Governance and Water Management: Progress and Tools in Mediterranean Countries

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Summary

This paper reviews the progress with respect to Integrated Water Resource Management (IWRM) in Mediterranean countries, as addressed within the activities of the Nostrum-Dss project, a Coordination Action funded by the 6th Framework Programme of the EC, with a particular emphasis on the current use of decision support tools (DSS). The IWRM paradigm is a comprehensive management framework, which integrates the different aspects of water resources – from the underlying ecological and physical aspects, to the socio-economic values and needs (horizontal integration); and calls for increasing decentralisation and privatisation of water services (vertical integration), and the devolution of planning authority, without however forgetting the need to ensure equitable access to water resources. Substantial progress has been made in the last decades in Nostrum-Dss Partner countries, although a disparity can still be seen between the Northern and Southern banks. New institutions have been established for implementing IWRM, existing institutions have been reformed, and decision making processes increasingly require public participation. Decentralisation of decision making, implementation and monitoring are also well underway, although improvements are still needed to ensure that the traditional power structures do not prevail. More efficient technologies and infrastructures are in place, especially for the production of high value goods or in agriculture. Finally, several DSS have been developed: yet, while operational/technical DSS instruments have been successfully employed, DSSs tools developed in a participatory way, or tackling more complex, political as well as environmental and economic problems are still de-linked from actual decision making processes. Laws and regulations for water management in most Mediterranean countries embrace and support the paradigms of IWRM – and EU framework directives have played an important role in fostering this shift from more traditional, vertical governance to new, horizontal governance based on soft laws. Yet, the implementation of such laws and regulations is often only partial – often because of the lack of a clear monitoring and enforcement strategy, but also because of governments' financial and human resources constraints. Strong overlaps of roles and competences among different government institutions remain, hampering effective implementation of water management. The tendency to centralisation of decision making persists, and actors' involvement is scanty. The shift towards the use of demand side policies as opposed to supply side policies is not yet completed: yet, supply side policies are very costly, as they are based on greater mobilisation of financial resources. Full cost recovery pricing is not practiced widely. This reluctance to introduce full cost recovery pricing in developing countries may be due to ethical and moral considerations, but in developed countries it is often associated with strong lobbying power of interest groups. This study was supported by funding under the Sixth Research Framework of the European Union within the project "Network on Governance, Science and Technology for Sustainable Water Resource Management in the Mediterranean- The role of Dss tools" (NOSTRUM-Dss, contract number INCO-CT-2004-509158).

Keywords: Integrated Water Resources Management, Decision Support Systems, Environmental Governance

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1 Introduction and rationale

Numerous development and research projects have been promoted and initiated in the last decades, including Nostrum-Dss, a project funded by the EC which involves several countries around the Mediterranean area, both in the north and in the south, and aims at favouring and promoting the implementation of IWRM.

Nostrum-Dss – which stands for "Network on gOvernance, Science and Technology for sustainable water resource management in the Mediterranean area. The role of DSS tools" is a Co-ordination Action funded by the European Commission under the Sixth Framework Program and specifically contributing to the implementation of Specific Measures in support of International Co-operation - Mediterranean Partner Countries (INCO-MPC).

This Co-ordination Action aims to contribute to the achievement of improved governance and planning in the field of sustainable water management, by establishing a network between the science, policy, and civil society spheres, by fostering active involvement of the relevant stakeholders, and through the development and dissemination of Best Practices Guidelines for the design and implementation of Dss tools for IWRM in the Mediterranean Area. The guidelines will be developed with the active participation of scientists, policy makers, and key stakeholders (such as small and medium enterprises, as well as user groups), through a structured sequence of actions aimed at favouring efficient exchanges of information, knowledge and experiences between the various components of the project.

In theory, Decision Support System (Dss) should have an enormous potential as tools for the identification of optimal water resource management regimes in the Mediterranean basin, where water resource scarcity could prove a contributing factor to conflict and instability. Dss tools can help to design management strategies which are flexible enough to accommodate changing political and socio-economic situations as well as technological innovations, but, at the same time, strict enough to ensure the ecological sustainability of water uses. Yet, Dss' potentiality is too often not exploited because of various reasons, first of all a lack of interaction between policy makers and researchers: on the one hand, researchers are often not responsive to the needs of stakeholders and policy makers; on the other hand, policy makers have a tendency not to use scientific information for the formulation of water resources management policies. In addition, water planning is traditionally understood within a centralised framework, which focuses on engineering solutions: the current attempt to move towards participatory planning for water resources can significantly be improved by the adoption of suitably designed Dss tools, which take into consideration the interests, needs and objectives of all relevant stakeholders.

The project attempts to addressed the observed gap between theory and practice of IWRM, specifically promoting the potential of Dss tools for helping policy makers to bring the principles of IWRM into practice for managing socio-political conflicts over competing demands for water uses in different environmental situations seems to be not yet exploited. Nostrum-Dss addresses this gap approaching the analysis of needs expressed by stakeholders belonging to the various Mediterranean countries, and by fostering mediation between policy objectives and scientific knowledge to create an enabling environment for a more equitable and efficient water resource management in the basin.

The key objectives of this Co-ordination Action are:

1. To establish durable links between scientific institutions, governments, NGOs, SMEs and other stakeholders and improve public awareness on water management;

2. To improve scientific knowledge and applied methodologies in IWRM;

3. To promote the development of suitable Dss tools built upon real needs of policy making in IWRM.

4. To improve public awareness on water management.

The European Union supports the development of IWRM plans, with stronger stakeholders' participation, pro-poor emphasis and gender sensitivity, and Nostrum-Dss will offer support to this policy through its emphasis on the development of useful Dss tools. In short, Nostrum-Dss has a strong potential to support and further the achievement of many EU initiatives and international relation policies, especially with Partner Countries in the Mediterranean through the contribution to the Euro-Mediterranean Partnership.

Activities undertaken in Nostrum-Dss involve a core group of five partners drawn from the North and South of the Mediterranean (FEEM, ICS-UNIDO, EIA/UATLA, NCSR, CEDARE), which are responsible for the day-to-day implementation of the Co-ordination Action. FEEM has the responsibility for the overall scientific and administrative management and co-ordination of Co-ordination Action. Alongside the core group, the Consortium is constituted by a broader number of organisations, institutions, and individuals operating in the field of water resource management. All the partners provide the Co-ordinator with National Reports including the outcomes of the direct involvement of local stakeholders.

The main expected results of the Co-ordination Action are:

- Improved communication between science and policy;
- Improved co-operation among Mediterranean institutions;
- Identification of multi-sectoral approaches to the design, development and implementation of DSS tools in IWRM;
- Identification of multi-disciplinary approaches to the design, development and implementation of DSS tools in IWRM;
- Assessment of data availability and constraints in relation to DSS users' needs;
- Establishment of durable links and long-term collaborations between the partners and representatives of the policy and academic institutions in the Mediterranean Area;

This report aim at analysing the concept of IWRM within the framework of decision making processes, and with the purpose of identifying the tools and strategies which can help Mediterranean partner countries in furthering its implementation. In particular, the main observed progresses will be reported, together with the observed obstacles to effective integrated water governance, in an attempt to identify potential strategies to overcome the remaining gaps.

2 The concept of Sustainable Governance

Problems related to water availability are becoming increasingly pressing at the global, national and local level. In addition to water scarcity, the resource is deteriorating due to widespread pollution and overexploitation, and there are now serious doubts about the sustainability of current patterns of water use. The need to change and improve current practices is thus clear and pressing, and a new paradigm of natural resources governance, based on the concept of sustainability, is now being called upon to break the vicious cycle of overuse and mismanagement of natural resources.

In Section 2.1 we will briefly review the concept of Governance, before turning our attention to how this new paradigm is being implemented in the field of sustainable development and natural resources management (Section 2.2).

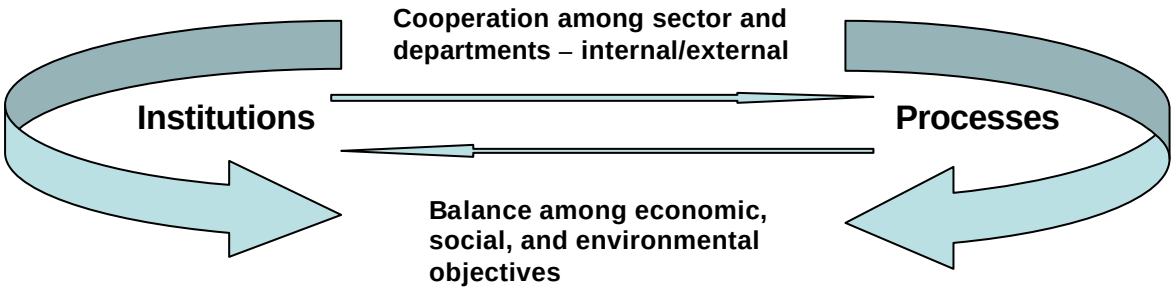
2.1 "New" governance: background and rationale

There are various definitions of Governance, depending on the field of reference. Extensive literature has developed in the last years over the relationship between "governance" and "new modes of governance" (see, for instance, Hey et al, 2006; Treib et al, 2005; Borzel et al, 2005; Jordan and Schout, 2006). The traditional approach to governance relies on (national) state authority, sectoral differentiation, and "command and control" types of instruments, relying on legislation and hierarchical, top-down, decision making. It has now become apparent that this model of governance is ill-suited to dealing with the new issues and problems raised by sustainable development. New forms of governance have thus been defined, which are better able to accommodate the new requirements of sustainable development, especially with respect to environmental stewardship and empowerment of people. These "new" forms of governance (Jordan and Schout, forthcoming; Scott and Trubeck, 2002) are associated with non-hierarchical decision making processes, with a strong involvement of stakeholders – both private and public actors.

For the purposes of this report, we can define or "new" governance as a different mode of governing people, institutions and resources, which is well distinguished from the traditional, top-down approach, and is characterised by a more predominant role for cooperative approaches and positive interactions among State institutions and local actors, an increasing emphasis on public-private partnerships, and the systematic adoption of a bottom-up approach to development[2]. The new paradigm strongly relies on the vertical and horizontal integration of both institutions and processes: the former refers to actions of collaborative planning and management at different levels, through the integration of bottom-up and top-down approaches; horizontal integration refers to the integration of economic, social and environmental objectives through sector-wide approaches. Vertical integration traditionally uses "soft governance" tools, in particular learning, while horizontal integration uses central steering mechanisms, e.g. coordination at Cabinet level.

A precondition for effective governance is the full cooperation among different institutions and actors – being them local or national, government or non-government – who should act together to attain a shared objective. An important objective of this new governing paradigm is the management and resolution of existing conflicts, as well as the prevention of new ones, at the local, national and global levels. Consensus building actions and participative processes thus become central in decision making, which should become more transparent, be based as much as possible on scientific, objective knowledge, and guarantee access to information for all.

