
Proposals for Improving the Water Management in Barada River Basin
Water Pricing:
A more effective pricing system should enable water authorities to recover.
The water prices system should make a good distinction between the agriculture crops and industrial kinds.
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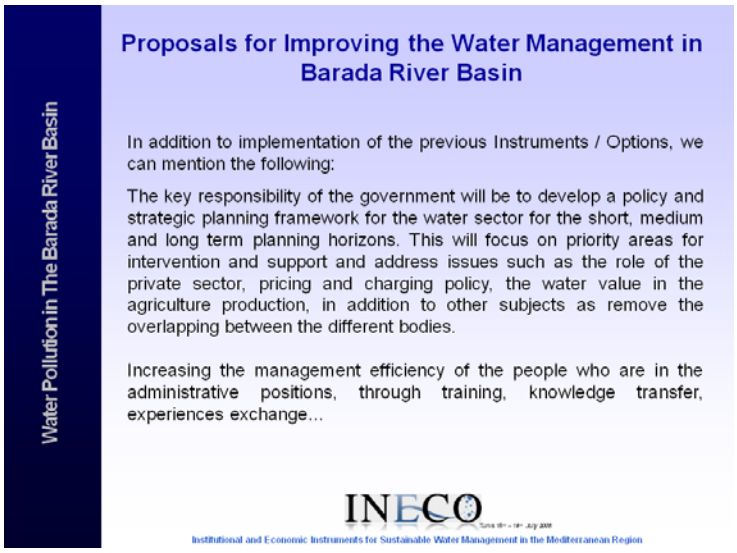
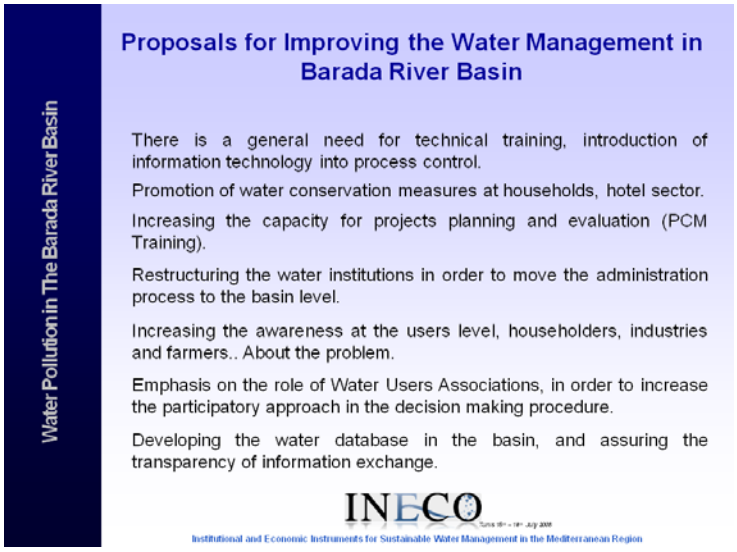

Water Pollution in The Barada River Basin
Proposals for Improving the Water Management in Barada River Basin
In addition to implementation of the previous Instruments / Options, we can mention the following:
The key responsibility of the government will be to develop a policy and strategic planning framework for the water sector for the short, medium and long term planning horizons. This will focus on priority areas for intervention and support and address issues such as the role of the private sector, pricing and charging policy, the water value in the agriculture production, in addition to other subjects as remove the overlapping between the different bodies.
Increasing the management efficiency of the people who are in the administrative positions, through training, knowledge transfer, experiences exchange…
INECO
Institutional and Economic Instruments for Sustainable Water Management in the Mediterranean Region


Water Pollution in The Barada River Basin
Proposals for Improving the Water Management in Barada River Basin
There is a general need for technical training, introduction of information technology into process control.
Promotion of water conservation measures at households, hotel sector.
Increasing the capacity for projects planning and evaluation (PCM Training).
Restructuring the water institutions in order to move the administration process to the basin level.
Increasing the awareness at the users level, householders, industries and farmers.. About the problem.
Emphasis on the role of Water Users Associations, in order to increase the participatory approach in the decision making procedure.
Developing the water database in the basin, and assuring the transparency of information exchange.
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Water Pollution in The Barada River Basin
Other INECO Activities
Many meetings had took place with the stakeholders: Ministry of Irrigation, Ministry of Housing (Damascus City Water Establishment), Ministry of Local Administration and Environment (Water Directorate), Ministry of Agriculture (Agriculture Research Centre), Ministry of Industry, Ministry of Tourism, Damascus Governorate, Damascus Countryside Governorate, Mayors, Farmers, industrialists, NGOs as Syrian Environment Association , Damascus Friends Association, Sustainable Development Association, Women Union…
In order to record the sufferings of this river, the INECO project team visited most of the villages situated along the river bed, and met some farmers and industrialists. He also photographed and make a video movie for many of the contaminated phenomena existing.
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Water Pollution in The Barada River Basin

Other INECO Activities

According to the dissemination, the INECO team provide Media with many newspaper articles about the problem, in addition to several TV and Radio interviews.

