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AQUASTRESS: MITIGATION OF WATER STRESS THROUGH NEW APPROACHES TO INTEGRATING MANAGEMENT, TECHNICAL, ECONOMIC AND INSTITUTIONAL INSTRUMENTS - DEFINITION OF THE CASE STUDIES

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SUMMARY – Aqua Stress is a project funded by the EC within the 6th R&D Framework Program whose aim is to develop stakeholder and society driven holistic approach to mitigate water stress involving researches and stakeholders at different stages of the planning process. The Project is based on the conduct of research in eight test sites (Italy, Portugal, Poland, Bulgaria, The Netherlands, Tunisia, Morocco and Cyprus) where case studies have been developed that are relevant and representative of the European context. This paper provides an overview of the methodology utilized to identify relevant case studies in the eight test sites and describes the issues that are addressed in each of the case studies, highlighting the importance of integrating "technical" and "non technical" (including social and public participatory aspects and training) in the development of water stress mitigation strategies.

Key words: water stress, case study, stakeholders, public participation, interdisciplinary, mitigation options

INTRODUCTION

Overview

Water scarcity problems in many regions of the World, including south of Europe and Mediterranean countries, have threatened these regions' economies and the health and well being of the affected populations. An evaluation of the measures taken to combat water scarcity in these regions has revealed in the last years that projects based exclusively on the application of "technical" options have failed to satisfactorily mitigate water stress at the local, regional and global scale. To identify more effective solutions to mitigate water stress, the need has manifested itself of integrating, within the research, social and public participatory aspects, making stakeholders, citizens and policy makers the key actors to define appropriate solutions. This is the core assumption of AquaStress, a project funded by the EC within the 6th R&D Framework Program, whose aim is to develop stakeholder and society driven holistic approach to mitigate water stress involving researches and stakeholders at different stages of the planning process. This approach is in line with the European Water Framework Directive (WFD) guidelines and with the EU orientation prevailing in the acts of the Process of Lisbon (Commission of the European Communities, 2005), which emphasize the integration of environmental, economic, social and institutional dimension for the solution of water scarcity problems.

In line with the its interdisciplinary and inter-sector nature, Aqua Stress involves thirty-five partners, ranging from national research councils and universities to international organizations, SMes, NGOs and public bodies involved in water management. Objectives of the Project are the development of transferable guidelines aimed at harmonizing policy making at the local and regional scale, at providing more reliable options for responding to water stress across the EU and neighboring regions, and at creating new tools for problem diagnosis, prognosis and management of water stress. In line with its test site-driven approach, the research is being carried out in eight test sites (Italy, Portugal, Poland, Bulgaria, The Netherlands, Tunisia, Morocco and Cyprus) where case studies have been developed that are relevant and representative of the European context. In order to ensure that the

research is rooted in the local problems of the test sites, Local Stakeholder Fora have been instituted. At higher level, Stakeholder Council evaluates the Project choices, research and development.

This paper discusses the methodology used to develop case studies in the AquaStress project and provides a brief overview of the problems identified and research activities planned in each of the eight test sites.

Case Studies

A case study is a method of qualitative research, involving the in-depth examination of a single "instance" (such as an event, for example), rather than examining larger samples in their totality, in order to promote understanding of the dynamics that lead to the observed developments, while collecting data, analyzing information, and reporting the results in a systematic way. Case Studies promote the understanding of why the instance happened as it did, and what might become important to look at more extensively in future research

In the context of the present document, the examined Case Studies are "in-depth plans covering selected issues and possibly selected regions within a set of predefined Test Sites, by implementing specific Options, or combination of Options, in all or part of a Test Site, and offering integrated solutions coupling technical, economic, institutional, educational and social aspects". The selected approach aims at the testing of water stress mitigation options while ensuring the real involvement of local Stakeholders, through a set of Case Studies that distinguish between, and set off, the particular characteristics of the Test Site regions.

The Case Study definition phase, which was concluded in the second year of the Project, will be followed by implementation of the selected options in the Test Site regions. The implementation of the Case Studies in the Test Sites is the responsibility of multi-disciplinary "Joint Work Teams", which combine local stakeholders with researchers and experts in the fields of the selected options and in the analysis, modeling and evaluation of results. The local stakeholders will also be involved in testing the overall acceptance of the selected approach and processes, as well as in monitoring the implementation process and ensuring the reliability of obtained results. The implementation results will be analyzed and evaluated, and the lessons learned will be integrated into guidelines for dissemination.