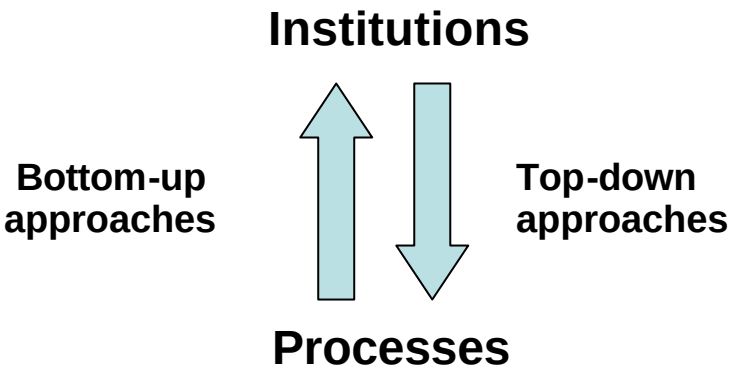
Figure 1: Horizontal integration of institutions and processes within the Governance paradigm



[2] www.kilia.it

Disseminating information and knowledge thus becomes crucial in applied governance, in as much as it helps identifying priority areas of intervention with the help of the interested actors, as well as to single out those sectors needing special attention, highlighting the most pressing problems.

Figure 2: Vertical integration of institution and processes within the Governance paradigm



Despite its theoretical appeal, and the attempt to address the major shortcomings of traditional decision making approaches, the concept of Governance is currently under scrutiny. This is partly due to the difficulties in implementing such an ambitious programme, but also because of the increasing complexities of socio-economic and environmental problems.

2.2 Sustainable Governance

The application of this concept of "new" governance to sustainable development is particularly challenging, due to the many remaining uncertainties in this field. Yet, new management and planning processes must respect the fundamental principles of sustainable development. There is no blueprint of how this integration should be carried out, because the very concept of Governance requires the tailoring of institutions and processes not only to the problems addressed, but also to the specific socio-economic and environmental situations faced. It is nonetheless possible to delineate a few key general principles of global governance, which can guide the application of its concepts by the mandated local and international institutions. From the discourse on global governance, one can conclude that global governance for sustainable development is expected to:

(i) focus on identifying and formulating shared objectives for transnational issues, as well as designing policies in a participatory manner, and monitoring their implementation.

(ii) Frame local intervention. Sustainability cannot by definition be achieved through localised, isolated, actions, but rather local actions should take place within a global development framework, supported by institutions and individuals.

(iii) Influence the behaviour of individuals, through their more direct involvement in decision making processes, with the ultimate objective of increasing their awareness and interest, and facilitating the implementation of agreed policy measures.

(iv) Identify new forms collaborations between Government and Non-governmental actors, with the aim of establishing strategic partnerships.

This new form of governing is called for by the shifts in traditional allocation of roles and responsibilities brought about by the introduction of sustainability as a development concept. There is therefore a requirement for new, ad hoc, decision making processes, tailored to each specific

objective, but constructed in such a way as to guarantee public involvement, transparent decision making and trade-offs, as well as clear allocation of responsibilities and accountability of the responsible institutions.

Finally, increasing awareness of the need for implementing this new concept of Governance at all levels is a prerequisite for its success, as individuals' attitude towards sustainability is a critical component for ensuring the achievement of sustainable development and its intermediate objectives.

In summary, an efficient and effective governance system needs to coordinate actions developed and implemented at the national level with global approaches and corrective measures, yet ensuring the clear allocation of responsibilities and accountability. Good governance requires reforming the traditional decision making processes to increase opportunities for public involvement, from consultation to environmental impact assessment and co-management – it therefore requires public debate and problem solving capacities (Risse, 2002).

Box 1: Key principles of Sustainable Governance

- It is a global process
- It entails the definition of shared objectives, and the development of national *and* transnational policies
- It requires the development of a strong monitoring and reporting framework and strategy to assess the results attained
- It envisages the coordination of national and international actions
- It must be supported and approved by all social actors, and involve civil society and stakeholders in decision making processes
- It requires efficient and effective dissemination and awareness raising strategies

2.2.1 Sustainable Governance in the EU

The EU White Paper on Governance (European Commission, 2001) calls for the implementation of new governance paradigms at the EU level.

A critical examination of the progress related to the application of this new governance paradigm in the EU highlights how there remain considerable gaps between the results obtained so far and the theoretical expectations. The role of the EU should go beyond its traditional duties, in an attempt to design and promote interventions aimed at sustained economic growth from the bottom-up, that is, by attempting to modify individual behaviour, fostering sustainable consumption, for instance.

Sustainable development requires the effective coordination of national and EU processes, as well as the active participation of local authorities and interested parties in both policy formulation and implementation. Effective coordination among national institution is also required, while EU policies need to be streamlined and aimed at guaranteeing an increasing legitimacy of decision making and of EU institutions themselves. Certainly, the entry point on which EU policies and institutions should focus for promoting sustainable development is individuals' behaviour, also through the promotion of partnership between EU institutions and local civil society organisations.

National and European non-governmental organisations must also be involved in the process of Governance, including research institutes, NGOs, and CBOs, with particular attention to those working in the field of environmental management. Scientific knowledge must be integrated in the

policy making process, both by ensuring that science and research address the needs of policy makers, and that policy makers are able to understand and interpret scientific results. Environmental organisations should also be more actively involved, especially with respect to defining environmental standards at the EU level. These organisations should also have easier access to information, and be represented in consultative and decision-making bodies at the EU level. Sustainability requires that the process of European governance be adequately structured, and include action programmes, supporting activities, and monitoring strategies.

2.2.2 Sustainable Governance in Developing Countries

The implementation of the Sustainable Governance paradigm in developing countries is even more problematic. The process must necessarily include the acquisition of new knowledge and capacity building at institutional as well as individual level, in addition to the collection of additional data and indicators. The current knowledge and capacity of DGC to deal with economic, social and environmental issues still needs improving, thorough additional investments in research and development, as well as transfers of knowledge and technologies from developed countries. Improved technologies are however not sufficient in themselves to guarantee the appropriate implementation of the new paradigm of governance based on sustainable development: technological progress must be coupled with an adequate use of the technologies themselves, thus requiring substantial capacity building and adaptation of current techniques. Strategic planning processes, integrating interventions at the national, regional and local levels, must be adopted throughout, and must always consider the impact of development strategies on the natural resource base.

Sustainable governance in DGC needs to be aligned with the objectives set out in the Millennium Development Goals[3], which requires signatory nations to undertake all efforts needed to reduce poverty, illiteracy rates, infant mortality, and reduce environmental degradation by the year 2015. Financial transfers from donor countries and agencies must be managed within the framework of sustainable governance, and with the shared objective of helping nations to achieve the MDGs.

Strong inequality and income differential, coupled with low capacity and awareness by both the population and governing bodies, may however hamper the process of implementing sustainable governance practices in DGCs. Current barriers to trade, the poor state of infrastructure (transport, communication, utilities networks,…), and the at times significant international debts of DGCs, coupled with continued population growth, all add to the already identified difficulties.

3 Integrated Water Resources Management as a paradigm for sustainable governance of water resources

There is no doubt that water is an essential resource for the socio-economic development of every nation, as well as for the maintained functioning of key ecosystems, and environmental goods and services. Ultimately, water is a fundamental component of current strategies for actions in many areas of national and international policy development, as well as an integral part of recent efforts towards the achievement of sustainable development. This is emphasised by the numerous initiatives involving, to various degree, water management and water specific targets[4].

Water resources are mostly renewable, yet their availability can rapidly decrease with over-exploitation – that is, if the rate at which water is abstracted exceeds the natural rate of replenishment. Recent publications by international organisations have confirmed how water scarcity is on the rise, both in terms of quantity and quality, and several studies have identified

[3] UN Millennium Development Goals, http://www.un.org/millenniumgoals/

[4] See, for instance, the UN World Water Development Report (2003), UNEP's Global Environment Outlook 3 [UNEP 2002], the numerous reports by the World Water Council (http://www.worldwatercouncil.org), and references therein.

water scarcity as a serious and growing problem, particularly in arid and semiarid areas (see, for instance, Gleick, 2000 and Raskin et al, 1998).

At the global level, water demand for domestic consumption has increased significantly, especially in rapidly urbanising areas. At the same time, there is increasing pressure on water resources for non domestic uses: agriculture remains the largest consumer (in developing countries over 80% of water is used for irrigation), and demand for industrial and recreational uses is set to increase. In fact, water demand has increased by almost 40% since 1950, but less than 0.01% of the world's water is available for human use, given current technologies (Lonergan, 2001).

Water shortage has many causes, variously interrelated with each other, as summarised in Box 2. The increase in human population, which has tripled in the past hundred years, has certainly played a critical role: per capita water supplies decreased by one third since the 70s, with the impact both direct through higher water demand for domestic consumption, and indirect through increased demand for water-consuming goods and services, such as food and energy (UNESCO World Water Development Report, 2003). Furthermore, changes in land use patterns have increased the pressure on water resources: growing urbanisation and population density in urban areas is posing serious problems of overloading of water supply and sanitation facilities, and badly planned development is resulting in increased risks of floods in urban and peri-urban areas, to mention just the two major problems. Industrialisation is also contributing to a large extent, both because of additional water requirements, and, perhaps most importantly because of the threat that industrial development poses to water quality.

Box 2: Pressures on water resources

Demographic factors	*Growing population* and *increasing per capita demand* for water as socio-economic conditions improve put increasing pressure on water resources. Additional uses of water resources are becoming more widespread, e.g. recreational.
Economic factors	There are pervasive market failures in water management, which have led to economic scarcity of the good: *water price* has consistently failed to reflect the true value of the resource; the *public good* nature of some water services has led to their under-provision (or overprovision, in the case of pollution); finally, there are significant *externalities* in water use, both negative, whereby individual users fail to recognise the negative impacts their water use has on other agents; and positive, through the reduced health hazards, reduced time spent collecting water,…
Climate change	*Climate variability* has significant consequences for water management, both directly (through stochastic changes in water availability) and indirectly (through its impacts on water-using sectors, e.g. agricultural productivity, and economic output).
Food security	There is an important link between water and food security, which has strong influences on the way water scarcity is perceived at the political level. Water is a key strategic resource, and important decisions regarding water issues depend on public perceptions. According to Merret *et al* (Merret S, Allan J, Lant C (2003), "Virtual water: the water, food and trade nexus. Useful concepts or misleading metaphor?", *Water International*, 28(**1**):4-11) politicians have often constructed a notion of water "security", especially in the Middle East, supported by globalisation and the facilitated access to "virtual water", i.e. water imported through the import of water-demanding food crops or products.

Even where there is enough water, its quality is rapidly deteriorating: industrial discharge, salty water intrusion, human wastes, are either decreasing the quantity of water suitable for direct use, or significantly increasing the costs of using freshwater. Such degradation of water is both a

national and an international problem, exacerbated by the fact that downstream users are often vulnerable to upstream pollution.

Water shortages are not only absolute – that is, physical – but also – and perhaps more importantly – economic: the "water crisis" has been further aggravated by the inefficient management and allocation of the resource, degradation of available water by pollution, or inappropriate sharing rules. Water, like many other natural resources, has traditionally been considered a "free" good, access to which cannot be restricted, or is very difficult to regulate. The poor integration of water resources into the economic system is often blamed for the numerous cases of this economic scarcity of the resource, whose cause is therefore to be found in inefficient management practices. By contrast, water should be seen as an economic good, which has a value in relation to its uses – be they economic, social or for ecosystem maintenance. This failure to appropriately manage water resources can also be traced to a governance crisis in the water sector (Rogers, 2003), with the failure of clearly determining the new roles and responsibilities for private and public actors.