The INECO project team distributed 1000 bookmark calendar to different bodies with a cartoon photo to explain the problem and invite all to handle their responsibility.

The INECO Project team distributed CD's with a lot of information, photos, presentation about the problem for different bodies.

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Institutional and Economic Instruments for Sustainable Water Management in the Mediterranean Region

Water Pollution in The Barada River Basin

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Institutional and Economic Instruments for Sustainable Water Management in the Mediterranean Region


Water Pollution in The Barada River Basin
Thank you
Malek Al Haddad
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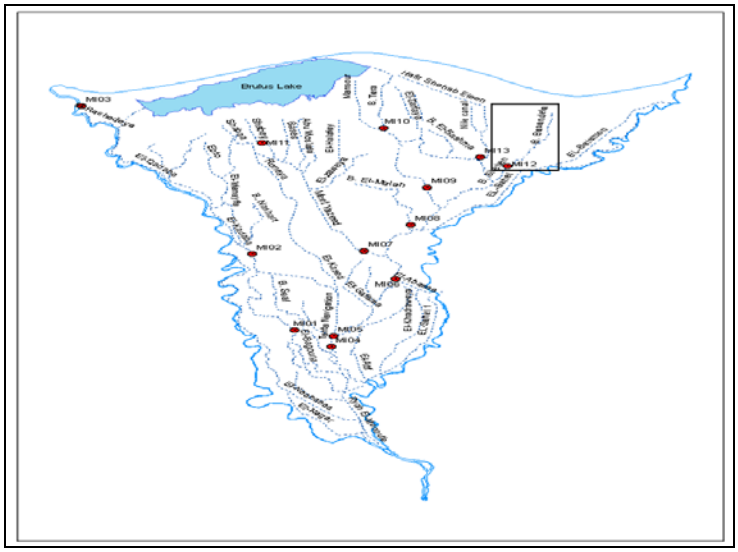
Institutional and Economic Instruments for Sustainable Water Management in the Mediterranean Region

3.12 Water quality deterioration in the Bahr Basandeila Canal, Egypt and associated drinking water quality issues

Dr. F. El Gamal, Water Management Research Institute



Important Information (Governorate level)

Water Supply :

- Population is about 5 million inhabitants
- Population growth rate is about 1.9 %
- Daily production of water supply company 1 million m3
- Drinking water supply is about 200 liters / capita /day
- Losses from water supply network is about 50 %
- Cost of drinking water varies according to the consumption and the uses activity. It ranged from 5cent/m3 for housing to 20 cent for industrial production.

Important Information (Governorate level)

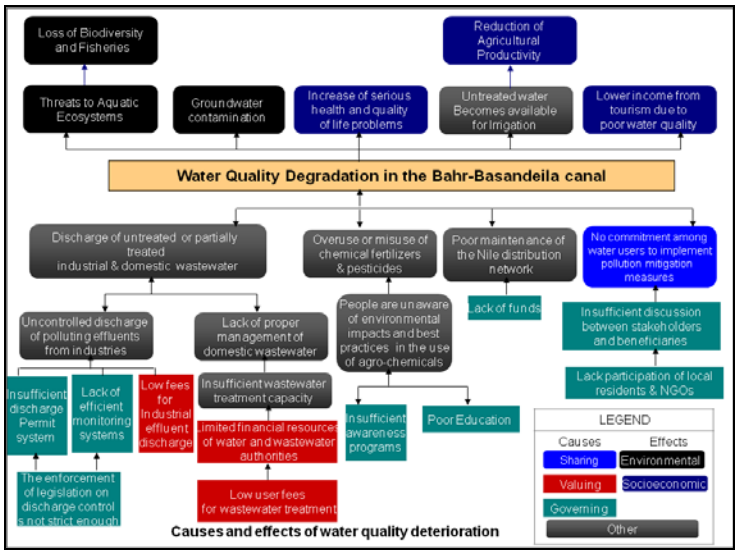
Sewerage network coverage:

- Population served by sewerage network is about 30 %
- Population served by septic tanks and open drains is about 70 %
- Only about 25 % of Waste water is treated
- In the last 25 years, about $ 900 millions is located for carrying out sewerage network projects ($ 200 / person).
- The cost have been recovered completely.

