

Coping with Water Deficiency

Introduction

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Aridity and water stress are global problems with far-reaching economic and social implications. Furthermore there is evidence that the world is enduring a serious water crisis. Its causes can be traced in the unsustainable management of water resources, and water scarcity from effects of the natural environment and increasing demand patterns. Given the numerous and increasing pressures on water resources, due to climatic conditions, over-exploitation of existing surface and ground waters, insufficient recharge due to diminishing precipitation, excessive water use by agricultural activities or tourism and conflicting interests between various users it is vital that effective legislation clearly address the problems and help secure these resources for future generations.

These issues are even more acute in many arid and semi-arid regions in Southern Europe, the Mediterranean, as well as in developing countries, which are characterized by high spatial and temporal imbalances of water demand and supply, seasonal water uses, inadequate water resources and poor institutional water management. There, the need for appropriate strategies and guidelines for water management are necessary for the formulation and implementation of sustainable water resource management.

The multitude and variety of problems faced by water resources worldwide, emerging from sources as diverse as environmental and socioeconomic conditions, stress the need for the implementation of strategies for integrated water resources management (IWRM) in water-deficient regions. Integrated Water Resources Management could achieve sustainable social and economic development combined with the protection of natural ecosystems and the aquatic environment. Thus management of this most precious resource would be accomplished by an interdisciplinary methodology that takes into account environmental and economic parameters to ensure that the resulting guidelines may be applicable to the entire range of conditions found in water-deficient regions.

In this respect, the Water Framework Directive (WFD) developed jointly by the Member States and the European Commission and agreed in May 2001, adopts a holistic approach towards sustainable water resource management and sets clear objectives that a “good status” must be achieved for all European waters by 2015. In essence, the Framework Directive aims to prevent pollution at source and sets

out control mechanisms to ensure that all pollution sources are managed in a sustainable way. The Directive also aims at providing sustainable solutions to water scarcity problems that derive from unmanaged demand. Finally, the Directive also requires cooperation across countries and encourages citizens and stakeholders such as NGOs and public authorities at all levels of government to get more involved to ensure that its ambitious objectives will be met within the given deadlines.

The first aim of the book is to report the culmination of the results of the ARID cluster of projects which examine water scarcity and demand in arid and semi-arid regions, as well as participatory and adaptive approaches for appropriate management strategies in the Mediterranean and Southern European Countries. In this sense this is the second book in a series of two, the first entitled: *Water Management in Arid and Semi-Arid Regions: Interdisciplinary Perspectives*. In order to stress the similarities and differences in water management practices and enhance the understanding of their problems around the world, this volume also reports recent examples of methods for the identification of water management issues and the proposed mitigation measures in developing countries, which were produced outside the ARID cluster. A wide spectrum of topics important to water resources management is covered, including research tools for the characterization of water stress, as well as policy proposals for its alleviation, tools and methods for decision making, water policies and pricing schemes, stakeholder participation and social issues. The project's outcomes, lessons learned and conclusions reached are incorporated and discussed in an attempt to formulate water management policies appropriate for arid and semi-arid regions in the context of implementing the Water Framework Directive. Emphasis is given on the potential transfer of research results into concrete policy recommendations towards the development of integrated water resources management strategies acceptable to the communities in Mediterranean countries.

The ARID Cluster of projects aimed at consolidating the work of three EU-funded projects with a view at ensuring that through collaboration, information sharing and dissemination, a consistent set of recommendations, user-friendly tools and methodologies for water management in arid and semi-arid areas are developed. In addition, the Cluster attempted to outline the unique characteristics of aridity and related concepts and stress the demand for comprehensive water resources planning and management as these are proposed in the European Water Framework Directive. The three projects that formed the Cluster were:

- WaterStrategyMan which aimed to develop an integrated water resources management framework to meet the EU requirements concerning preservation and enhancement of the water quality in water-deficient regions
- AQUADAPT which aimed to generate knowledge supporting the strategic planning and management of water resources in semi-arid environments at catchment level under changing supply/demand patterns
- MEDIS which focused on the specification of recommendations for sustainable use of water on islands of the Mediterranean (Corsica, Crete, Cyprus, Mallorca, Sicily) where conflicting demand for water is combined with a wide range of hydrological, social and economic conditions