The intensification of pressures on water resources leads to increasing tensions over water use – and, in some cases, to open conflict – placing strains not only on the resource itself, but also on socio-economic structures of nations and regions. This is especially true in the case of transboundary water resources: a problem which typically arises is that of dividing a common water basin or river flow between two or more countries. In such a case, there is no supranational authority that can impose a solution to the parties involved, because these are sovereign countries. In addition, a feature peculiar only to international river (as opposed to boundary rivers, seas or enclosed sea basins) is the *unidirectionality* of river flow, which makes the allocation process even more difficult. At the same time, shared water resources can encourage cooperation, both at the national and international levels. In fact, over the past 50 years there were 1,831 international interactions over water issues, either cooperative or conflicting. Only thirty-seven of these events resulted in violent conflicts, compared to 200 negotiated agreements being signed over the same period of time (Wolf et al, 2003).

As a matter of completeness, it should be pointed out that technological innovations have led to better and more efficient exploitation of available water resources, as well as to cheaper technologies for water purification and desalinisation. However, the benefits of technological innovation are not shared equally, and fall mainly on the most developed nations – where, on average, the primary needs for water have long been satisfied, and additional water is used to maintain a highly consumptive life style.

In the Mediterranean area in particular, the problem of water scarcity is strongly felt. The Mediterranean sea has relatively little water recharge and circulation, and is characterised by a hot climate and significant evaporation rates – implying a very slow dispersion of pollutants and the consequent intensity of pollution. Pressure on water resources is continuing to increase, both because of growing populations and demands in the southern bank of the sea, and as a consequence of state policies favouring the agricultural sector, traditionally the largest consumer of fresh water.

Despite the recognised importance of water resources, our record of use and management remains dismal. For this reason, and given the strategic and political nature of water, as well as its human right aspect, new approaches have been explored to tackle the problem of water sharing and, more broadly, management, moving away from the traditional belief that gains to one water user must necessarily come at the expenses of other user(s) towards a logic of integration and cooperation. Aspects related to governance modes arise then as key issues to the implementation of sustainable development strategies, the understanding and description of the system and the interactions among its various components. "New" modes of governance depend on the legitimacy of the political system and on the respect and trust that private actors have for public institutions, their capacity to respond to changing needs and demands, as well as to achieve social consensus

and resolve conflicts (Machado et al, 2002). Lundqvist (2000) identifies several steps that lead to changes in the governance approach for water management. In the first phase, physical water scarcity becomes binding, and supply side solutions are sought to increase water availability. It is then recognised that increasing water supply indefinitely is not possible, and alternative solutions to water scarcity are sought, which focus on improving the efficiency of water use. Finally, additional demand-side management strategies are implemented, to induce water saving as well as increased efficiency in water use. It must be however pointed out at this stage that IWRM can potentially be implemented through both traditional and "new" modes of governance – or a mix of the two – even though the less rigid structures characterising "new" modes of governance would seem more suitable to the specific aspects of integration and participation involved in IWRM.

3.1 Integrated Water Resource Management: Definition and Principles

In recent years, one of the responses has been to promote the adoption of Integrated Water Resource Management (IWRM) strategies, which seek to find a balance among the needs of satisfying water demands from different users, at the same time ensuring that water resources are not irreversibly depleted. IWRM as policy paradigm can be traced back to the early 90s, when concerns for the health of key ecosystems, such as rivers, coastal areas, hydrological basins, and groundwater resources, acquired significant importance. IWRM has many theoretical advantages, and it addresses several of the fundamental challenges to traditional approaches to water management, as shown by its rapid adoption at all level of governance – global, national and local.

The main objective of IWRM is the achievement of an efficient and equitable system of distributing and managing water resources, through actions aimed at reducing demand pressure on the resource on the one hand, and at protecting it from pollution minimising the adverse impact of land as well as water use patterns. IWRM thus applies the concepts of sustainable development to the field of water planning and management, aiming at ensuring that water use is efficient, without however compromising intra-generational as well as inter-generational equity. IWRM seeks to ensure all individuals have access to at least the minimum water quantity necessary for human security.

An interesting definition of IWRM is provided by the Global Water Partnership[5] as follows: IWRM is a process which promotes the coordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems". The emphasis is thus on the coordinated development and management of water and land resources, with the shared objective of maximising socio-economic welfare in such a way that key ecosystem functions are maintained.

IWRM adopts some principles of ecological sciences in terms of system approaches and technical and analytical tools to tackle water management problems. It is within this framework that information system tools are acquiring increasing importance, both in shaping policy making processes and in providing an exchange platform to facilitate interactions among different interested parties.

[5] Global Water Partnership, Technical Advisory Committee: "Integrated Water Resources Management", 2000, Global Water Partnership, Stockholm, p. 22.

Box 3: The Principles of IWRM

Principle No. 1 - Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment

Principle No. 2 - Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels

Principle No. 3 - Women play a central part in the provision, management and safeguarding of water

Principle No. 4 - Water has an economic value in all its competing uses and should be recognized as an economic good

IWRM is based on four fundamental principles, formulated and adopted in Dublin in 1992 – also known as the Dublin principles (Box 3)[6]. The first principle, which focuses on fresh water as a resource in limited supply, implies the need for the adoption of a comprehensive and holistic approach to planning and management, able to consider the water cycle as a whole, and its interactions with other natural resources and ecosystems. The potential non-renewability of water resources requires its use to be such that the hydrological cycle is not significantly altered, and that overexploitation is avoided to avert a water crisis in the future. Human activities that require the consumption of water need to be monitored and controlled, in an attempt to mitigate their negative consequences. The approach which IWRM promotes is the full coordination of different human activities exploiting water, with economic and development policies that take into account the hydrological cycle and ecological water needs.

The second principle of IWRM promotes a participatory approach to water policies, where the interested of all different parties are considered and, whenever possible, integrated. There are different levels of public participation and, according to the principles of IWRM, in this case interested parties should not only have a consultative role, but take active part in the process of defining water management policies and implementation strategies. IWRM thus calls for the establishment of new institutions and exchange platforms and mechanisms which can facilitate the active participation of interested parties, at all levels of governance.

Women's role in water management is the subject of the third principle of IWRM, which calls for the full integration of women in policy making processes. All too often women are not allowed to have an active role, because of gender disparities or their vulnerability, yet their role is fundamental in the application of sustainable water use policies. The effective implementation of this principle requires positive policies that address the specific needs of women, and empower women and vulnerable groups to participate at all levels in water resources programme, including decision making and implementation processes.

Finally, the fourth principle of IWRM calls for the management of water as an economic resource, in direct opposition to the traditional belief that water – and renewable natural resources in general – are freely available and in infinite supply. The prevailing perception of water as freely available needs to be changed, through the adoption of economic tools which can alter consumers' behaviour, favouring the conservation of water and its sustainable use. Water consumers should pay for the service of water delivery, and the price should be enough to guarantee the full cost

[6] The Dublin Statement of Water and Sustainable Development, http://www.wmo.ch/web/homs/documents/english/icwedece.html

recovery, as well as any negative or positive externalities existing in water consumption – economic, social and environmental. Only an accurate and comprehensive economic evaluation of the costs and benefits associated with different water uses can allow an efficient allocation of the resource among competing sectors.

IWRM also requires the implementation of measures to guarantee good chemical and ecological status of water resources, addressing the root causes of pollution and adopting a two-pronged strategy to (i) reduce input of pollutants into water bodies; (ii) the restoration of degraded river courses, with particular attention to the natural clean-up capacity of ecosystems. Activities and strategies aimed at protecting or restoring water quality need to be coordinated with strategies to ensure that water quantity is sufficient.

IWRM requires the full integration of global, national and local strategies, and the devolution of decision making and implementation power to the lowest possible governance level. Effective local implementation of global strategies requires cooperation among different actors, governmental, non-governmental, research, etc. Public-private partnerships are to be promoted with the objective of improving the efficiency and effectiveness of water policies. It also implies the active participation of all key stakeholders in designing and implementing management policies, through negotiation processes, voluntary agreements, and partnerships.

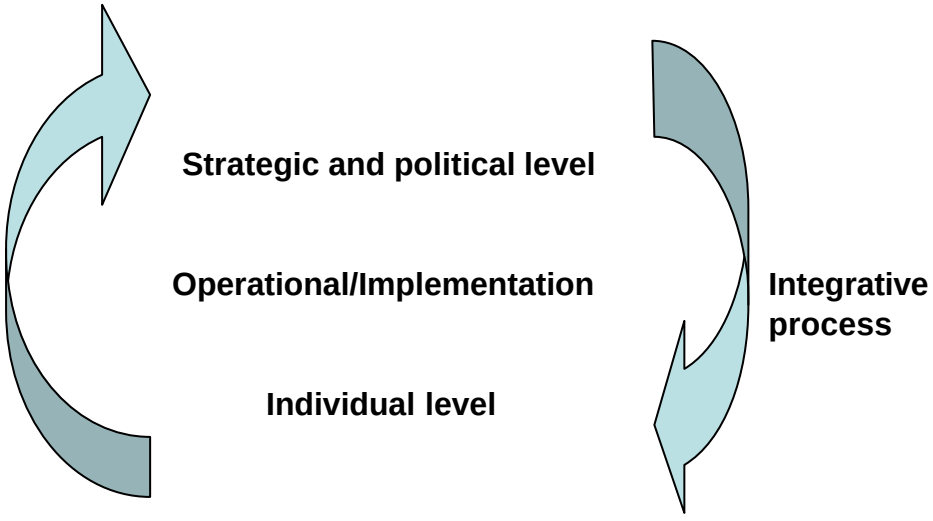
Despite its theoretical appeal, translating the philosophy principles of IWRM in practice at the local and national level is a daunting task, as appropriate tools and instruments to operationalise the concepts are still being experimented with, and different, local contexts may require very different solutions.

3.2 Decision making processes for IWRM

One of the key challenges for decision making within the IWRM paradigm is the necessity to integrate the different perspectives, needs and preferences of all the interested parties, and of the different sectors and disciplines.

IWRM needs to adopt a holistic approach, considering within the same, integrated framework not only different water sources – be they surface or groundwater resources – but also their qualitative and quantitative aspects. Water policies need not only to consider the different perspectives and objectives of actors, but also their interdependencies with sectoral policies, *in primis*, with economic development strategies.

Figure 3: The levels of decision making for IWRM



Decision making processes for IWRM take place at three governance levels: individual, operational, and strategic planning. These three levels must be integrated for the achievement of appropriate, sustainable, governance practices in the field of water resources. Horizontal integration is also necessary, with a clear need to consider all aspects influencing water availability and quality: the finiteness of the resource, the existing technological constraints, perceptions and needs of different actors, such as individual users, NGOs, governmental organisations, the risks of natural hazards, and other key socio-economic indicators.

Key principles that IWRM strategies need to consider are:

(i) the need to improve the economic efficiency of water use, as an attempt to regulate demand and reduce the pressure of increasing water scarcity;

(ii) at the same time, there is a need to ensure a balance between efficiency and equity, guaranteeing to all access to safe water in adequate quantities, and that water allocation is not biased in favour of some consumers;

(iii) the ecological and environmental sustainability of water use strategies must also be ensured, with the aim of preserving equal development opportunities for future generations.