Problem:

Deterioration of Canal Water

- **Problem analysis after the stakeholder validation workshop (problem tree)**



Causes and effects of water quality deterioration

Causes of water quality degradation

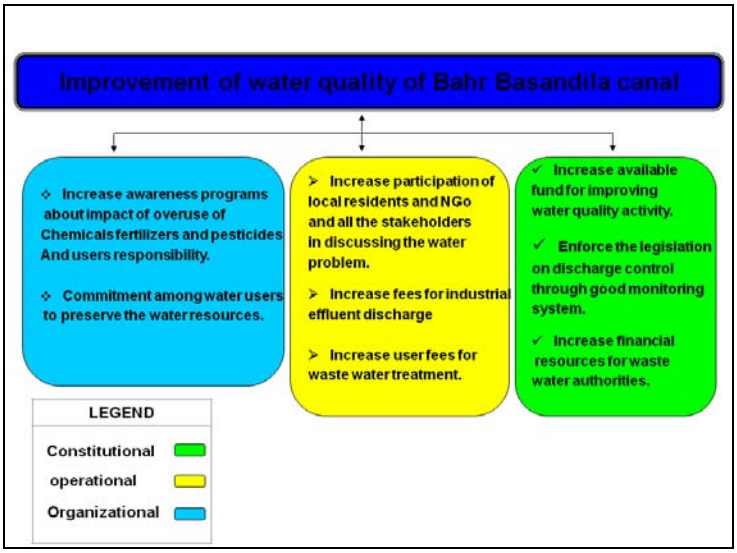
Water pollution is mostly due to:

- **Discharge of Industrial and municipal effluents without proper treatment.**
- **Excessive application of chemical fertilizers and pesticides.**
- **Lack of appropriate infrastructure for waste water treatment.**
- **Limited awareness of farmers on best agriculture practices.**
- **Poor maintenance of the drinking water supply system.**

Objectives

Improvement of water quality of Bahr Basandila canal through (principal policy):

- Control the discharge of untreated industrial effluents
- Control the use of chemical fertilizers and pesticides
- Proper maintenance of the drinking water supply system.
- Improvement of the quality of water services provided to drinking water supply reliability and safety and sanitation
- Commitment among water users to implement pollution mitigation measures and community empowerment



Developed Indicators:

The developed indicators are relevant to the causes and effects of the problem analysis:

Potential Indicators

To monitor the discharge of untreated waste water into the canal, the following indicators have been measured:

Coliform, Fecal, BOD, COD, DO and nitrate to measure the impact on crop quality, human health and fish production.

Potential Indicators

To monitor the discharge of agriculture drainage water into the canal, the following indicators have been measured:

- Ze, MN, Fe, CU, Adj SAR, EC and PH to measure the impact on crop production an the deterioration of agriculture land.

Pollution in Bahr Basandeila Canal

- Pollution in Bahr Basandeila Canal is due to Sewage wastewater.
- Pollution from Agriculture Drainage Water in water quality is still limited.
- Pollution from industrial effluents has no effect in water quality.

Recommendations of the stakeholder workshops

- Increase applied research in the field of water and health .
- Work to raise awareness of water among all classes of people so as to rationalize water consumption
- Make contact with the executive bodies to reduce industrial pollution to the Nile River water
- Maintain groundwater against pollution through rationalization of the use of pesticides, fertilizers and chemicals in the agricultural field
- Cooperation with international and civil societies to reach a cup of clean water fit for the use of human, animal and agriculture.
- Doing analytical studies to study the relation between water pollution and reproductive health problems in men

Recommendations of the stakeholder workshops

A- Applying demand management approach in different sectors.

- **Increasing the area in which irrigation improvement project is carried out.**
- **Using modern methods of irrigation instead of flood irrigation in old lands and new methods of irrigation in new lands.**
- **reusing of industrial wastewater within industry field.**
- **reusing of wastewater after processing.**
- **Reducing losses from drinking water network.**

B- Keeping water resources from pollution.

C- Increasing awareness of all sectors of society to change and improve users' behavior and focusing on the role of woman's since the main reason of pollution is users behavior.

D- Enforce the law

E- Increasing the sharing of Urban Society, People's Assembly and religious and cultural forums in efficient water use and Keeping water from pollution.

F- Suggestion of applying simple substitutes for water purification in places in which there are no water networks.

Questionnaire

Evaluation of the applicability of economic and institutional Instruments:

The following Instruments are most preferable

- Decentralization of water management operations
- Public participation in water management
- Water pricing was the least preferable

Evaluation of the applicability of economic and institutional Instruments:

- The term water pricing is not acceptable at the private level, the use of cost recovery is more appropriate in case of Egypt
- The volumetric pricing is used only for drinking water (water supply)
- The liability system is exist but not enforced (environmental regulation and legislation)

Pollution control on a national level

- **Bahr Basandeila canal is a representative for most of our irrigation network.**
- **Pollution is a national problem**
- **Pollution is not always a result of an increased input of matter, but can also result from a decrease in the quantity of diluting water.**

National water resources plan 2017

Sources of pollution:

Domestic sources (waste water)

- Construction of water supply networks without parallel construction of new sewage systems or rehabilitation of the existing one.

Agricultural sources (salts, agrochemical residues from fertilizers, pesticides, herbicides

Industrial sources (waste water without treatment)

National water resources plan 2017

- Finding solutions (water quality policy)

The pollution control activities are:

Prevention, reduction, treatment and impact modification.