The volume is organized as follows: Part I includes Chapters 2–6, which examine case studies from Southern Europe and the Mediterranean and provide the results and conclusions from research done under the ARID Cluster, together with Chapter 7, which presents research results carried out with partial financial support from the European Commission projects MULINO, TRANSCAT, NOSTRUM-DSS, and of the Italian Ministry for University and Research. Part II, is composed of Chapters 8 and 9, and provides insights and research results from the developing world. The research presented in Part II of the book was funded by the World Bank Research Committee, the International Water Management Institute and the China Council for International Cooperation for Environment and Development. The chapters of the book present broad and general concepts related to water deficiency management and shed light on ways to choose among potential management options.

In Chapter 2, Antonia Donta, Manfred Lange and the MEDIS consortium argue for integrated water resources management stressing the importance of merging the approaches of natural scientists and engineers with the consideration of social and economic aspects. In line with this, authors suggest the examination of specific natural and socioeconomic indicators as analytical tool in order to derive the most appropriate recommendations for water management on the Mediterranean islands and the wider Mediterranean area by consulting local stakeholders as a key of the approach. Such indicators facilitate the characterization of an integrated picture of water management conditions and the existing situation, and render the comparison between different situations and catchments possible. By using indicators and following the Driving forces-Pressures-State-Impacts-Responses approach, both environmental, i.e., pressures exerted by natural phenomena, and the socio-economic stressors, i.e., conditioned by anthropogenic activities, can be considered. Stakeholder involvement was secured via workshops and discussion with the stakeholders. Responses were not given in a technical way but were rather derived through stakeholder consultation and the process was expanded beyond political and scientific limitations. This chapter shows how this approach was carried out in the MEDIS-project conducted on the islands of Corsica, Crete, Cyprus, Majorca and Sicily. For each of the MEDIS case studies natural environment, agricultural, water quality and socioeconomic indicators including aridity index, water availability and exploitability, gross, person and sector water consumption are presented. A comparison of the islands' water management situations is carried out based on these indicators and proposals are given for a more sustainable and sound water management. These proposals contribute directly to the implementation of the Water Framework Directive (WFD) on the Mediterranean basin.

The precise characterization of the circumstances relating to water supply and demand in arid and semi-arid Mediterranean and Southern European countries is crucial for appreciating the nature of the problems pertaining to water availability and use. This in turn could facilitate the development of policies and actions tailored to the needs of each specific site for the implementation of the Water Framework Directive. In this spirit, in Chapter 3, Bernard Barraqué, Christos Karavitis and Pipina Katsiaridi descriptively present the range of existing circumstances in a number of case studies, carried out by the WaterStrategyMan project. Information relating

to climatic conditions, water availability, water quantity and quality, water use and demand, pricing system, water resources management and water policy development priorities is presented for 15 regions selected from six countries. These include Attica, Thessaly and the Cyclades Islands in Greece, Belice basin and Emilia-Romagna in Italy, Doñana and the Canary Islands in Spain, Algarve, Sado and Guadiana in Portugal, Akrotiri, Germasogeia and Kokkinochoria in Cyprus and Tel Aviv and Arava in Israel. For each of the case studies region-specific summary matrixes of descriptive indices are constructed related to the prevailing natural conditions and infrastructure, economic and social system, and decision-making processes.

The conservation and future sustainability of vulnerable fluvio-coastal environments, along with the need for viable planning criteria and policy instruments for their long-term management, are some of the central issues at the heart of the contemporary environmental discourse. In addressing a number of water management related issues, Chapter 4 by James McGlade, Brian S. McIntosh and Paul Jeffrey focus on resilience as a manifestation of sustainability and the notion of “landscape sensitivity”, assessing its usefulness as a theoretical construct that might contribute to a better understanding of watershed dynamics, in climatically marginal environments. Perhaps the most significant barrier to interventionist strategies for sustainable water resource management stems from the lack of holistic thinking at governmental and managerial levels resulting in further increase in pollution, soil erosion, pressure on water consumption and general degradation of the environment including its cultural and natural heritage. Authors take a critical look at the theoretical basis within which current research on socio-natural systems is undertaken and express their opposition towards the utilitarian philosophy which, to their view, underpins the recent environmental valuation approaches. Further this chapter stresses the importance of considering moral and ethical issues in the environmental debate and of providing historical and archaeological evidence on the co-evolutionary relationships between human settlement and water availability in semi-arid environments. The link between governance and resilience is also addressed, though this is brief as there is little empirical evidence to support characterization of such dynamics.