THE AQUASTRESS PROJECT CASE STUDY FRAMEWORK

Description of The General Content of a Case Study

The AquaStress Case Studies aim to serve as learning platforms to understand responses and impacts of different types and conditions of water stress, to refine the guidelines for water stress mitigation, and to develop policy recommendations. To that end, the Case Study objectives definition also focuses on integrating across common themes, from the local (Test Site) level towards broad horizontal axes:

- Sectorial issues (irrigation, domestic-industry)
- Water stress dimensions (quality, quantity, extreme events)
- Relevant policies and legislation (WFD, Climate change, CAP, IPPC)

An iterative process was utilized for the definition of the Case Studies, to be undertaken by the Joint Work Team members in collaboration with the Local Stakeholders, which can be summarized in three main Steps.

Step 1. Definition of the overall Case Study objectives, ensuring consistency with European policies, legislation and sustainability criteria (WFD, Climate change, CAP, IPPC) and focusing on integrating across common themes, from the local level towards broad horizontal axes.

- Addressing the three main water using sectors (domestic, agriculture, industry) and the dimensions of water stress (quality, quantity, extreme events)

Step 2. Selection of water stress mitigation options to be applied in the Test Site

- Definition of assessment indicators and criteria for option evaluation
- Evaluation of the selected options (and their combinations) by the Local Public Stakeholder Forum members
- Option ranking according to the evaluation results
- Preliminary proposal for Options to be included in the Case Study (on the basis of ranking)

Step 3. Implementation and assessment of options

- Determination of the extent (or size where appropriate) of the application of each option and at each Test Site (the implementation of the same option may differ from site to site, as it has strong local character and depends on previous events)
- Training for the Local Public Stakeholders Fora on using tools, criteria, assessment of options and evaluating Case Study outcomes
- Implementation (field and/or virtual) of the options, undertaken by the JWTs and the LPSF Stakeholders
- Assessment of option impacts and synergies in the specific environment of the Case Study (using defined tools and indicators), and combinations of (new with old) options.

Iteration, where necessary, from Step 2 or 3

In order for a Case Study to be suitable for implementation at a Test Site, it should exhibit the following characteristics:

- It should present some degree of innovation compared to traditional practices in the region
- It should offer potential for the evaluation of the selected water stress mitigation options under the specific conditions of the Test Site
- Its implementation in the region/Test Site should be feasible (technically & institutionally)
- It should be acceptable to the local public
- It should promote the involvement of stakeholders in its implementation
- It should exhibit European relevance and offer potential towards:
    - Generating guidelines consistent with the Water Framework Directive and other EU policies
    - Yielding paradigms of water stress mitigation plan (or water management plans)
    - Creating a research added value of European dimension

The determination of Focal Problems and Options for their Mitigation

The term “options”, in the present context refers to measures adopted in order to combat water stress and to interventions employed for the mitigation of water stress. These include policy mechanisms, economic tools, administrative initiatives, participatory processes, and education and awareness efforts, and refer to cost-effective, broadly supported decisions for the sustainable management of water resources.

For the determination of the set of water stress mitigation options best suited to the circumstances of each of the Test Site regions, problem trees were constructed in order to determine the underlying causes and the Focal Problems faced in each of the eight regions. The construction of the problem tree aims at:

- Determining all the parameters that are affected by the water stress in the regions
- Providing an overview of and promoting the understanding of the cause and effect relationships that have resulted in the Focal Problem identified
- Providing a realistic view of the feasibility of solutions/available mitigation options

The Problem trees were constructed using the DPSIR (Drivers-Pressures-State-Impacts-Responses) and the Log Frame frameworks as a basis for the analysis. The choice of the

combination of the two methods was based on the wide range of indicators which had to be taken into consideration.

The Log Frame Analysis (LFA) is an analytical, presentational and management tool that can assist in the design, implementation and evaluation of development projects. It provides a structured, logical approach to analyzing existing problems and current situations, setting and prioritizing objectives, identifying potential risks in achieving the set objectives, determining the intended results and activities of a project, formulating a strategy and monitoring its implementation (AusGUIDE, 2003). It is undertaken in four distinct steps:

1. Situation Analysis: The analysis of the existing situation and the definition of objectives for addressing real needs, which includes stakeholder analysis and identification of current state, problem identification and analysis, and objective analysis.
2. Strategy Analysis: An analysis of alternatives for the most appropriate responses to the existing problems.
3. Project Planning Matrix: Development of the Project Planning Matrix based on the strategy analysis, and including the goals, purpose, inputs/activities, and outputs/results of the selected strategy.
4. Implementation: The operational phase which follows after the strategy formulation, and where response activities initiate, based on a plan of operations (IUCN, 1997).