Decision making processes must therefore consider various alternatives, and be able to select the most appropriate strategy with the substantial input of all interested parties, considering the social, economic and environmental viability of the selected policy. These complex decision making processes can be supported by the use of information and communication tools and system analysis, coupled with accurate monitoring strategies and instruments. IWRM also entails the explicit consideration of risk factors and their mitigation, with the aim of balancing out expected benefits of actions and the uncertainties that still surround them. The Precautionary Principle is normally invoked, calling for the need to avoid undertaking potentially damaging actions in the first place, rather than having to repair the damage in the future. Finally, IWRM requires policy makers to have a clear mandate in terms of enforcing the policies agreed upon, and punishing divergent behaviours.

3.2.1 The role of information dissemination and communication

Information acquisition and dissemination are critical components of IWRM. Carefully crafted awareness campaigns and information dissemination is necessary to ensure the meaningful participation of actors, especially those who are not formally part of decision making bodies – such as NGOs and individual stakeholders. Conflict management is also facilitated by the timely and accurate dissemination of information on different water needs, but also of data on water availability.

One of the tools available for information dissemination – both for scientific and popular communications – is the use of monitoring and assessment indicators, which need to cover social, economic and environmental aspects of water management. Within the context of IWRM indicators may serve three purposes: they provide the building blocks on which success or failures of different measures can be assessed; they also make up the conceptual framework for organising and simplifying otherwise complex systems; and they help project conceptual analysis and future scenarios. Indicators of performance and system assessment must be clear, measurable and relevant – that is, agreed upon by interested parties. There is in fact a need to balance, on the one hand, internationally agreed science and standards and, on the other hand, the specific local requirements and needs of actors, in order to ensure both indicators' soundness and their appropriateness to their application context. Despite the crucial role played by indicators, quantitative and qualitative data, as well as dissemination and awareness raising strategies, there

is still a widespread gap in existing knowledge, fragmentation of information, which is often not circulated or made available.

3.3 The role of institutions in IWRM

The success of IWRM depends to a large extent by the institutional context in which the process takes place, both at the international and national levels. In fact, the balance of power between central government and powerful municipalities and/or private stakeholders significantly influences the final outcome of the process. Furthermore, ethical and political considerations play a crucial role in shaping government's approach to water resources.

The application of IWRM varies depending on the application context, as differences in the social, economic, political as well as geographical situation will require different, tailored, approaches. As a consequence, it is not possible to draw a uniform map of institutional roles and responsibilities, to serve as guidelines for adapting and improving local institutional settings for efficient IWRM. As it is often the case, however, one can draw some general suggestions from past experience, which may prove useful in translating the set-up for IWRM from theory to practice.

First of all, experience shows that it is good practice to designate one institution with the mandate of undertaking strategic planning, development and management strategies for water resources. This institution should provide a clear framework and national guiding principles to implementing agencies. Because of the very political nature of water, it is advisable to make this body independent of, but reporting to, the national government, and make sure it remains neutral with respect to the interests of different water users and needs.

At a lower strategic level, different institutions with an interest in water resources will have the responsibility of planning for infrastructure developments – at the national or local level, depending on the type of intervention – but they will also be responsible for deciding on priorities for allocating scarce resources – both water and financial. The allocation of water resources cannot continue along the lines adopted in the past, but should rather be based on the economic value of water under different uses, and allocation strategies must include conflict management tools in case of emergency water scarcity situations, through for instance consensus building.

Finally, and as already mentioned, one of the key challenges of IWRM is to ensure coordination among different sectors and disciplines: an appropriate institutional framework will thus include clear and efficient mechanisms to coordinate policy-making, planning and implementation of different sectoral policies and plans. Similarly, governing institutions must ensure the active involvement of all relevant actors in the formulation of policy objectives and strategies, as well as in implementing agreed upon policies, with the objective of reducing conflicts, reconciling different objectives in a transparent and accountable manner, and facilitating policy acceptance and implementation. However, bottom-up strategies can only be effective if implemented through the right platform and by a dedicated organ, such as local communities' organisations, consultative organs with members from the public, etc. Final responsibilities for policy decisions must remain with the mandate government institutions.

Box 4: Suggestions for institutional setting

(i) Clear roles and responsibility: it is often better to mandate one single institution with the task of strategic and framework planning.

(ii) Institute clear and efficient mechanisms to coordinate the activities of different institutional actors.

(iii) Put in place a conducive environment for public participation, and provide a platform for information dissemination, awareness raising, and exchange of information.

IWRM in the Mediterranean area need to deal with additional constraints, as water management strategies need to ensure the equitable distribution of resources, both within and between countries, at the same time take into account the peculiarities of socio-economic and environmental aspects of the area. In particular, governing institutions will need to ensure that both the urban and rural population have access to safe drinking water and sanitation services, bearing in mind environmental constraints, but not jeopardising economic development, especially in the South bank of the sea. This requires institutional and technological innovation, and calls for:

- the strengthening of existing institutions mandated with water management tasks;
- the adoption of a two-pronged strategies, dealing on the one hand with water supply and, on the other hand, managing water demand;
- urgently reforming and modernising the agricultural sector, favouring less water intensive crops and more efficient irrigation technologies;
- improving water quality and tackling health related issues;
- building capacity to deal with crisis situations, such as floods and droughts, as well as implementing an early warning signal to limit the damages; and
- fostering international cooperation among countries sharing water resources.

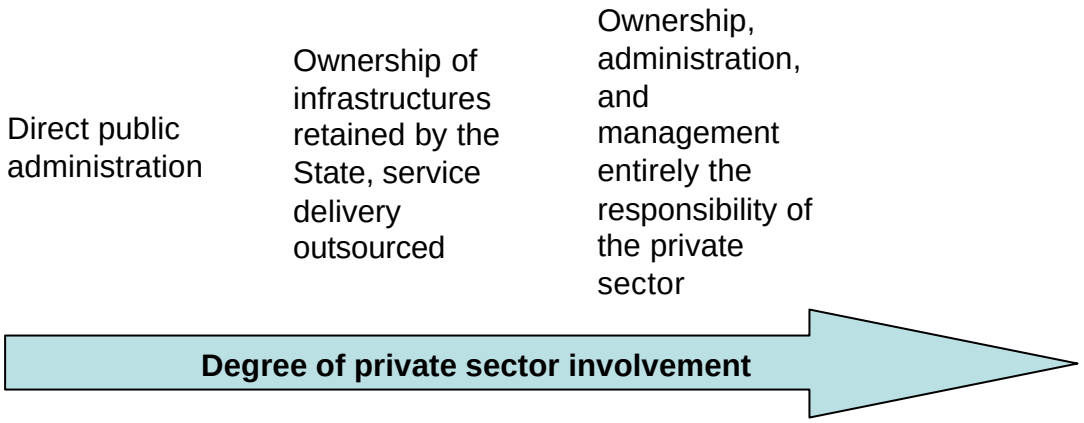
3.3.1 The role of the private sector

The role of the private sector in water resources is increasing in importance, with the attempt of governments to improve the efficiency of service delivery by attracting private investors. In fact, the public sector proved inefficient in terms of delivering water services: large water losses coupled with financial non-sustainability due to the pricing systems did not provide any incentives to water users for managing efficiently the resource; poorly managed infrastructures, and insufficient investments in new infrastructures also characterised the sector.

Privatisation of water and sanitation services is deemed to improve on the efficiency of the service, ensuring technological improvements as well as better managerial capacity, and is in line with an overall tendency observed in the past decade. However, it may have various negative social and economic impacts: changes in the tariff structure, for instance, may harm the poor; or business-minded water companies may favour productive sectors who are more willing to pay for the service, leading to an imbalance in productive activities. There is therefore a need for the public sector to act as a watchdog, ensuring that increased efficiency in service delivery is not to the detriment of equity and social balance.

Thus, to deal with this risks, and because of the ethical consideration that water is a human right, which should be accessible and affordable for every one, different degrees of privatisation have been experimented with.

Box 5: Three main models of water services delivery



Investments in the water sector require innovative financing mechanisms: government institutions need to promote private investments, fostering public-private partnerships, implementing full cost recovery pricing systems, facilitating access to international funds for developing countries and access to micro-credit, encouraging local development initiatives to focus on the water sector. Some countries have also experimented with the introduction of new taxes on infrastructure development, with the purpose of collecting funds to re-invest in water development projects, especially in developing countries.

4 Implementing IWRM: tools and instruments

The integrated approach to water resource management rests on principles which are difficult to contradict, but also difficult to operationalise. This section will briefly present the main instruments available to water planners and managers for implementing IWRM, from the legislative, management and technological points of view.

4.1 Regulatory instruments

The first category of tools which have been experimented with, albeit with varying degrees of success, includes regulatory and legislative reforms. A legislative framework conducive for IWRM needs to:

(i) rest on a national policy framework based on the horizontal integration of different sectors' plans, as well as different objectives and preferences of actors;

(ii) ensure that the regulatory environment is conducive to attract private sector investments;

(iii) have as an overarching principle the attempt to balance the needs of growing and developing economies and sustained ecosystems' functioning and the safeguarding of water quality.

Regulatory instruments can be divided into three categories: command and control tools (C&C), economic instruments, and the fostering on voluntary agreements. It is commonly argued that command and control tools should be substituted with more individual based, market approaches. Yet, in practice, command and control are still favoured by many governments worldwide: this is partly due to the inertia in the system, but also because C&C can, when implemented effectively,

guarantee the achievement of the desired environmental quality – which, on the other hand, market based instruments can not always guarantee. Furthermore, there are innovative tools which fall under the C&C category, but considerably lessen some of the shortcomings of their earlier, less elaborate, versions.

Box 6: Main Command and Control tools

- Executive legislative decrees, which can be promulgated quickly, but also quickly amended in the face of new information or changing situations. This approach is often used to determine the requirements for issuing water abstraction permits.
- Water rights systems, which clearly establish the right to use and enjoy the resource, considering it as a good in limited availability and with restricted access. Water rights systems are often designed to facilitate and provide incentives for private sector investments in water infrastructures and related services.
- Standards and operational guidelines are the more traditional C&C approach, often used to define minimum technological requirements for water saving, wastewater emissions,…
- Controls and limitations to land uses in sensitive areas, often used to favour water recycling and prevent pollution of water sources.
- Water services regulatory instruments and institutions, which try to maintain a balance between the interested of the (private) service providers and society's needs.

Economic instruments have often been proposed as a viable alternative to the more costly C&C tools, and they are indeed used increasingly often, in particular in developed countries. Market based instruments seek to alter the incentives/disincentives faced by individuals or organisations, so as to induce a modification in their behaviour to be more socially and environmentally friendly. The efficient and effective implementation of market based instruments requires appropriate standards, monitoring and implementation capacity, coordination among institutions, and economic stability. Economic instruments for water management include water prices, charges for water use, subsidies,…For instance, different tiers of water tariffs could be implemented, in order to penalise excessive water use and incentivate conservation, or foster technological innovation, especially for large water consumers such as agriculture. Water pricing could have significant positive impacts on sustainable use of water resources, but it may also have adverse equity impacts, and it thus be designed with care.

In the last decade, voluntary agreements have been promoted among private sector actors, or between the private sector and public authorities. Voluntary agreements are less costly for the managing authorities in terms of development, monitoring and enforcing, but doubts remain about their environmental effectiveness. In an attempt to foster it, voluntary agreements need to be accompanied by monitoring strategies, and include details as to which measure public authorities or signatories to the agreement themselves can initiate in case of non-compliance. An example of voluntary agreement is the adoption of standard activity guidelines, regulating the operation of productive categories or large transnational companies. The concept of Corporate Social Responsibility thus fits well within this framework.