Finding a compromise between the interests of socio-economic activities that cause pollution and the need for a good water quality to protect human health and the environment.

National water resources plan 2017

Policy objectives for the strategy of water quality are:

- Improvement of water related public health conditions
- Sustainable use of ground water resources
- Meet the water quality requirements of the various functions of the water ways.

National water resources plan 2017

To achieve these goals the following priorities and principles were applied:

- Based on precautionary principle, measure should be aimed at preventing emissions, or treatment or finally controlled emission can be considered.
- Every polluter is responsible for his emissions (polluter pay principle)

National water resources plan 2017

- Pollution problem should not passed from one region to another down stream in the water system
- Measures that do not rely on institutional or legal changes are preferred on the short term.

Summary of measures on Municipal and Industrial water

Demand management

- Install/rehabilitate metering system and apply progressive tariff structure
- Initiate public awareness campaign to reduce wasteful use of water
- Promote the application of water saving technologies in industry through incentives

Reduction of losses

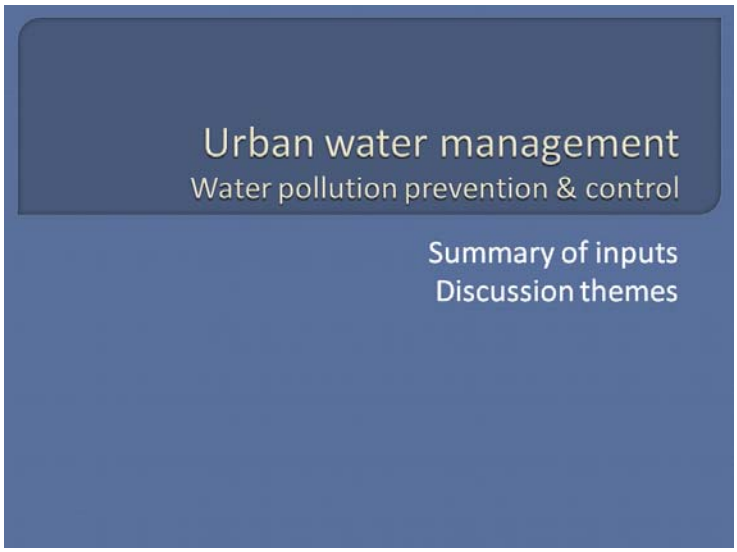
- Reduce leakage losses through leak detection and repair based on priorities for the most urgent rehabilitation work
- Reduce other losses through repair/installation of metering system

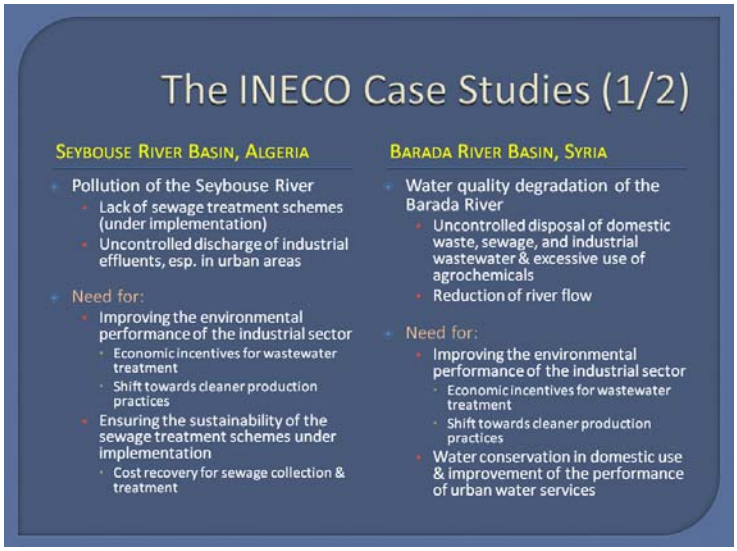
Reuse of treated wastewater

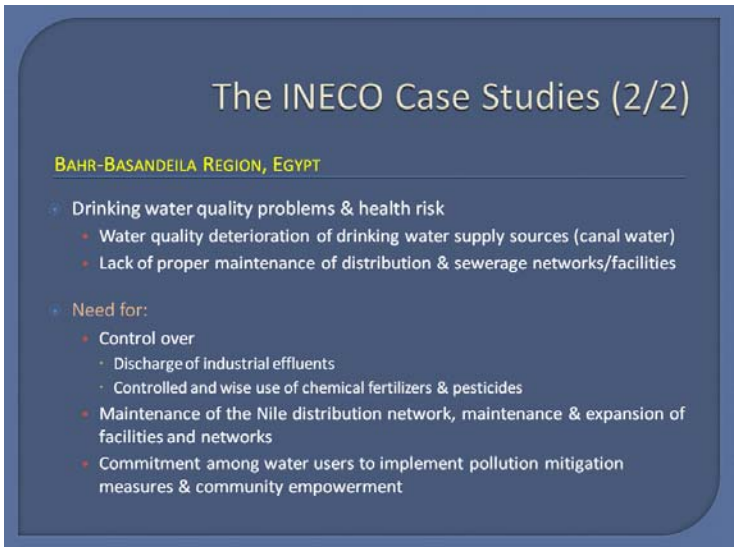
- Carry out feasibility studies, including environmental impact assessment for reuse of treated wastewater in the New Industrial Cities and the Canal Cities