The DPSIR framework (Fig.1) clearly defines pressures and management objectives, provides an evaluation of the state of waters and of impacts and consequences on the environment, and makes use of indicators, targeting the identification of viable options/responses/solutions to the problems. The approach is useful in describing the links between the origins and the impacts of environmental problems (Smeets & Weterinds, 1999). It identifies cause – effect relationships, allows the categorization of issues expressed through indicators, and provides flexibility for use, analysis, evaluation, and action implementation.

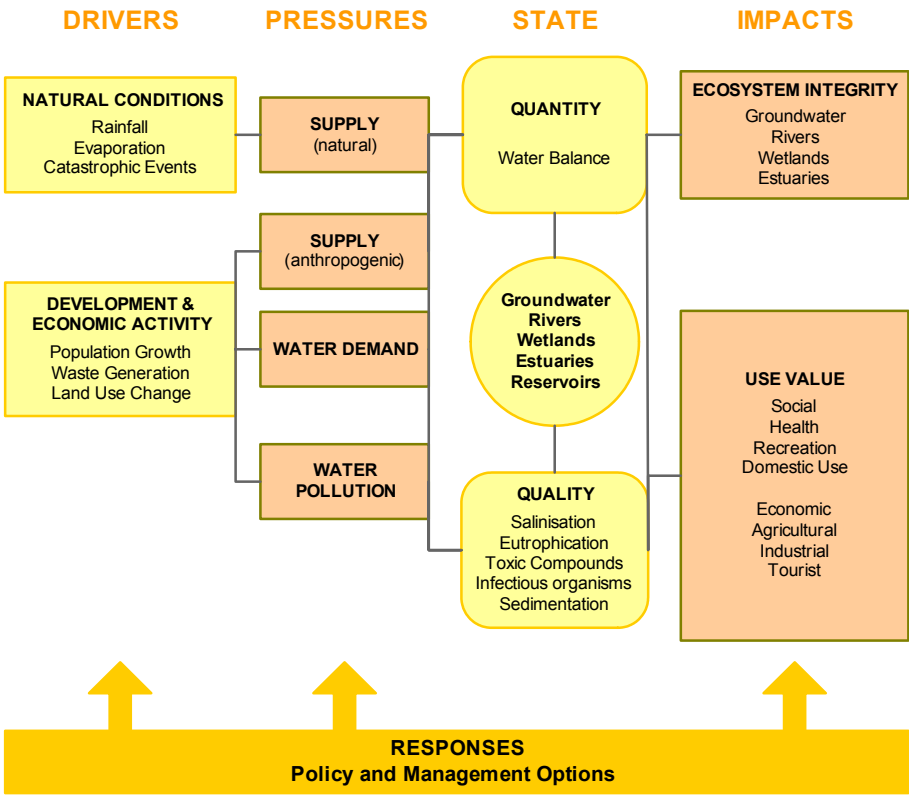

Fig. 1. The DPSIR framework (adapted from Walmsley, 2002)

The DPSIR indicator categories are:

- Driving Forces: The driving forces are expressed through indicators on natural conditions affecting water conditions, human influences in the water resources of region, social, demographic, and economic developments.
- Pressures: Pressures describe developments in release of pollutants to the water bodies, the use of water resources and land. Pressures are described through indicators to measure the natural supply of water to a catchment's area, the anthropogenic supply, water demand, and water pollution.
- State: The state of the environment in an area is directly affected by the driving forces and pressures, and the indicators to assess it are those addressing water quantity and quality issues.
- Impact: The changes in the state of the environment often have impacts on the water resources, and the social and economic functions. Indicators to assess impacts are related to ecosystem integrity, water use value, and the socio-demographic consequences.
- Responses: Responses refer to attempts by groups (and individuals) in the society, as well as governmental efforts to prevent, compensate, ameliorate or adapt to changes in the state of the water resources and conditions.