4.2 Integrated River Basin Management

Integrated River Basin Management (IRBM) can be seen as the local application of the IWRM principles and concepts, and can be defined as "an integrated and coordinated approach to the planning and management of natural resources of a river basin, one that encourages stakeholders to consider a wide array of social and environmental interconnections in a catchment/watershed context" (Hopper, 2005, p. 9). IRBM entails the integrated planning and management of natural resources at the level of a hydrological basin, coupled with social impact evaluations, and the inclusion of economic, social and biological and ecological indicators within the same framework of policy analysis.

Box 7: Fundamental principles of IRBM

- The presence of coordinated activities.
- The integration of top-down and bottom-up management practices.
- Strategic planning.
- The promotion of partnerships and cost-sharing arrangements.
- The strengthening of decision making abilities and processes at local and regional level, instead of centralised processes.
- Problem-solving approach to management.
- The existence of an appropriate and relevant information system.

(Modified from Hopper, 2005)

Three are the factors determining the successfulness of IRBM plans: the context and final objectives, the degree of integration among natural resources, economic development, and environmental conservation; and finally the degree of maturity of the decision making process at the basin scale. This last aspect is particularly relevant for the analysis of institutions and processes leading to "good" or "new" governance in general, and in the context of IWRM in particular. Of relevance are the experience of institutions mandated with implementing IRBM, their freedom of decision making, and their power to enforce river basin management plans. The degree to which processes of decision making are consolidated, for instance, with respect to involving local stakeholders or experts, will also determine the success or failure of IRBM.

Thus, several factors will influence the process of developing and implementing river basin management plans within the framework of IRBM, such as:

- the context and existing conditions, such as the socio-economic development level, which influences the capacity of the government to sustain the initial phases of the process;

- the process of devolution and decentralisation, with an increasing involvement of local and regional authorities in planning and management. Representatives of local communities need to be involved as well, in particular, because of their ability to validate – or hamper – the decision-making process;

- the existing relations between central authorities and local administration, as well as local communities and private sector. In this respect, IRBM calls for the devolution of decision making and executive powers to the lowest possible level – although in line with the general framework and policy directions set out by the central government;

- the basin's characteristics, not only ecological and geographical, but also and foremost institutional: the capacity of local authorities, the degree to which information is available and shared, scientific knowledge, actors' interest and active involvement, so on and so forth, will all influence the process of IRBM and its successful implementation.

Finally, it should be noted that, for internationally shared river basins, IRBM calls for joint planning and implementation, with the aim of reducing tensions over water sharing and use, manage existing conflicts, and avoid inequitable distribution of the resources: the challenge is to ensure that cooperative agreements among nations are not a challenge to national sovereignty.

In the EU, IRBM is being promoted through the integration and coordination of different community tools, and the promotion of best practices from different European countries, with the aim of achieving a shared and, in principle, uniform strategy for the implementation of IRBM.

Box 8: The River Basin Organisations (RBOs)

The process of IRBM planning is based often of the creation of specific institutions, River Basin Organisations (RBO), which can have different roles and responsibilities, depending on the context. RBOs are generally mandated with the task of allocation water resources, planning and managing its use , increasing the awareness and knowledge of the local communities, compromise seeking and consensus building, etc. RBO can have different institutional structures as well –they may, for instance be in the form of Trust Funds, Authorities, Commissions, Committees, Tribunals, Federations,…Some tasks remain with local authorities, such as water delivery and sanitations services. RBOs may however play a crucial role in the management of transboundary waters.

4.3 Water as a strategic resource: the concept of Virtual Water

The concept of Virtual Water (VW) has recently been proposed as a framework for analysing country's water policies and strategies, and finds its origin in the explicit realisation that water resources are often highly politicised.

With the term Virtual Water one designate the quantity of the resource "contained" in a product, that is, the amount of water needed to produce any given good. In particular, VW is associated with food production and agriculture. The concept of Virtual Water is often associated with that of comparative advantage, that is, the theory according to which a country would benefit by specialising in producing goods or providing services which are cheaper/easier to produce or provide in that country relative to others. As a consequence, countries would be better off by importing goods and services for which they have no comparative advantage. There are however several differences between the two concepts, even though they both related to international trade. First of all, VW does not rely on opportunity cost or production technologies, which are at the basis of comparative advantage theory. Furthermore, it is not necessarily the case that a country affected by water scarcity will not have a comparative advantage in producing a good with respect to a water rich country.

Thus, the two key concepts on which the theory of VW rests are: the amount of water needed to produce a good must be taken into account; and the international trade in goods and their virtual water content should also enter in water balances. For a correct allocation of water resources – and to understand countries' strategies with respect to managing water – one necessarily needs to consider the implications of virtual water and comparative advantage, especially with respect to food production. The quantification of virtual water contents of food goods may however not be straightforward, and in fact, there exist varying estimates, depending on the underlying assumptions and the specific characteristics of producing areas (see, for instance, Zimmer and Renault). In some situations, water consumption for food production may reach up to 90% of the total water available (Allan, 1997).

According to the virtual water approach, countries with scarce water resources would do better by importing goods which require a large quantity of water for their production, rather than overexploiting its own resources. Along the same line, water-scarce countries could specialise in the production of crops requiring less water. The concept of virtual water may thus be used to shape national policies with respect to water management, but other considerations enter into play.

Countries, for instance, are reluctant to rely excessively on imports of primary goods such as food, as this would make them vulnerable to shocks as well as adverse strategies of exporting countries.

The concept of virtual water is increasingly featuring in the global discourse on water resource management. Recent estimates show that about 15% of water resources used globally is exported in form of virtual water. Of this, 67% is exchanged through international trade in agricultural products, 23% is livestock, and 10% is used in the production of industrial goods. Examining trade patterns, it emerges that the areas which export virtual water most are North and South America, Oceania, and the South East of Asia. Importing areas are, on the other hand, central and southern Asia, the Middle East, North Africa and Western Europe[7]. It must be pointed out that countries with very similar socio-economic and environmental conditions may still differ substantially in terms of virtual water trade.

4.4 Technological innovation

Technology plays a crucial role in implementing IWRM strategies, which indeed rely on technological innovation for more efficient water management. Two main sectors of technological innovation may be discerned: on the one hand, information technology for the management and monitoring of water; on the other hand, innovative technologies for the supply and use of the resource. For instance, improved monitoring and information technologies help to better predict climatic events and water availability, as well as to tailor in real-time water abstraction or regulation. Risks and uncertainty are thus reduced.

Technological innovation may interest both the demand and the supply of water – with increasing attention being devoted to demand side management as opposed to the more traditional supply side focus.

On the supply side, for instance, new desalinisation technologies lead to an increase in water availability, even though the plants are still expensive and not very efficient. More promising in the short term are technologies for the recycling of water in both industrial and agricultural production.

On the demand side, innovation has interested both individual consumers and producers. For instance, new technologies allow for waste disposal techniques which use a much reduced quantity of water, while agriculture can now use more efficient irrigation technologies, such as drip irrigation. Domestic consumers can adopt several strategies to reduce consumption, such as WC saving devises.

Water managers have the duty and responsibility of continuously updating their knowledge of technological innovation, and to collaborate with other sectors to ensure that research and development are coordinated and the results shared.

Technological innovation requires substantial investments in research and development: governments should provide incentives to private and public development centres, especially in developed countries. Transfers of technologies and know-how should also be fostered, especially from developed to developing countries. Care must however be taken, as new technologies need to be adapted to the local context – what is viable in developing countries may not be profitable for developing countries, for instance. The best alternative is not necessarily the use of the latest technologies, which may prove to be too sophisticated or expensive, or may be rejected by local communities because not aligned or compatible with the prevailing culture. Traditional knowledge and tools still have an important role to play in IWRM, and must therefore be considered.

[7] www.wateryear2003.org

4.5 Decision Support Systems

As mentioned in Section 3, IWRM calls for the use of innovative tools to facilitate the integration of different disciplines and perspectives within a common framework, to facilitate trade-offs, exploit synergies, and avoid policy conflicts. A promising instrument to facilitate this trans-disciplinary integration is constituted by a family of computer-aided decision making instruments, Decision Support Systems (DSSs), and the process of developing them.

DSSs tools are used to explore different policy options, assessing their impacts, effectiveness and efficiency, as well as equity consequences, thus helping policy makers to take informed decisions. DSSs could be defined as "An interactive computer-based system or subsystem intended to help decision makers use communications technologies, data, documents, knowledge and/or models to identify and solve problems, complete decision process tasks, and make decisions[8]. In recent years there has been a shift in focus of the DSS literature and managers, and it is now widely recognised that the processes of developing DSS tools is at least as important – and sometimes can be more important – than the DSSs tools themselves. The reason is that developing DSS models – understood to encompass a broad range of aspects, that go beyond mere physical models mimicking ecological or operational processes to include the integration of social and economic dimensions – has proven useful in shaping concerted policies, facilitating actors' involvement in the process, and reaching compromises on conflicting issues.

From the review of the National Reports of Nostrum-Dss partner countries, as well as several discussions held within other EU funded projects[9], it is clear that different people view DSS differently. Within the context of Nostrum-Dss, for instance, most of the experience with DSSs reported by partners refers to modelling tools, whereas in the meaning described above DSSs for facilitating decision making processes should encompass more than tools to arrive at the identification of the "best" policy, also aiming at facilitating the process of decision making in all its steps through the involvement of actors and experts in all the phases of DSS design and use. In this broader context, DSSs instruments are based on information tools, and facilitate the collection, integrated analysis, and presentation of data and information, enabling DSS users to highlight the key impacts of different policies through the exploration of possible future scenarios, the effects of alternative policy instruments, and their comparison. Ultimate aim is that of helping decision makers in assessing the potential impacts of the policy options available to them, as well as to help them communicate their decisions and the rationale on which they are based.

DSS tools have a relatively recent history, and their origins can be traced back to the 60s and 70s, in concomitance with significant improvements in informatics and computer tools. According to the literature in the subject, one can identify five main types of DSSs tools:

- communication-driven DSS, which have the main purpose to favour communication among decision makers, or between the decision maker and the public. Communication-driven DSSs also help experts of different disciplines to find a common language, thus ensuring an easier integration of sectoral perspectives and expertise;

- data-driven DSS, which include databases, management and reporting systems, analysis systems,…This group of DSS aims at exploiting large informational datasets, from different disciplines, and analyse them within the same framework;

- document-driven DSS integrate database and reporting tools, with the aim of supporting data and information gathering, as well as dissemination, in particular web-based;

[8] www.dssresources.com

[9] For instance, Harmoni-CA, DSS Guide,…

- knowledge-driven DSS, on the other hand, focus mostly in one discipline as the backbone of their structure, and aim at addressing disciplinary specific problems and requirements;

- and model-driven DSS, which use mathematical models (accounting, financial, ecological, optimisations,…) to assess changes in the system represented.

In IWRM, DSSs are useful for improving the decision making process for two main reasons: first of all, DSS tools can inform decision makers and reduce the risks of inappropriate policies by facilitating the integration of different disciplinary knowledge and expertise, combining geographical, ecological, economic and social information; secondly, the processes involved in developing DSSs tools can foster public participation in problem structuring and decision making, thus lending support and validating the underlying models, ensuring the assumptions are shared and realistic.