Thanks

3.13 Urban water management and Water pollution prevention and control – A summary of inputs from the Algeria, Syria and Egypt Case Studies







Summary of Suggested Options (1/2)

Seybouse River Basin, Algeria

- Stricter discharge & technology standards for industries
  - Regular monitoring of discharges
- Effluent charge systems, Tradable permits
- Voluntary agreements, eco-labelling schemes
- Grants & incentives for industrial wastewater treatment
  - Relocation
  - Grants, subsidies, soft loans
- Training of industrial operators
- Awareness campaigning & participation

Barada River Basin, Syria

- Stricter discharge & technology standards for industries
  - Regular monitoring of discharges
- Effluent charge systems, Tradable permits
- Voluntary agreements with industries & farmers, eco-labelling schemes
- Grants & incentives for industrial wastewater treatment
  - Relocation incentives
  - Grants, subsidies, soft loans
- Reform of water pricing policies (cost recovery, incentives)
- Decentralization, institutional reform, awareness & participation

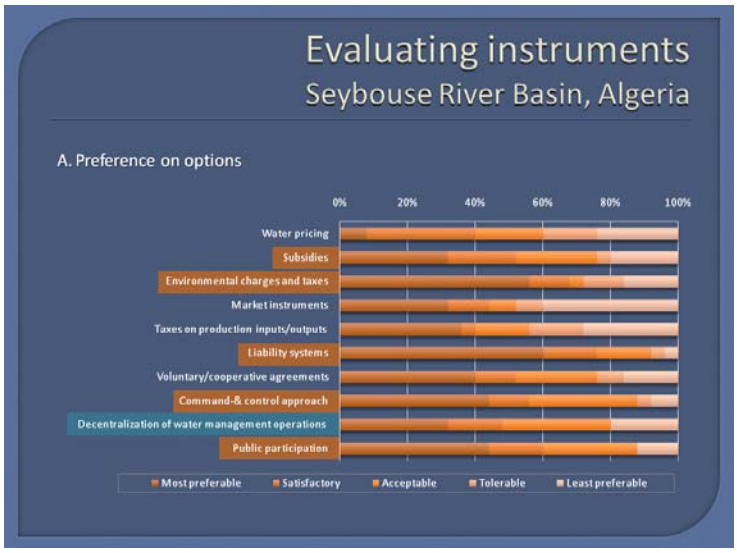
Summary of Suggested Options (2/2)