The indicators used in DPSIR analysis provide information on water management and system performance, set priorities in policy making and support policy development, monitor and evaluate effectiveness and efficiency of policy responses/instruments, and can be categorized as:

- Indicators on Water Stress (UNESCO, 2003; Plan Bleu, 1996; Department of Environmental Affairs and Tourism of South Africa, 1999)
- Indicators for the users' perception on water stress (and water allocation) as well as on acceptance of options (solutions)
- Indicators for evaluating Options.

The combined approach selected was successful in identifying focal problems in relation to water management, which were categorized into four major thematic areas:

- Environmental Considerations (resource depletion and ecosystem degradation)
- Social Considerations (including access to resources, water uses, and cost and its allocation to users)
- Development Considerations (including strategies, master plans and social priorities)
- Water Deficit.

Testing and Evaluation of Water Stress Mitigation Options

The process of Testing and Evaluation of the identified and selected water stress mitigation options is a central promise and an overall objective of the AquaStress Project. It involves two main components:

- Technical component: testing and evaluating the performance of water stress mitigation options, using specific performance indicators, under the specific conditions at the Case Study (local) level, and
- Public participation component: establishing the acceptance of the selected and applied options by the local Stakeholders (LPSF).

To that end, the Case Study activities that have been proposed are developed in two parallel axes, Public Participation and Training activities, aiming at the promotion of a New Water Culture in the Test Site regions, and Option Implementation activities, aiming at the testing of the selected water stress mitigation options under the prevailing local conditions, through the use of modeling tools and virtual implementation techniques in addition to actual implementation.

Summary of the AquaStress Case Studies

The AquaStress Case studies in the eight Test Sites, defined using the above discussed methodology, are the following:

- Guadiana, Portugal: Use and allocation of water resources among the agriculture, urban, and environmental sectors to maximize environmental, economic and social welfare in the Serpa-Mertola region
- Merguellil Valley, Tunisia: Improving water use efficiency in intensively irrigated areas of the Merguellil Valley
- Tadla, Morocco: Integrated and sustainable water management in Tadla
- Prsemsza, Poland: Adaptation of water management in the Przemsza catchment to meet the need of industrial transformation
- Iskar, Bulgaria: Decrease of the Water Exploitation Index in the Sofia region through improved industrial and urban water management and flood/drought prevention
- Flumendosa, Sardinia: Integrated and sustainable water management in the Flumendosa-Campidano Test Site
- Vecht, the Netherlands: Improvement of water management by the Velt en Vecht Water Board through participatory approach and water system analysis
- Cyprus: Decreasing groundwater overexploitation through the rationalization of the irrigation practices employed, and promoting the use of reclaimed water

CASE STUDIES ACTIVITIES OVERVIEW

The eight AquaStress Case Studies have foreseen a wide range of activities, in order to tackle different problems faced in each of the regions. As the regions examined present different geographical, climatological, and also political and economic conditions, the drivers of water stress also vary significantly.

In five of the eight regions, the problems faced are predominantly involved with the agricultural use of water for crop irrigation. The relative aridity of the Mediterranean regions and the dependence of most communities on local agricultural activities have resulted in increased exploitation of available freshwater resources for the irrigation of valuable crops, generally shifting from surface to groundwater towards the south.

Guadiana, Portugal

The Guadiana (Portugal) Case Study, summarized in *Table 1*, focuses on the balance of the agricultural demand with other uses while trying to determine options to promote sustainability in agricultural production and in the management of water resources.

Table 1. Guadiana Case Study: Use and allocation of water resources among the agriculture urban, and environmental sectors to maximize environmental, economic and social welfare in the Serpa -Mertola region

Activity	Rationalization and optimization of water resources use in the Case Study region	Technical options application and best practices for agriculture sustainability
Sub activities	➢ Case study region characterization ➢ Water quantity/quality evaluation ➢ Economic evaluation ➢ Evaluation of scenarios for wastewater reuse ➢ implementation, Assessment of sanitary risk of water reuse ➢ Implementation of training programmes ➢ WSM-DSS application ➢ Outcomes for dissemination ➢ Stakeholder involvement, T&D and complementary activities	➢ Agriculture water use: assessment and optimization of best practices ➢ Irrigation water management/ tailoring cropping patterns; investigation of Agricultural water demands and Performance indicators ➢ LPSF, T&D and complementary activities; Meetings, Workshops, Training and dissemination activities

Flumendosa (Sardinia) Italy

The Flumendosa (Italy) Case Study, summarized in *Table 2*, also aims at promoting integrated water resources management, while attempting to determine suitable methods for agricultural pollution reduction and overall sustainable levels for agricultural practices; the Case Study also incorporates flow rate modelling for the determination of optimal dam operation in dry seasons.