DSS tools have the added advantage of facilitating information communication, making trade-offs among different policy objectives more transparent, thus lending stronger justification for the final policy choice. The decision making process can thus rely on strong scientific bases, and be more objective.

The process of developing DSS tools may however be lengthy and costly, and the use of the tool itself may require specific expertise which policy makers may lack. Furthermore, it is not always easy to adapt a DSS tool developed for a specific context to another policy making process, and care must be taken in ensuring that specific local characteristics are integrated in the tool and taken into account in the process of its development or fine-tuning.

5 Progress towards implementing IWRM in Nostrum-Dss partner countries

The previous Chapters introduced the general principles of, and tools for, IWRM. In the remaining parts of this document, the progress and obstacles for the implementation of IWRM in the Nostrum-Dss partner countries will be reviewed[10].

The progress towards implementing IWRM in the Nostrum-Dss partner countries varies considerably, both among countries and areas. These differences reflect environmental and climatic variability, as well as different levels of development – economic, social and institutional. For instance, the Middle East and North Africa are characterised by arid climate, with limited water availability – over 50 million people do not have access to safe drinking water in the region (AWC/UNDP/CEDARE,2005). The situation in the European side of the Mediterranean sea is quite different: although climatic variables are similar, water scarcity is less dominant, and the technological and institutional settings are such that safe water is available to all.

The assessment of IWRM processes in the Nosturm-Dss partner countries can be carried out at different levels: institutional, strategic and political progress, or progress with new technologies, and DSS in particular. Furthermore, the issue of water management in face of increasing scarcity could also be assessed within the framework of virtual water. The strategic review of water resource management would allow the identification of the sustainability of current water management and food production strategies in the Mediterranean area. The estimation of virtual water in food production is beyond the scope of this paper, but needs to be considered for further research and analysis of the information provided by the Nostrum-Dss partner countries.

5.1 Progress with respect to the institutional structure

Institutional and political stability are a prerequisite for the successful implementation of IWRM, and differences in progress are thus strongly affected by the stability of a country. Financial resources are also a limiting factor, as substantial investment is needed for technological innovation, renewal, development projects, etc.

Substantial progress has nonetheless being made in the field of institutional reforms, with the creation of new institutions, streamlining of existing ones, clearer and more rational assignment of responsibilities, with the objective of IWRM in mind. The institutional reform has been coupled with new development strategies, especially in developing countries, which attempt to assess development projects within a unified framework, thus ensuring that their individual implementation exploits existing synergies, and that their objectives and strategies are all compatible with IWRM and other government strategic policies.

5.1.1 International and regional institutions promoting IWRM

At the international level, one of the most important institutional reforms is the creation of the Arab Water Council (AWC), with a geographical focus on North Africa and the Middle East. The AWC works in close collaboration with CEDARE (the Centre for Environment and Development for the

[10] The information presented in these Chapters is summarised from the other deliverables of Nostrum-Dss, in particular, countries' National Reports; D2-4 Report on multi-sectoral approaches to DSS uses in water management; D3-1 Report on economics of the water cycle in the Mediterranean Countries; D3-2 Report on social issues in water management in the Mediterranean Countries; D3-4 Multi-disciplinary report on approaches to decision making and integrated water resources management; D5.5 Report on development and implementation of DSS tools in the Mediterranean Area; D6-2 Comparative assessment of decision making processes, regulations, and laws in Mediterranean Countries; and D6-6 Thematic report on social aspects of conflicting water uses.

Arab Region and Europe), and UNDP (United Nations Development Programme). The AWC involves representatives of countries, NGOs, research organisations, but also individual experts. Its establishment can be seen as a substantial contribution towards the achievement of IWRM in North Africa and the Middle East, as the AWC has a potentially important role to play in promoting this paradigm of water management in member countries. First of all, the Council can promote the exchange of data and information, as well as knowledge; it can favour communication thorough web-based exchange platforms and fora, and provide technical support to water projects, thus further contributing to the practical dissemination of best practices, know-how and expertise. The AWC also plays a crucial role in acting as an intermediary among the Arab League, the scientific community, and international organisations, fostering cooperation among the three parties. Another important role of the AWC , in close collaboration with CEDARE and other local and international institutions, is that of monitoring progress towards IWRM in Arab countries.

UNDP has played a crucial role in the adoption of IWRM strategies in the Mediterranean, supporting participative decision making processes, but also providing technical support to countries in their efforts to develop national IWRM strategies and plans. UNDP has a very important role to play in improving the capacity of the AWC, strengthening its role in the region.

Several other institutions have been very active in the promotion of IWRM, including the World Bank, UNESCO, and FAO. The role played by international organisations is thus critical in terms of supporting countries in their adoption and implementation of IWRM practices, especially for those Mediterranean countries not members of the European Union. International organisations have been pivotal for improving capacity of Mediterranean countries, as well as for financing several IWRM initiatives at the national and regional levels.

CEDARE itself has been active in promoting IWRM in the Mediterranean area, especially through capacity building with respect to environmental planning, integrated natural resource management, transfer of technologies and know-how. CEDARE has also undertaken important research projects in support of regional water development projects, providing technical and scientific expertise, and favouring the establishment of an exchange network among participating countries.

5.1.2 The development of national IWRM plans

The most important institutional innovation in the application of IWRM principles is the adoption, at the national level, of an IWRM plan. This document spells out the overarching principles and strategies that each country intends to implement for the enactment of IWRM, including specific environmental and social objectives that countries pursue through the implementation of integrated water resource management. In Arab countries, the overarching objectives traditionally include to combat desertification and halt the observed land degradation trend; to protect and mitigate the adverse impacts of floods; to manage resources in such a way as to mitigate the incidence of water scarcity, for instance, through the promotion of non-traditional water sources, such as water recycling.

In the last years, substantial progress has been observed with respect to the development of national IWRM strategies and plans, partly thanks to the support of the AWC and UNDP and their capacity building strategies. Several Arab countries have developed advanced drafts of IWRM plans, while others are just beginning the process of setting out overarching national strategies.

Egypt, for instance, is one of the most advanced countries with this respect. The Government has already developed an advanced workplan for the adoption and implementation of a national IWRM Plan, integrating the principles subscribed to at the Johannesburg Summit. Key aspects highlighted in the plan are the need to coordinate NGOs, civil society and public authorities; the need to implement an institutional reform aimed at facilitating IWRM in the country; planning and financing strategies; and the privatisation of water services. The planning model proposed is based on a

comprehensive, integrated approach, in line with the principles of IWRM, attempting to integrate different perspectives and disciplines in a united effort for sustainable water use.

Even those countries on the south bank of the Mediterranean which do not at the moment have a national IWRM plan, or have not formally began the process of developing one, can count on existing documents and strategies which are good starting points for adopting and implementing the IWRM paradigm. This is the case, for instance, with respect to the Occupied Palestinian Territories, where the national water plan already contains several of the key IWRM principles, or Tunisia, where several official reports and documents embrace the paradigm. Other countries, such as Lebanon and Algeria, lag behind in terms of developing a National IWRM plan, although they have expressed the willingness to do so. The political situation and recent instability in these countries may account for the delay. In Algeria, there are several government documents promoting the adoption of an IWRM approach, some of which can be considered as solid foundation for the further development of a national strategy, and water problems feature prominently in the national political agenda. The governments of these countries have been active in addressing water scarcity problems, and are attempting at estimating future water demands and needs. Furthermore, the basis for actors' involvement in the development of further plans has been put in place.

On the northern side of the Mediterranean, Croatia is in a similar position, with a national document promoting activities, strategies and legislative measures aimed at developing new infrastructures, maintaining existing ones, and improving the hydrological system at the river basin level.

In the EU area, the institutional and legislative situation is more advanced. The national implementation of the EU Water Framework Directive has provided further impetus to water resource management in partner countries. In Greece, for instance, the WFD has been transposed in national legislation with a particular emphasis on the prevention of degradation of water resources, especially in wetland areas. Portugal, on the other hand, has introduced a new law to implement, at the national level, the WFD. Italy has shown substantial progress in terms of water legislation, especially with the attempt to reduce the existing fragmentation of laws and responsibilities. An attempt to integrate different strategies and objectives is currently under way, and the new Legislative Decree on Environmental Matters (Law No. 152/2006) was adopted. Section III of the new law deals with water and soil management, but there are several concerns that the reforms introduced in this sector are not in full compliance with the WFD[11].

5.1.3 National institutional reform

Progress in implementing the required institutional reform for the implementation of IWRM is not only in terms of the development and adoption of an IWRM, or the integration of water concerns into other national strategies, but also in terms of the establishment of new organs with different roles and responsibilities for water management and, in particular, for the promotion of IWRM. Egypt has, for instance, established a Committee tasked with managing the process of IWRM, and responding to the Ministry of Water Resources and Irrigation. Other important organs and institutions have been established in Morocco and Algeria, with the aim of promoting public participation in water management, but also private-public partnership for the delivery of several water services, and implement local water development projects. In Turkey, the presence of several NGOs operating specifically in the field of water management and with significant influence at the political level has promoted the IWRM at the decision making level, as well as at other levels of governance. In Spain, a National Water Council has been established, which includes representatives of different public institutions, as well as water agencies, local authorities and communities, experts and consumers, and has predominantly consultative functions.

[11] See http://www.gruppo183.org/english.html and http://www.gruppo183.org/sintesidirettiva.html (in Italian only).

Decentralisation of water management has achieved substantial progress in theory, with basin authorities and institutions responsible for planning at management at the basin level, and the existence of tested partnerships and exchange platform among different stakeholders, water users, managing institutions, etc. It is through this process of decentralisation that local communities are increasingly involved in decision making processes. Another positive impact of decentralisation is a reduction of red-tape, with the consequent speeding up of decisions and interventions at the lower level. France is the leading country in terms of decentralising water management roles and responsibilities, a trend which is observed in all fields of environmental and natural resources. In Spain, decentralisation of powers to local authorities is limited to the maintenance of rivers' ecosystems and the delivery of water services. In Southern Mediterranean countries, decentralisation involved mostly the devolution of responsibility for the maintenance of irrigation infrastructures to local authorities or water users associations. This model has been followed in Turkey, for instance, with important improvements in the efficiency of the irrigation systems. Yet, by large, the current practices in water planning and management in most Nostrum-Dss partner countries remain highly centralised.

In line with the principle of decentralisation and integrated water resource management, partner countries have experienced with the creation of river basins management units. Croatia, Lebanon, Algeria and Morocco have all established relatively recently river basin authorities for the application of IRBM. River basins as planning units have been established in France in the last decades, where basin authorities have been instituted at different levels of governance and geographical interest (national, inter-regional, and regional). Similarly, Italy and Portugal have developed hydrological basins plans. Greece differentiates itself from the practice in other countries, as the boundaries for river basin authorities have been defined on the basis of existing administrative units. In all cases, the authorities have the mandate to implement at the local levels the general guidelines promulgated by the central government for the implementation of the WFD. IRBM processes have been useful especially for the design of risk management tools to tackle water scarcity situations, and for developing and implementing local strategies to combat water pollution.