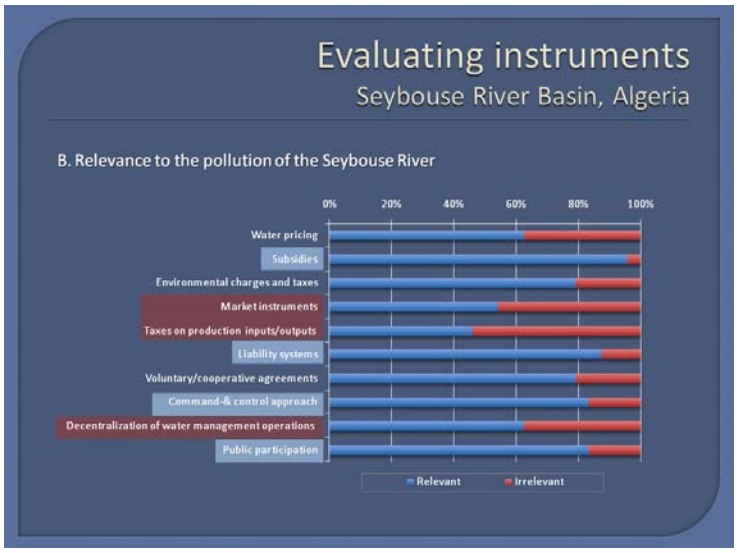
Bahr-Basandeila Region, Egypt

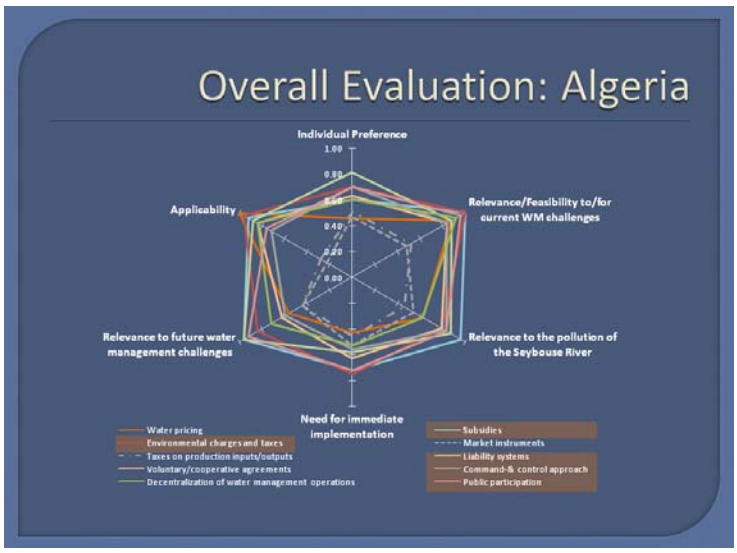
- Stricter discharge and technology standards for industries
- Effluent charge systems
- Voluntary agreements (industry & agriculture)
- Increased taxation of agricultural inputs (fertilizers & pesticides)
- Incentives for organic farming
- Reform of utility pricing policy
  - Cost recovery for water supply & sewage collection and treatment
- Community management for water supply and wastewater treatment in villages

Option Analysis
Seybouse River Basin, Algeria

- Limited availability of financial & monitoring data throughout the river basin
  - Infrastructure and possibly part of running costs are state-funded
- Discharge standards exist but technology standards for industrial processes have not been defined
- Effluent charges are introducible according to the overall institutional framework
  - The specific legislation has not been yet introduced
- Voluntary agreements have been introduced by the Ministry of the Environment
  - 5 industries out of 86 in the Seybouse River Basin have signed a contract
- Possible forms of grants offered to industries for wastewater treatment
  - Direct grant from the State
  - Exemption/reduction of pollution taxes, reduction of water taxes


Evaluating instruments
Seybouse River Basin, Algeria
A. Preference on options
0%
20%
40%
60%
80%
100%
Water pricing
Subsidies
Environmental charges and taxes
Market instruments
Taxes on production inputs/outputs
Liability systems
Voluntary/cooperative agreements
Command-& control approach
Decentralization of water management operations
Public participation
Most preferable
Satisfactory
Acceptable
Tolerable
Least preferable


Evaluating instruments
Seybouse River Basin, Algeria
B. Relevance to the pollution of the Seybouse River
0%
20%
40%
60%
80%
100%
Water pricing
Subsidies
Environmental charges and taxes
Market instruments
Taxes on production inputs/outputs
Liability systems
Voluntary/cooperative agreements
Command-& control approach
Decentralization of water management operations
Public participation
Relevant
Irrelevant

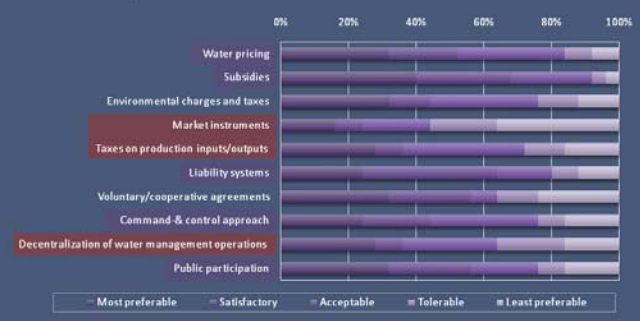

Overall Evaluation: Algeria
Individual Preference
Relevance/Feasibility to/for current WM challenges
Relevance to the pollution of the Seybouse River
Need for immediate implementation
Relevance to future water management challenges
Applicability
Water pricing
Environmental charges and taxes
Taxes on production inputs/outputs
Voluntary/cooperative agreements
Decentralization of water management operations
Subsidies
Market instruments
Liability systems
Command-& control approach
Public participation

Option Analysis
Barada River Basin, Syria

- Establishment of the "Water Police" in 2005, with the aim to monitor violations on environmental legislation
  - Enforcement remains inadequate (dispersion of many small-scale industries)
  - Further "grace" periods provided for compliance with environmental legislation
- Incentives to small industries are considered inadequate
  - The installation of wastewater treatment facilities for tanneries (a major source of pollution) would impact on competitiveness
  - Industries require further incentives to relocate to industrial areas but the Government considers that the difference in land prices would cover the relocation cost
- Urban water pricing recovers almost fully operating costs
  - Tariffs are considered low and provide little incentive for conservation
  - Sewerage charges cover only a small share of sewage collection & treatment costs

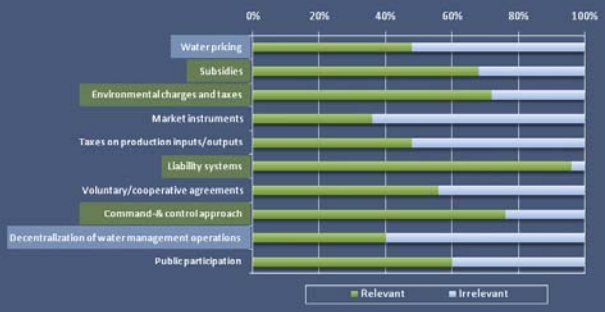
Evaluating instruments
Barada River Basin, Syria