Table 2. Flumendosa Case Study: Integrated and sustainable water management in the Flumendosa-Campidano Test Site

Activity	Sustainable crop growth in the Campidano/ Fluminimannu basin: Determination of irrigation requirements to ensure sustainable agriculture	Research activities related to improvement of agricultural practices to decrease pollutants losses	Flow rates and dam operation during dry periods	Activities related to economic aspects	Training and Capacity building activities - Awareness, dissemination and communication activities
Sub activities	➢ Work plan formulation ➢ CRIWAR further development ➢ Data collection Model runs / Field testing activities ➢ Implementation of improved irrigation scenarios	➢ Discussion with stakeholders on water quality goals ➢ Data collection / management ➢ Group session with local farmers pilot group ➢ SWAT model environmental database setup ➢ Model Calibration / validation ➢ "Perceptual model" development ➢ Reporting and discussion with stakeholders ➢ Group session for perceptual model validation and discussion ➢ "Hot spots" identification ➢ Selection of BMPs for simulation ➢ Discuss viable BMPs with stakeholders ➢ Definition of procedures for motivation towards BMP adoption	➢ Literature review ➢ Investigation of suitable operation patterns ➢ Investigation of effects of different possible operation schemes to related sectors Identification of most suitable operation plans	➢ Economic analysis	➢ Workshops courses, dissemination events

Cyprus

The Cyprus Case Study, summarized in *Table 3*, centers on the mitigation of groundwater overexploitation, through the determination of options that can contribute to the rationalization of irrigation practices and to the promotion of alternative water resources for the coverage of irrigation water demand and for groundwater replenishment.

Table 3. Cyprus Case Study: Decreasing groundwater overexploitation through the rationalization of the irrigation practices employed, and promoting the use of reclaimed water

Activity	Decrease of Groundwater overexploitation through the rationalization of the irrigation practices employed	Promote the use of reclaimed water
Sub activities	➢ Analysis of Limassol groundwater basin ➢ Irrigation management and alternative water uses ➢ Economic dimension analysis ➢ Training and dissemination	➢ Reclaimed water ➢ GW replenishment by artificial recharge ➢ Training and dissemination ➢ Social dimension analysis ➢ Economic dimension analysis ➢ Public participation

Merguellil Valley (Tunisia)

In the Merguellil Valley (Tunisia) Case Study, summarized in *Table 4*, groundwater exploitation is again a focal point; water use in irrigation is approached from different angles, for the promotion of sustainable agricultural practices by attempting to determine optimal irrigation and land use patterns in combination with pricing.

Table 4. Merguellil Valley Case Study: Improving water use efficiency in intensively irrigated areas of the Merguellil Valley

Activity	Remote sensing and Spatial modelling techniques in assessing the GW flow	Irrigation System Performance and relation with groundwater yield assessment from collective to catchment scale	Improving the availability of high quality water at catchment scale by assessing different schemes of land use pattern and management	Efficient water pricing schemes and institutional settings	Methods for fostering the integration of women in agricultural water management
Sub activities	➢ Use of remote sensing data for inventory of irrigated crops ➢ Analysis of data ➢ Synthesis and operating data analysis ➢ Confirmation of results on basis of sampling ➢ Report and publication	➢ Data collection and survey ➢ Conceptualisation of infrastructure performance ➢ Meeting with local stakeholders ➢ Modelling and simulation of best system performance practices ➢ Results discussion with stakeholders ➢ Recommendations for improved practices ➢ Performance and water saving scenario simulation ➢ Provision of inputs for groundwater balance	➢ Discussion with stakeholders on quality goals ➢ Data collection / management ➢ Setup SWAT model environmental database ➢ Model Calibration / validation ➢ "Perceptual model" development ➢ Identification of pollution "hot spots" ➢ BMP selection for simulation ➢ Discuss viable BMPs with stakeholders ➢ Definition of procedures for motivation towards BMP adoption	➢ Water pricing survey (farmers) ➢ Pricing schemes discussion and evaluation in stakeholders forum	➢ Information collection from LPSF

Tadla (Morocco)

The Tadla (Morocco) Case Study, summarized in *Table 5*, also focuses on the integrated management of water resources in the region and on irrigation water demand management, and attempts to determine optimal levels of irrigation and crop growth for the promotion of sustainable agricultural practices.