5.2 Policy reforms

At the policy level, different strategies for managing the water sector have been implemented in line with the IWRM paradigm. First and foremost, Nostrum-Dss partner countries show a tendency towards the privatisation of water delivery services, with positive results in terms of improved efficiency and service quality in many instances. The privatisation of water services has also attracted substantial investment in the sector. In Morocco, for instance, the process of privatisation has reached a considerable level, with the result that the network of water delivery has been expanded substantially. Thus, in Nostrum-Dss partner countries, State irrigation schemes and Water Utilities, also due to incentives from the World Bank, are more and more privatised (Ahmad 2000). But some peripheral offices are not self-sufficient and do not attract sufficient investment, and rather need assistance (Nostrum-Dss D6-6, p.27). Most of the companies operating in the sector are, however, predominantly foreign – an aspect which may compromise the long term sustainability of the water sector. Privatisation is in its infancy in Croatia, which is for the time being concentrating mostly on privatising water treatment services, rather than water delivery services. This can be a good compromise between the quest for efficiency and the need to maintain the equity of water access.

As mentioned earlier, privatisation does come at a risk in terms of accessibility of water services. Despite attempting to limit regressive impacts of water tariffs, however, several countries – especially in the North side of the Mediterranean – are experimenting with full-cost recovery, as contained in the EU Water Framework Directive. France, for instance, has already promulgated many laws and legislations emphasising the need to manage water resources efficiently, minimising excessive use also through the use of economic disincentives.

One crucial aspect of the new governance paradigm for water management where progress remains slow is the adoption of demand side management strategies, as opposed to more traditional, centralised, supply side strategies. Water pricing policies can be considered the most basic form of government intervention to mange and somewhat decrease the demand for water services. As expected, progress is more advanced in EU countries, where the tariff systems, despite national differences, is linked to actual water consumption, and usually organised in tiers – with higher water consumption level being charged at a higher price per cubic meter. Such tariff systems are usually employed for domestic water consumption, and mechanisms and checks are put in place to ensure that large families are not penalised. The implementation of pricing strategies to control water demand in agriculture is still not well developed on both shores of the Mediterranean. Water used in agriculture is not traditionally charged on the basis of actual consumption levels. There are several exceptions – for instance, Greece and Cyprus, where agricultural water is charged, where relatively high water prices discourage farmers from using water for low value crops such as cereals and pulses (Nostrum-Dss, D 2-4, p. 59). In other countries, such as Tunisia, farmers are charged according to their volumetric consumption, but the government heavily subsidises the cost of irrigation (up to 30% of the total cost) (Nostrum-Dss, D 2-4, p. 63; Nostrum-Dss, D3-1, pp. 20-21). Furthermore, the slow uptake of demand-side management policies often leads to the disregard of rational and efficient water allocation among competing sectors: cheap water prices for all sectors' uses encourage wastes, shortage of conservation and lack of knowledge among users of methods and techniques to use efficiently the resources (Nostrum-Dss, D 6-6, p. 46).

5.3 Infrastructure development and technological innovation

In the last year, the priority area of intervention for many countries, especially in the south Bank of the Mediterranean, has been the upgrading of water infrastructures, with the objective of reducing water leakages and increasing the efficiency and cost-effectiveness of water sectors' investments. Egypt, for instance, has initiate water management policies targeting water infrastructures, and which also attempt to spread evenly the costs and benefits of projects and investments in the sector. Similarly, Lebanon is fostering public-private partnerships for the delivery of water services, and encouraging the efficient use of water through a pricing policy which also takes into account regional differences. The experience of Tunisia is very instructive: starting from the early 90s, the Government has promoted several water development projects based on the principles of IWRM, which have significantly increased the quantity of water available for consumption (AWC/UNDP/CEDARE, 2005, p.37), thus reducing the existing conflicts among domestic, industrial and agricultural users. Through significant investments in water infrastructures, Tunisia has been able to exploit about 67% of the water available in the country (Mondello and Mondello, 2006, p. 7). Another example of targeted water investment is Syria, whose national policies have managed to allocate investments to different aspects of water use in an efficient manner, including in building reservoirs and dykes, but concurrently investing in hydroelectric power plants, drainage systems, etc. At the same time, the government has encouraged the adoption of innovative technologies for irrigation and wastewater treatment, thus reducing pressure on water resources. Libya is also carrying our awareness raising campaigns among its farmers, in an attempt to encourage the adoption of water-saving irrigation practices and technologies. Different strategies have been adopted in other countries, where water conservation is a priority as opposed to augmenting water availability (e.g. Morocco), ensuring that both the rural and urban population's demands are satisfied. Turkey has moved towards IWRM in an attempt to align its policies and strategies to those favoured by the EU, anticipating its EU membership. Turkey has, for instance, a very efficient and modern system of water pricing, managing water as an economic resource, with a realised profit for water companies of around 10% (Mondello and Mondello, 2006, p. 18).

Research and development play a crucial role in IWRM. Many Nostrum-Dss partner countries have invested substantial resources in exploring new technologies aimed at both increasing the supply of water and at reducing its consumption, such as the exploitation of rain water, or water recycling. Substantial progress has been made in the field of irrigation, where more efficient and effective

irrigation technologies have been developed. It is however clear that until water becomes a binding constraint for farmers, inefficient irrigation technologies will persist. Water could be a scarce resource because it is not physically available, such as in the case of arid or semi-arid countries; the Government could however also intervene to change the incentives face by farmers through appropriate pricing policies, with water becoming economically scarce and innovative irrigation technologies a sound investment. Finally, technological progress for controlling point source pollution has been substantial, especially in fragile, coastal areas.

Most of the progress in the field is observed in European countries: in the south of the Mediterranean sea, financial and human resource constraints have, to some extent, slowed down the adoption of new and more efficient technologies. Different in legislations are also partly responsible for this. In France, for instance, water companies have to use treatment plants and processes for drinking which clean up water to very stringent standards – a legal obligation which is not present in many countries on the south side of the Mediterranean.

Substantial efforts are now put in fostering and promoting technology transfers from EU to non-EU countries, with a good degree of success. International organisations have also played a crucial role in promoting the adoption of more efficient and water saving technologies. For instance, the Palestinian authorities have been supported by international organisation in studies to further the progress with IWRM, as well as in research and development investments. Extension services and training centres are set-up in several Nostrum-Dss partner countries.

New technologies have allowed the exploitation of non-traditional water sources, such as wastewater and drainage waters, thus augmenting considerably the available quantity of water. Importantly, new technologies are employed in agriculture, with the aim of reducing the quantity of water needed for irrigation: substantial progress has been made in Mediterranean countries where water resources are less abundant, such as Israel and Lebanon, where new irrigation technologies are being increasingly employed (Nostrum-Dss, D2-1, p. 46).

5.4 Progress through the use of DSSs

DSSs have recently gained prominence in the agenda of decision makers, and the tool has been used to aid decision making processes for water management. In this section, we will review the role of DSSs processes and tools in implementing IWRM in Nosturm-Dss partner countries.

DSS tools have been used to design development policies in line with the paradigm of sustainable development, especially for planning at the level of the river basin, and for providing support to decision making for irrigation technologies. The usefulness of DSSs, however, is not limited to the tool itself, but rather it extends to its components and development processes.

In Croatia, for instance, hydrological and meteorological databases, part of DSS tools, have proved useful planning instruments. In Italy, several DSS tools for water management have been developed, even though their use in policy making has been limited. Several managing authorities have nonetheless invested increasing efforts in acquiring information systems on climatic conditions and events, on earth science, in support of water planning. DSSs have been used in Italy to foster the participation of stakeholders in decision making processes, in addition to providing structure and support to policy makers in defining sustainable water resource strategies. Among the countries members of Nostrum-Dss, substantial progress has been made by Egypt, where DSS models have been used in decision making for water resources. DSSs have been used for exploring the link among economic development, hydrological resources and land uses. DSSs have been very useful for collecting information about the preferences and water needs of the population, about the physical characteristics of land and other natural resources, and on the characteristics and structure of decision making processes. DSSs have also been used for exploring the implications of different drainage systems to be employed in agriculture, and on the strategies to prevent non-point source pollution of groundwater.

DSSs tools have been successfully used in France as well, where networks for collecting, storing and processing information relevant for water planning have been established in the process of developing DSS tools. DSS tools have been used for planning in the Senna river basin, with the purpose of monitoring anthropic pressures. As in the other countries, DSSs have been extensively used for planning for irrigation, or for developing future scenarios of water demand and its impacts on agricultural and hydrological policies.

Greece has experimented with DSSs in the framework of the WFD, for instance for exploring the link between water demand and different water policies, use efficiency and economic development. Particularly interesting is the DSS tool designed for water management in Crete, aimed at developing a comprehensive, integrated analysis framework for the identification of water policies able to satisfy a growing water demand and the island's environmental needs – especially in the light of tourism demand.

Lebanon has, with the help of international agencies, developed several DSS models, whose use has however been limited in practice. Similarly, Syria has developed the tools with the help of donors, but with more success: the DSSs developed there have been useful for assessing the value of different water uses, thus optimising water allocation and helping prioritising investment in water infrastructures.

Despite several DSSs tools have been developed in Nostrum-Dss partner countries for water planning and management, their usefulness is still limited in actual decision making processes. In particular, Nostrum-Dss partner countries lament a lack of knowledge and efforts to develop DSS specific for managing the industrial use of water (Nostrum-Dss, D2-4, p. 100). Another shortcoming of DSS as they are currently developed and designed is that they are not well suited to justify decisions taken by politicians, which are not only based on technical grounds alone, but perhaps more importantly on political aspects. In fact, DSS that are strictly related to technical problems – such as routing, operations of water infrastructures,… - are widely used in practice (Nostrum-Dss, D5-5, p.37).

5.5 Decision making processes and actors' involvement

What emerges from the analysis of Nostrum-Dss deliverables is that the institutional structure for water governance is and remains strongly centralised in most Nostrum-Dss partner countries. Some progress can nonetheless be observed in terms of actors' involvement, which has become a cornerstone of the new governance paradigm, and is also enshrined in EU directives and regulations. Public participation (PP) as an important prerequisite for achieving sustainable development emerged in the discussion. In particular, Agenda 21 (UN, 1992), the action plan which was the result of the UNCED held in 1992, identifies "information", "integration" and "participation" as key factors for helping countries to achieve a sustainable development. Indeed, Public Participation can significantly contribute to sustainability, improve the effectiveness of environmental activities, and build the capacity of the actors involved in order to continue the initiative. Public participation is expected to lead to increased public awareness on environmental issues, better use of local and specialised knowledge, improve public acceptance, commitment and support, and increase the transparency of decision making processes, thus reducing conflicts and delays in implementation (EC, 2003a).

Despite the wide acceptance of the benefits of public involvement in decision making processes, in the Nostrum-Dss partner countries one can still distinguish four main approaches to decision making for water governance (Nostrum-Dss, D6-2, p. 32):

(i) Top-down approach, where only government institutions and primary actors take part in the decision making. Primary actors are those who are affected by the decision directly. This is the case, for instance, of Tunisia and Syria, as well as Morocco.

(ii) Top-down approach with the possibility for secondary actors to have an active part in the process, but because of various constraints they do not. Intermediaries in the process of decision making are considered as secondary actors. The constraints to their participation can either emerge from existing conflicts among different governance level and individual actors, as is the case for Italy and Lebanon; or due to a lack of communication and dissemination of information, as in the case of Portugal and Turkey.