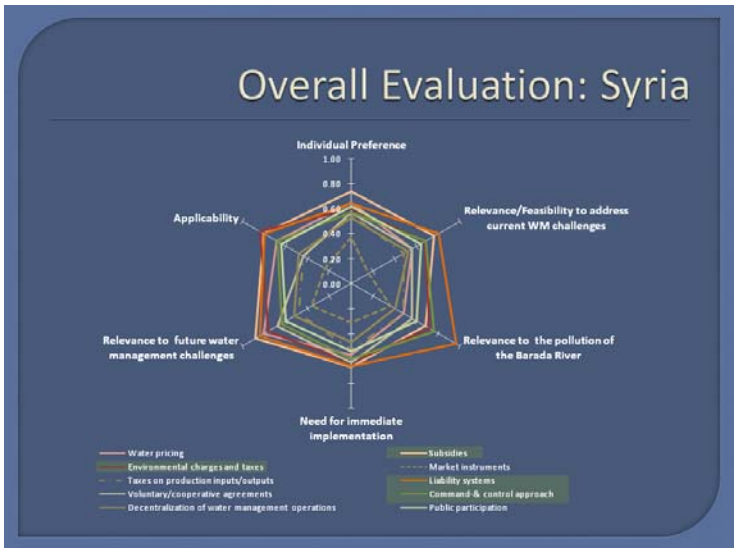
A. Preference on options



Evaluating instruments
Barada River Basin, Syria

B. Relevance to the pollution of the Barada River




Overall Evaluation: Syria
Individual Preference
1.00
0.80
0.60
0.40
0.20
0.00
Relevance/Feasibility to address current WM challenges
Relevance to the pollution of the Barada River
Need for immediate implementation
Relevance to future water management challenges
Applicability
Water pricing
Environmental charges and taxes
Taxes on production inputs/outputs
Voluntary/cooperative agreements
Decentralization of water management operations
Subsidies
Market instruments
Liability systems
Command & control approach
Public participation


Discussion themes
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

Annex I: List of workshop participants

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	Name	Country	Affiliation	e-mail
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32	Samy El Fellaly	Egypt	SWERI, MALR	escc@link.com.eg
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34	Jihen Ghiloufi	Tunisia	Agence d'urbanization grand Tunis	
35	Salwa Louzir	Tunisia	CITET	

Annex II: Event poster

INECO

Institutional and Economic Instruments for
Sustainable Water Management in the Mediterranean Region
Project website: http://environ.chemeng.ntua.gr/ineco

Stakeholder Assembly Workshop

Discussing alternative instruments for improved water management in the Mediterranean Basin

15th-16th July 2008
Tunis International Centre for Environmental Technologies, Tunisia

INECO is a Coordination Action Project supported by the European Commission through the 6th Framework Programme, and addressing the "Specific Measures in Support of International Cooperation (INCO Programme) - Mediterranean Partner Countries (MPC)" Priority (Contract No: INCO-CT-2006-517673)

SIXTH FRAMEWORK PROGRAMME

Annex III: Workshop flier and Agenda

WORKSHOP PROGRAMME

Tuesday, 15th July 2008

Session 1: Introduction

9:00 Welcome & Introduction: The INECO Workshop Scope and expected outcomes *Prof. D. Assimacopoulos, INECO Project Coordinator*

9:30 Information exchange, participation & networking for sustainable water management, *Mr. D. Valensuela, International Network of Basin Organizations*

09:45 Evaluating current & potential institutional and economic options at the INECO Case Studies: Context and Methodology, *Prof. A. Massarutto, IEFE, Italy*

10:15 Coffee Break

Session 2: Presentation & discussion on the INECO Case Study Outcomes - Focus on River Basin Management

10:30 Water stress in the Damour River Basin, Lebanon, *Mr. C. Tabbal, Conseil et Développement s.a.l.*

11:15 Enhancing efficiency in irrigation water use in the Oum Er Rbia Basin, Morocco, *Mr. A. Affia, ISKANE Ingenieria*

12:00 Discussion panel on proposed options for the Lebanon & Morocco case studies

13:00 Lunch Break

14:30 Groundwater exploitation in Pegeia, Cyprus, *Dr. I. Glekas, Aeoliki Ltd*

15:15 Groundwater overexploitation in Tunisia , *Mr. A. Bouzid, CITET*

16:00 Discussion panel on proposed options for the Cyprus and Tunisia case studies

Wednesday, 16th July 2008

9:00 Link with first day outcomes, *Prof B. Barraqué, ENGREF & Prof. E. Vlachos, Colorado State University*

Session 3: Presentation & discussion on the INECO Case Study Outcomes - Focus on water quality management

9:15 Pollution of the Seybouse River, Algeria, *Mr. A. Bouchedja, Agence de Bassin Hydrographique de Constantinois-Seybouse-Mellegue, Algeria*