Water resources include surface and groundwater, inland water, rivers, lakes and wetlands. These resources have attracted significant interest in the economics literature because of the diversity of values they possess and the challenges involved in their accurate estimation. In order to achieve efficient and equitable water resources management it is necessary for policymakers to have appropriate estimates of the values for water resources to be used in further analyses. In Chapter 5, Ekin Birol, Phoebe Koundouri and Yiannis Kountouris present the issues involved in the economic valuation of water resources. The authors first define the concept of the Total Economic Value (TEV) of a resource and list the plethora of values of sub-values accruing to water resources, following the distinction between use and non-use values. The methodologies employed by economists for the valuation of environmental goods and natural resources are presented in the next sections highlighting their respective strengths and weaknesses. These approaches can be broadly distinguished in revealed and stated preference methods. Revealed preference methods examine related market where the environmental good is traded and information

derived from those markets is used to estimate the Willingness to Pay of the individual for the environmental good which represents her valuation for it. Stated preference or direct valuation methods are employed for the cases where no markets exist for the environmental good under consideration. These are survey-based methods that can also be used for the estimation of non-use values. While presenting environmental valuation methodologies the chapter also reports on their applications on water resources valuation in Mediterranean and Southern European Countries.

In Chapter 6, Phoebe Koundouri highlights an important challenge of moving from research to policy in water resources management by stressing the significance of choosing the appropriate discount rate when conducting Cost Benefit Analysis (CBA) for projects with extremely long horizons. The EU WFD explicitly mentions that the policy maker needs to choose the most appropriate ‘measures’ in order to achieve “good water quality” by 2015. The choice among different “measures” and policies for water management is facilitated by (CBA). To implement a CBA, one needs to choose a discount rate. If the chosen discount rate is wrong, then the results of the CBA are wrong and thus the chosen measures and management options are inefficient, non-equitable and unsustainable. Whereas the conventional view has always been that there is a unique social discount rate – the value of which has been disputed over 30 years or so of debate – new work suggests powerful reasons why the discount rate is not a single number, but a number that varies in a declining fashion with time. The chapter provides a non-technical review of the formal justifications supporting the use of Declining Discount Rates (DDR). It proceeds to illustrate the arguments for DDR by presenting a case study of applying different discounting schemes to a CBA for flood defences investment in Shrewsbury in the UK. In particular, two flat and four declining discounting rate schemes are applied and their policy implications regarding the adoption of the flood defences project are reported and compared. These results can aid in the design of sustainable and equitable policies for integrated water management, with Europe-wide implications. The message of this chapter is that policy makers need to understand that the constant discount rate that they continue to use in the implementation of the WFD is inappropriate.

Many research efforts have recently began exploring means and ways to tap into the yet unrealized support that models and the modelling process could offer to participatory river basin planning for IWRM. It is within this context that Chapter 7 originates, with the aim of building on recent research experiences to offer insights into future research needs in support of participatory planning for integrated water management. More specifically, the purpose Carlo Giupponi and Alessandra Sgobbi in this chapter is to illustrate how models, in the broad meaning of the term, could support the integration of political and social dimensions in IWRM. In order to put the present research into context, they analyse in more detail the role of Public Participation (PP) in natural resources management, while the following section explores the use of the terms “model” and “DSS” (Decisions Support Systems) within the IWRM paradigm. They also discuss the specific experience of the MULINO Project (“Multi-sectoral Integrated and Operational Decisional Support System for Sustainable Use of Water Resources at the Catchment Scale”) for the implementation of the concepts of IWRM, with specific reference to the EU

Water Framework Directive and its implementation process, drawing some general lessons for what concerns public participation. The last section of the chapter presents some concluding remarks and insights for future research agenda for improving the effectiveness of participatory modelling, with focus on the problems typical of the Mediterranean Region.

