

# Improving water management through the IWRM approach in the Mediterranean countries

BERNARDINO QUATTROCIOCCHI\* LUCA PASQUALINO\*\*  
FRANCESCO MERCURI\*\*\*

## Abstract

**Purpose of the paper.** The paper is aimed to analyze the importance of water reuse within a strategy of integrated management of water resources.

Using an integrated systemic approach, related to water resource management, the role of water in the set of relations which constitute a valuable source for the Mediterranean countries will be analyzed.

**Methodology.** An integrated water resource management approach and key economic, regulatory, social and technical factors that help to make water reuse projects successful will be reviewed.

**Findings.** At the Mediterranean regions the management of water appears to be complex, due to inhomogeneity of water availability. This should prompt to rethink the means of intervention in these countries, considering structural investments in order to ensure a fair exploitation of water resources.

**Research limits.** The paper is based on the data of the survey conducted by AMCOM.

**Managerial and social implications.** The article aims to demonstrate how a correct management of water resources, have a positive impact on the socio-economic aspects of the area.

**Originality of the paper.** This article will analyze the current state of water management in South Africa after twenty years of applying the IWRM model.

**Key words:** water resources management, water availability, wastewater, IWRM

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\* Full Professor of Management - Sapienza University of Roma, Italy  
e-mail: [bernardino.quattrociochi@uniroma1.it](mailto:bernardino.quattrociochi@uniroma1.it)

\*\* Ph.D. in Management - Sapienza University of Roma, Italy  
e-mail: [luca.pasqualino@uniroma1.it](mailto:luca.pasqualino@uniroma1.it)

\*\*\* Ph.D. Candidate in Industrial Production Engineering - Sapienza University of Roma, Italy  
e-mail: [francesco.mercuri@uniroma1.it](mailto:francesco.mercuri@uniroma1.it)

## 1. Introduction

One of the key factors of economic and social development is water, which has also a basic function in maintaining the integrity of the natural environment. This should not lead to consider the management of water resources separately from the others; on the contrary, the approach to this consideration should be systematic, so we could generate value from the interaction of the elements researched.

The situation of the Mediterranean countries is particularly critical because they have a supply of renewable water distributed in an extremely heterogeneous way. In this region, the scarcity of physical water is an important (critical) issue, and consequently the management of water resources is of great relevance in order to achieve sustainable development. A sustainable approach of water resources management should derive mainly from policy-makers directives, which could ensure that the actual requirements for drinking water, irrigation water, water for industrial use, as well as the continuity of biotopes are fulfilled without constraining the achievement of the very same objective over time. It is based on responsible, effective, as well as efficient water consumption, strongly related to traditional local knowledge and techniques, as well as modern technologies and political approaches targeted at different scales of time and space.

In most Mediterranean countries, the main problem is not only the scarcity of water in terms of average per capita, but also the high cost of making water available at the right place, at the right time and with the required quality. In addition to water scarcity, the wide enough range of technologies that now exist to purify this wastewater to acceptable levels, increased the chances of wastewater to be reclassified as a renewable water resource rather than waste (Asano *et al.*, 1996; Kalbermatten Associates, Inc., 1999).

Various strategies have been developed over the years in response to the growing water demand, such as building infrastructures to transport water to deficient areas. Due to the fact that such projects require a great amount of time and money, alternative solutions are being proposed, such as desalinating seawater or brackish water, water reuse and water conservation measures using water-efficient technologies such as drip irrigation and low-volume flush systems. Discussing alternatives, it is important to examine not only technical solutions but also socio-economic issues such as willingness to pay, public perceptions, risk analysis, assessment of monetary and non monetary benefits, as well as the environmental impacts.

Nevertheless the solutions proposed, wastewater utilization continues to be a considerable alternative with significant development potential but still underused, despite the water scarcity and the strong demand for water supply augmentation.

Analyzing these premises, in these countries, more than anywhere else, an integrated approach for water resources management including wastewater reclamation and reuse locally is required. As a result, and following a general increase in wastewater treatment, wastewater reclamation and reuse is expected to

increase sharply in the Mediterranean basin and become an important aspect of integrated water resources management.

Within the paper is utilized as the basis of investigation the Integrated Water Resource Management (IWRM) model; This is a process which promotes the coordinated development and management of water, land and related resources in order to maximize economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems and the environment. This model has been accepted internationally as the way forward for an effective, equitable and sustainable development and management of limited water resources worldwide and to the face of conflicting demands. Integrated water resources management has been one of the principles of international water management since the 1970s (United Nations Water Conference, Mar del Plata, Argentina, 1977).

Through the IWRM will be proposed an analysis about the state of water resources management in the Mediterranean countries.