10:00 Pollution of the Barada River, Syria, *Mr. M. Haddad, Studies & Integration Consulting*

10:45 Coffee Break

11:00 Water quality deterioration in the Bahr Bazandeila Canal, Egypt and drinking water quality issues, *Prof. M. Abou Rayan, International Consultants Egypt*

11:45 Discussion Panel on proposed options for the Algeria, Syria and Egypt case studies

13:00 Wrap-up and conclusion, *Prof. D. Assimacopoulos, Prof. E. Vlachos, Prof. B. Barraqué*

13:30 *End of Workshop (Lunch)*

The INECO Consortium

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INECO

Institutional and Economic Instruments for Sustainable Water Management in the Mediterranean Region

Stakeholder Assembly Workshop

Discussing alternative instruments for improved water management in the Mediterranean Basin

15th-16th July 2008

Tunis International Centre for Environmental Technologies, Tunisia

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BACKGROUND
THE INECO CASE STUDIES

The INECO Project started in July 2006 with the objective to discuss shared problems in the decision-making process and the deficiencies of current water governance structures around the Mediterranean Basin. The research of INECO follows a case-study driven approach, focusing on alternative or improved institutional and economic instruments which can promote equity, economic efficiency and environmental sustainability with emphasis on the sharing and governance challenges.

The first year of the project focused on the analysis of governance frameworks and the selection of one significant water management issue (focal problem) in each of the countries analysed in INECO, Cyprus, Egypt, Tunisia, Lebanon, Syria, Algeria and Morocco. These focal problems, representative of the range of water management issues experienced around the Mediterranean Basin, constitute the INECO Case Studies. The analysed problems per country are:

- **Cyprus**: Increasing vulnerability of the Pegeia Aquifer (western part of Cyprus) due to the rapidly increasing residential and tourism demand and the lack of sewerage and wastewater treatment infrastructure. Groundwater resources are significantly degraded in several regions of Cyprus, as a result of many years of overabstraction, and are further associated with the inability of the current water management framework to promote the use of alternative supply sources, such as treated wastewater, institutional framework overlaps and inadequate legislation enforcement.
- **Tunisia**: Aquifer depletion and sea intrusion, mostly due to uncontrolled abstractions for irrigation purposes and the inadequacy of the presently applied alternatives and disincentives to groundwater overexploitation. The problem is further exacerbated by the lack of technical capacity in the agricultural sector, the limited application of water saving methods in irrigation and the current water-intensive cropping patterns.
- **Egypt**: Water quality deterioration in the region of the Bahr Basandeila Canal of the Dakahlia Governorate, where waste disposal, heavy use of pesticides, inadequate domestic wastewater treatment, and uncontrolled discharge of industrial effluents have transformed the open waterway to a repository and conveyor of liquid waste. The major water pollution issue, which is common in the entire Nile water distribution network, poses great risks for human health, agricultural production, and the river and coastal ecosystems.
- **Lebanon**: Increasing water stress for meeting domestic, agricultural and industrial water demands in the Damour River Basin, further exacerbated by upstream pollution, groundwater interbasin transfer, and lack of financial and technical capacity to address infrastructure requirements and enforce legislation.
- **Syria**: Water pollution in the Barada River Basin (Greater Damascus Area), due to the discharge of high loads of industrial and domestic waste and wastewater, which exceed the river's self purification capacity, and the decrease of river flow, resulting from rainfall decrease and 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.
- **Algeria**: Pollution of the Seybousse River, which receives large volumes of untreated industrial and domestic effluents posing both direct and indirect risk on human health, agricultural production and the river ecosystem.
- **Morocco**: Increasing water stress in the Oum Er Rbia Hydraulic Basin, resulting from increasing demand and inefficient water use in the agricultural sector, where high losses in irrigation distribution networks combined with the currently adopted irrigation practices (inefficient irrigation methods and water intensive, economically unsustainable cropping patterns) contribute to significant water waste.

The INECO methodology framework

THE INECO STAKEHOLDER ASSEMBLY WORKSHOP

The INECO Stakeholder Assembly Workshop follows from a series of individual workshops organized in each region analysed within INECO. These workshops had as objective to initiate the discussion on what the real and significant water management problems are and how these can be addressed in a desired water management situation, while at the same time achieving the widest possible consensus from all the parties concerned.

This participatory approach, also supported by individual consultation meetings and workshops, culminates with the Tunisia Stakeholder Assembly Workshop. The event brings together stakeholders from all the INECO Case Studies, with the following objectives:

- Present and evaluate the outcomes of the analyses undertaken during the 2nd year of INECO on the applicability of institutional and economic instruments in each Case Study;
- Share, exchange and integrate experience associated with the application of solutions across the Mediterranean Basin and assess the corresponding economic, environmental and social trade-offs;
- Derive recommendations for enabling the effective implementation of proposed instruments at both regional and national levels.