Water management and development policy often neglect the importance of institutions and the synergies among past, present and planned policy interventions and the impacts of policy changes. Following this observation, in Chapter 8, Maria Saleth, Ariel Dinar and Susanne Neubert present a unified framework for taking into account the institutional impacts and development synergies in achieving meta development goals such as the Millennium Development Goals (MDG) and especially food security, while also presenting a methodology for testing their significance quantitatively. In their analysis, the authors build on the institutional ecology framework that allows basin institutions to be viewed under a given social, economic and physical context. This is combined with the institutional decomposition and analysis approach in order to identify and reveal the linkages between basin institutions and the adaptive instrumental evaluation approach that facilitates the collection of ex ante qualitative information on the institutions from stakeholders. Following this combined methodology the authors develop a representation of the linkages between development policies, institutional configurations impact pathways and the goal of food security and proceed to present a stylized system of equations capturing all interactions and links. The model is then applied in the case of Kala Oya Basin in Sri Lanka: a Three Stage Least Squares procedure is applied for the simultaneous estimation of 21 equations composed of 32 institutional, development intervention and impact variables using qualitative data from stakeholder surveys. The results reveal the importance of institutions in the generation and transmission of impacts and the synergies among various policy interventions.

The significant interlinkages between poverty and the state of the environment, including those between poverty and the shortage of water, are getting increased recognition, but little consideration is being given to the fact that protecting ecosystems directly or indirectly related to water is crucial to sustainable development. Fears that protecting the environment may hinder development are ungrounded since more and more evidence shows that environmental protection and development are mutually reinforcing. One of the most important health hazards, particularly for urban dwellers in developing countries, is extend contamination of water and food due to poor or non-existent sanitation systems and inadequate hygiene, compounded by unreliable and unsafe drinking water supply. The conservation of ecosystems that are water-related, directly or indirectly, should therefore be the basis of any strategy aimed at achieving poverty eradication on a sustainable basis, through, inter alia, the provision of reliable, sufficient and good-quality water. At the same time given that water is not a commercial product like any other, but rather a precious heritage efficient pricing is significant to act as an incentive for long-term sustainable water resources use. Firstly, water pricing will limit demand to efficient levels and secondly revenues will be generated which can ensure the maintenance of reticulation systems and the reliability of water supply. Chapter 9 by Ben Groom, Xiaoying Liu

and Tim Swanson addresses these issues by examining alternative water pricing strategies that will ensure water cost recovery and identifying their impact on the socio-economic environment with emphasis to the poverty alleviation target. The study is based on data obtained from arid North East of China, and in particular Beijing, a region suffering serious water shortages. Authors analyse one pricing policy, the implementation of Increasing Block Tariffs (IBTs), which is often claimed to alleviate the equity and poverty concerns surrounding water pricing by subsidising “lifeline” levels of water consumption. Panel data were used to determine the exact (Hicksian) welfare impacts on low-income groups of a move from uniform full cost pricing to the proposed IBT regime. Results indicate that in the context of Beijing although IBTs are more equitable, since they do soften the blow to the poor, they are unlikely to circumvent the equity-efficiency trade-off completely.

Since water sustains all life, effective management of water resources demands a holistic approach, linking social and economic development with protection of natural ecosystems. The EU defines a holistic approach to water resources management as one that encompasses “environmentally-sound water management; food security especially for the poor; private sector involvement; reduction of subsidies; decentralization of decision-making to the lowest appropriate administrative level; user participation in services; institutional reform and regulatory frameworks; and cost recovery and pricing”. In line with the Water Framework Directive, this book stresses the need for an Integrated Water Resources Management (IWRM) approach to balance the competing demands on water – domestic, municipal, agricultural, industrial and environmental – and promote conservation and sustainable use in an equitable fashion in many regions in the Mediterranean and the developing world. Research outcomes of the projects included in this book, highly demonstrate that effective and appropriate water management tools and decision-making practices are needed in order to complement integrated interventions for increasing the availability of supply and/or managing the growing demand of scarce water supplies. Further the book attempts to bridge the gap between ideas and actions endorsed at the research-oriented environmental debate, and their translation into policymaking structures and programs in developed and developing countries.