(iii) Interactive processes, whereby key actors take active part in decision making activities, and a compromise solution is sought. Key actors are those who can significantly influence the process, or are important in determining the success or failure of an action. Algeria, Cyprus, Spain and Egypt normally follow this route. And

(iv) Bottom-up approaches, where secondary actors and end-users are actively involved and participate both formally and informally, as in Croatia and Greece.

5.6 Progress with the concept of Virtual Water

The analysis of the virtual water content in food production and global trade in Nostrum-Dss partner countries is beyond the scope of this report. Some general considerations can nonetheless be of interest, especially with respect to countries where water resources are traditionally highly strategic and politicised. In fact, the concept of virtual water is particularly relevant for countries with severe water scarcity conditions, such as the Middle East, where scarce water resources are increasingly used for ensuring food security, at times to the detriment of the population. In all the countries of the Middle East, water demand for food production has consistently been higher than internal capacity of each country for the past ten years at least, even though, for political and strategic purposes, this crisis situation has been hidden and minimised by governments (Allan, 1997, p. 4). A valid indicator for the water availability of a country could thus be its imports of food, with higher imports denoting a situation of water scarcity: considering the case of the Middle East, for instance, one observes that food imports have increased substantially since the 70s, in line with the predictions of virtual water concept (Allan, 1997, p. 5). Neither the governments nor farmers seem to have been able to adapt to the growing water scarcity in the area, as they would need to increase imports of food goods with a high content of virtual water while specialising in the production of food stuff with lower virtual water contents. There seem to be, however, strategic and social constraints hampering such a shift.

5.7 Obstacles to IWRM in the Nostrum-Dss Project Partner Countries

Despite the recent progress, significant gaps in the implementation of IWRM principles remain, especially in the Southern Mediterranean, which slow down progress in policy reform and environmental protection. The north-south divide is evident even in this field, with EU countries generally more endowed with financial and human resources and, importantly, with a stronger institutional setting.

One of the key obstacles to IWRM in Nostrum-Dss partner countries is the lack of institutional structures broad enough in scope and mandate to cover all aspects of this new mode of governance – or, as a second best option, lack of a clear coordination mechanism. In fact, when new institutions are created for the specific purpose of implementing and fostering IWRM – think for instance about River Basin Authorities – they often find themselves operating in closed power structures, without the strength of really carrying out their mandate (Nostrum-Dss, D5-5, p. 36). The most urgent area of intervention is thus the building and empowering of the necessary institutional structures to promote and implement IWRM within the existing system of governance.

In the majority of cases, strong centralisation of decision making in the field of water governance persists in practice, even though some countries are increasingly decentralising and attempting to involve local actors in decision making (Nostrum-Dss, D6-2, p.8), at least in theory.

From the governance point of view, the problems encountered in the Mediterranean area can be ascribed to low institutional capacity, unclear roles and responsibilities on the one hand, and very strong private interest on the other. Furthermore, cross-sectoral integration is still not complete, with severe consequences for the planning and management of water resources – which requires a holistic approach, in line with IWRM principles.

There are some key issues which will need addressing before the IWRM paradigm can be fully implemented:

i) the low level of experience and information sharing between EU and Arab countries.

ii) The slowness showed in abiding by the Johannesburg commitments for IWRM, and supporting the achievement of the Millennium Development Goals.

iii) Capacity building for both developing and implementing IWRM plans.

iv) Lack of human resources and expertise on IWRM in international organisations.

v) Scarcity of data on water resources, and low level of accuracy of water reports.

vi) Low level of coordination among donors, causing duplication of efforts and, therefore, low efficiency in using limited resources for water management.

Legislative constraints still exist: in several countries, water legislation is fragmented, with unclear distribution of responsibilities, or obsolete laws – in Cyprus and Lebanon, some water law date back to the colonial period. It is interesting to cite, in this context, the example of Syria: water legislation there is not well aligned with the actual reality of the country, including the increased demand and the worsening of water quality. Enforcement of laws in Syria is also poor, with authorities unable to control illegal water abstraction activities – both for surface and groundwater. Turkey is in a similar situation – with conflicting and fragmented water laws, unclear legislations and obsolete requirements. In Turkey, this situation is often resulting in conflicts over water rights, which are not clearly defined. Similar problems are encounter in most Nosturm-Dss partner countries – both in the north and south parts of the Mediterranean. In addition, the lack of coordination among institution worsens the problems caused by poor or not suitable legislation.

An aspect which is increasingly gaining importance in national legislation is the need to address demand-side management, in addition to the more traditional supply side approach. The shift in legislative emphasis is however slow, with a continued emphasis on strategies to augment water supply, rather than improving efficiency in water use and decreasing water needs. Critical in this respect would be the implementation of appropriate water tariffs, which are however opposed in some cases on the basis of the human right aspect of satisfying human water needs.

Traditionally, agricultural activities are favoured over other uses, with the result that the allocation of scarce water resources is not *regionally* efficient – suffice to cite the example of Israel, linked to the concept of Virtual Water. Israel is not the only country where agricultural production is heavily subsidised, even in its water consumption: Croatia, Greece and Cyprus all have subsidies for water use in agriculture. In some areas of Italy, farmers pay a flat rate for water, which is in no way related to the actual amount consumed.

Water networks and infrastructures are in many cases obsolete and inefficient – in the case of Egypt, for instance, over 50% of transported water is lost through leakages (Mondello and Mondello, 2006 p. 11). The problem is perhaps less urgent in EU countries, but in some cases water infrastructures are needing substantial investments on the north side of the Mediterranean as well: in Spain, for instance, the cost of water delivery is among the highest in the EU,

specifically because of the investment needs of water delivery infrastructures (Mondello and Mondello, 2006, p. 17).

Technological progress in the field of non-traditional water sources, as well as water saving technologies, is, generally, not satisfactory. In addition, substantial resources need to be invested in improving our understanding of groundwater systems: in some countries, such as Egypt, Morocco, and Syria, a significant proportion of water demand is satisfied by groundwater, yet our understanding of water recharge processes, pollution transportation, etc, is not sufficient for designing sustainable use plans.

The participation of actors in water planning and management is still very low in several countries, where water resources are highly centralised – such as Israel and Algeria, but also Lebanon, where a network of water users at the community level is still lacking. In EU countries, public participations should be contemplated in the decision making processes, but the mechanisms available are often highly inefficient, or means to integrate the preferences of actors in actual policies are not clearly established, with a resulting lack of transparency. A common problem identified in the practical experience of Nostrum-Dss partner countries is the reluctance of private actors and government authorities to participate in joint decision making processes – an obstacle whose roots are probably to be found in the specific social, political and economic situation of individual countries, as well as in the long history of social conflict over water in many countries, with the consequence loss of trust in the other parties.

Finally, the use of DSS processes and tools for IWRM is predominant in the research field, but as yet it has found limited use in concrete decision making processes. This is despite the potential of the tool to address some of the identified problems – especially in relation to integrating different sectors and strategies, and favouring the participation of interested parties in decision making processes. DSS tools have been designed and used in several partner countries, especially for the development of databases, numerical models and GIS applications. Despite the technical progress with DSS, which have become potentially valuable instruments to support the implementation of IWRM, there is still limited uptake in practice. This may be partly explained by a sort of inertia in governing institutions, who prefer traditional modes of decision making.

6 Concluding comments

The increasing scarcity of water resources – both physical and economic – has lead to the promotion of new management paradigms, in an attempt to break the link between water needs and water degradation, encouraging sustainable consumption patterns, and the maintenance of key water resources. IWRM is one of such paradigms, aiming at promoting a holistic approach to water planning and management, an approach which takes into explicit account actors' preferences and needs. The EC funded project Nostrum-Dss aims at exploring the state of the art with respect to the implementation of IWRM in countries around the Mediterranean, and in particular the role that Decision Support Tools have played of could play in this respect.

Each Nostrum-Dss partner country experiences different types of problems, or similar problems with different degrees of severity: some countries, for instance, are facing the problem of groundwater overexploitation; in other countries, pollution of water resources is the top priority. Most Mediterranean countries have to deal with water scarcity, a problem which is worsened by changing climatic events and growing demands. This problem is worse in North African and Middle Eastern countries – Algeria, for instance, is experiencing prolonged periods of drought (AWC/UNDP/CEDARE, 2005, p. 17). Egypt is in a similar situation: despite the substantial progress in IWRM, because of increasing industrial and agricultural demands. In Lebanon, despite the water availability is not now constraining, a water deficit is predicted in the next 10-15 years (AWC/UNDP/CEDARE, 2005, p. 27). Tunisia and Morocco have to deal with a very arid climate, which negatively affect water availability. Syria's efforts are severely hampered by a very high rate of population growth, with the consequent difficulties in satisfying growing water demands

(AWC/UNDP/CEDARE, 2005, p. 36). EU countries may be facing a less urgent situation, but are nonetheless suffering from water scarcity: Greece, for instance, is struggling to deal with high seasonal fluctuations in water demands, which are higher in the dry season, and which make planning very difficult (Mondello and Mondello, 2006, p. 13).

This report has briefly discussed the key progress in IWRM, at the institutional, legislative and technological level. Specific emphasis has been given to the role played by participatory processes and DSSs. Progress with respect to IWRM is still relatively slow in the Mediterranean countries, especially in the south side. This is partly due to lower resources – both financial and human – but also to the slow reform of the sector, obsolete or non implementable laws. One of the areas which needs most urgent attention is the existing – and, in some cases, increasing – disparity between rural and urban areas, especially with respect to access to safe drinking water and sanitation services. Furthermore, both in non-EU and EU member states, an excessive emphasis has been given to the agricultural sector, which has benefited from subsidised water rates, slowing down the adoption of more efficient irrigation technologies.

Governments need to change the prevailing orientation of their water policies, from increasing water supply to managing the demand of water, recognising it as an essentially economic resource, and providing incentives for its conservation through an adequate tariff system. The basic access to safe water must, however, not be compromised. Linked to the above is the need to create a market for water resources and water rights, thus promoting the allocation of a scarce resource to its most valuable use.

Public participation in decision making still requires substantial investment – both in terms of creating the right institutional platform, but also in empowering stakeholders and disseminating information and results. Transparent decision making and policies are a prerequisite for their implementation, and thus their effectiveness.

The full implementation of IWRM, especially in countries on the south bank of the Mediterranean sea, requires international cooperation, the transfer of technology and expertise, the adaptation of technologies to local situations and requirements. Financial resources must also be made available, both to promote institutional reform, build capacity, and acquire more data and knowledge of the systems to be managed.

The use of DSS is not widespread among partner countries – at least not in actual decision making processes. DSS attempt to increase the transparency of decision making processes, but as such they may threaten the existing power structure and therefore encounter the opposition of current decision makers. The integration of DSS development and implementation processes, and countries' strategies for enacting the principles of IWRM, should be encouraged as a means to improve water governance, and overcome the obstacles highlighted in Section 5.7 of this Report.

Within this context, the Nostrum-Dss project will finalise the review of IWRM strategies and tools, to identify the most appropriate governance approaches for IWRM with the specific aim of producing Best Practice Guidelines for policy makers, highlighting the potentialities of DSS to improve the implementation of IWRM in partner countries, as well as the critical knowledge gaps that still persist in the field of water resource management and DSS design

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