Table 5. Tadla Case Study: Integrated and sustainable water management in Tadla

Activity	Collective Irrigation Projects	Sustainable crop growth and groundwater control to ensure sustainable agriculture	Irrigation performance assessment	Integrated management of groundwater and surface water
Sub activities	- Farmer group identification - Progress report on farm descriptions and farmer perceptions - Modernisation project identification with farmers - Role playing games testing to facilitate dialogue, and evaluation of results - Co-elaboration of project with stakeholders - Call for tender support activities - Implementation of projects by farmers and water managers - Support to legal framework identification to management structure creation - Follow up and evaluation of Projects - Approach transfer and movies for expression of stakeholder views - Support for scenario definition - Ex post project evaluation	- Work plan development - CRIWAR further development - Data collection - Model runs - Improved scenarios formulation	- Work plan development - Tool requirements definition with - Stakeholders - Data collection - Data processing - Performance assessment tool development and implementation	- State of the art on resources and use of subterranean waters - Diagnosis of current state - Studies to fill knowledge gaps - Implementation of numerical model in transient conditions, management scenario simulation - Analysis of monitoring network functionality - Farmer survey on groundwater exploitation - Development and testing of DSS system for conjunctive use - DSS Implementation - Model Conceptual outline and software specification - Model Implementation - Farmer and water management behaviours model development - Institutional analysis - Qualitative interviews - Quantitative farmer survey - Validation of model and scenario development interviews/workshops - Workshops for discussing model results - Requirement and situation analysis, stakeholder interviews - Definition of interfaces and coupling of activities, interaction with research groups - Methodological protocol for integration of activities and tool design proposals

The three remaning Case Studies are undertaken in regions where aridity is not an immediate concern, and yet still face a wide array of water stress drivers such as pollution, floods and insufficient management.

Przemsza (Poland)

The Przemsza (Poland) Case Study, summarized in *Table 6*, centers on the problem of industrial water pollution, and attempts to determine options to address the challenges of modernizing the water management system of the region in view of the transition from mining to other economic (including industrial) activities.

Table 6. Przemsza Case Study: Adaptation of water management in the Przemsza catchment to meet the need of industrial transformation

Activity	Support to modernization of the local water supply systems which at present are based on "clean" mine waters in view of the foreseen closure of mines	Improvement of effectiveness of industrial wastewater treatment	Equip local authorities with legal and administrative capacity to go through conflicts around protection of unique ecosystems in areas of mining activities	Strengthening of public understanding of water stress and building a capacity for the integrated water management
Sub activities	➢ Identification of alternatives ➢ Proposal of evaluation criteria and stakeholder consultation, evaluation of alternatives ➢ Formation of pay-off matrix ➢ Application of MCA and selection of the best variant ➢ Exercise MCDM tools with stakeholders	➢ Problem identification and characterisation ➢ Industrial water balancing ➢ Remote Sensing for land use and biggest water users ➢ Identification of industrial hot spots ➢ Water and contaminant balances of "Szczakowa" tannery ➢ "Szczakowa" system components investigation ➢ Priority hazardous compounds use study, and suggestion of use reduction measures ➢ Industrial water system modelling and tool calibration ➢ Model based assessment of industrial water saving option impacts ➢ LPSF feed-back on activities for public perception assessment ➢ Action plan definition	➢ Non-market valuation study ➢ Cost-Benefit Analysis on the basis of non-market valuation study results ➢ Definition of instruments, on the basis of the CBA, for a sustainable compromise between land reclamation and preservation of natural resources	➢ Development of a collaborative understanding of water stress issues ➢ Short courses for decision makers and stakeholder groups covering capacity-building, empowerment, and education ➢ Public awareness-raising campaign and development of dissemination material

Iskar (Bulgaria)

The Iskar (Bulgaria) Case Study, summarized in *Table 7*, focuses on the high water exploitation index in the region, and attempts an integrated approach to the management of the local water resources, incorporating options for the mitigation of industrial pollution, for municipal demand management, and for the development of suitable flood and drought management strategies.

Table 7. Iskar Case Study: Decrease of the Water Exploitation Index in the Sofia region through improved industrial and urban water management and flood/drought prevention

Activity	Pollution reduction from the metallurgical plant Kremikovzi	Demand Management of Sofia's municipal water supply	Flood and drought management
Sub activities	➢ Water balancing at the Kremikovtzi Plant ➢ System components ➢ Reduction of use of hazardous compounds ➢ Modelling ➢ Laboratory study ➢ Workshops	➢ Questionnaire (to experts) ➢ Expert consultation ➢ Domestic consumer surveys ➢ Empirical evaluation ➢ Subjective evaluation	➢ First stage design and mutual education ➢ Final clarification of all activities ➢ Interviews with citizens ➢ Participatory modeling workshops ➢ Design strategies & scenarios ➢ Strategies multicriteria assessment ➢ Final evaluation and planning strategies

Vecht (The Netherlands)

Finally the Vecht (The Netherlands) Case Study, summarized in *Table 8*, aims to improve the local management of water resources through modeling analysis of the water system, and the determination of a suitable participatory approach that will enable the optimal management of the available water resources.

Table 8. Vecht Case Study: Improvement of water management by the Velt en Vecht Water Board through participatory approach and water system analysis

Activity	Water Systems Analysis	Participatory approach in optimal ground- and surface water regime (GGOR)
Sub activities	➢ Preparation of required models ➢ Application of the MIPWA model in the pilot areas ➢ Final evaluation ➢ Dissemination and training	➢ Definition of the project plan ➢ Interactive determination of GGOR ➢ Final evaluation for Aquastress ➢ Dissemination and training

CONCLUSIONS

The primary goals of the Case Study implementation and evaluation process, at its outset, were:

- To serve as learning platforms towards understanding the responses and impacts of different types and conditions of water stress
- To refine existing guidelines for water stress mitigation, and
- To eventually develop policy recommendations for water stress mitigation in a wide range of conditions.

Overall, there is a strong emphasis in all Case Studies on modeling and simulation-involving techniques for technical options in particular, a direct result of the prohibitive costs that actual implementation of technical options would incur. Strategic planning and action plan formulation are also very prominent among the options under consideration, foreseen in six out of eight Case Studies, as are economic surveys for the determination appropriate pricing schemes.

In all regions examined however, the strongest and most prominent theme is that of promoting public awareness and participation, for the adoption of the proposed water stress mitigation measures. Workshops and training seminars, summer schools and education/awareness campaigns, and overall efforts for the dissemination of relevant educational material are foreseen in every single Case Study. In addition, consultation and/or public participation sessions are in all cases considered integral to the Case Study implementation and evaluation.

Thus, in all instances, the Case Studies undertaken strive for the maximum possible degree of public involvement and empowerment (Fig.2), reflecting the principles set out in the Water Framework Directive.

Furthermore, through the wide spectrum of options foreseen, the Case Studies attempt to balance the principal goal of mitigating water stress conditions with the base requirements for the integrated management of water resources: Equitability in resource and cost allocation, Environmental Sustainability, and Economic Efficiency.

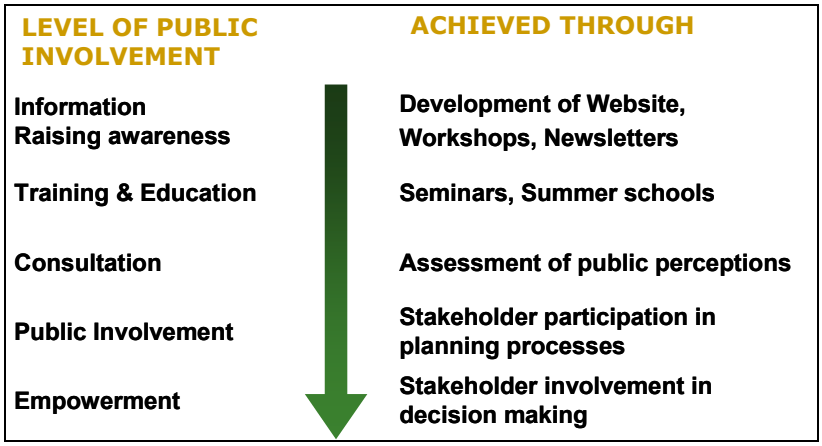

Fig. 2. Levels of Public Involvement in Decision-making

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