## **2. Methods: integrated water resources management approach**

The decision-making process about water management should necessarily recognize the importance of addressing the multi-faceted nature of the planning related to water resources and the decision-making for water use in varied contexts in order to meet diverse needs.

The integrated management of water resources (IWRM) is a management method based on a holistic and collaborative approach in order to manage uncertain and complex situations and to satisfy varied water purposes, having multiple benefits, thus increasing the interest in concepts, tools, and resources for system-based approaches. The systematization of the issues makes it easier to address the complexity arising from multiple factors that influence water management such as increasing demands for water, climate change, aging infrastructure, population growth, land use changes and evolving demands (Najjar & Collier, 2011).

The Global Water Partnership (2000) defines the IWRM as a “process which promotes the coordinated development and management of water, land and related resources in order to maximize economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems”. It is defined also as “a process that strives to balance regional economic growth while achieving wise environmental stewardship” (Bourget, 2006).

A key objective of IWRM is to foster a shared vision of the current challenges and a common desired future, i.e., an improved standard of life quality for people, alleviation of poverty, conservation of the environment, and equitably distributed resources in a socially acceptable and economically efficient manner.

*Box 1: Main variables considered in the IWRM model*

The following variables expands on common IWRM themes and attributes:

- ✓ Multidimensionality - the willingness to tackle water resources as a problem shed of temporal, spatial, environmental and institutional dimensions; to bring multiple stakeholders together; to consider multiple goals and objectives; to treat multiple water purposes; to seek multiple benefits from decisions and interventions made in relation to water resources . This suggests that tackling a water problem or an opportunity must take as many factors into account as are required through a comprehensive approach so as to understand all the key issues with all of the main stakeholders with all of the resources available to take action. Effective action requires defining the problem shed as a whole system.
- ✓ A Holistic System Approach - taking a perspective that examines the whole-a whole system of variables and their interactions and impacts. Variables may include threats and opportunities, stakeholders, resources, goals and objectives, historical precedents, cultural factors, best management practices and impacts of water resources decisions and interventions. Natural systems are defined as entire river basins, watersheds and coastal zones. This allows the application of theories, processes and models now available to describe, analyze and manage whole systems.
- ✓ Sustainability Goals - an appreciation for preserving natural and man-made resources to sustain the environment, economy, quality of life for current and future water uses and users, as well as public safety and security standards. This shifts the focus of outcomes to long-lasting benefits that conserve water and related resources for future use.
- ✓ Working at a Watershed Scale - the advantage of taking a broader geographic view to identify the many factors, actors, issues and opportunities that characterize the development and management of water resources within an area defined by natural watershed boundaries. A system's perspective is naturally afforded through defining the problem shed in the context of a geospatially-defined hydrologic system: a watershed, river basin or coastal zone.
- ✓ Collaborative and Participatory Approaches - the practicality and the benefits of using deliberate and deliberative processes to incorporate the views of diverse stakeholders and multiple objectives across multiple agencies and levels of government and multiple water uses (purposes) to join/share resources and to align aims and efforts. This acknowledges the advantages of using accepted methods and processes to bring people together to collaborate and to strive deliberately toward mutually-agreeable plans and actions.

Source: U. S. Army Corps of Engineers, 2014, p. 2.

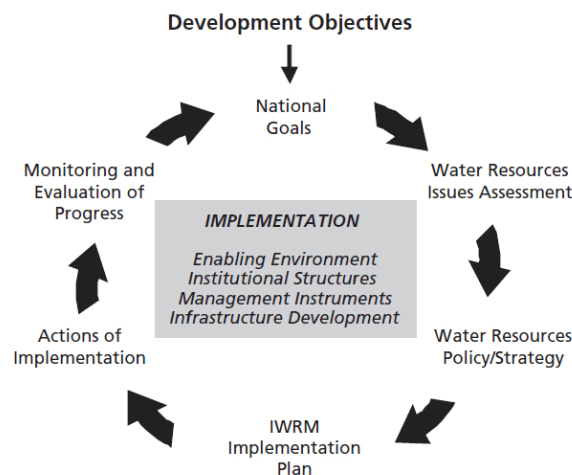
Beginning with the implementation of an analysis about global renewable water resources, recent studies have shown a general increase in wastewater treatment (Ducan, 2004; Judd, 2006; Spellman, 2013), wastewater recovery and re-use expected to improve significantly in the Mediterranean basin and become an important aspect of the integrated management of water resources, but there is still a lot to do.

This situation is caused by several factors such as demographic and climate changes, which is further increasing the stress on water resources. The traditional piecemeal approach is no longer viable and the need to implement an holistic approach to the management of water resources is essential.

In recent years, one of the primary objectives, as mentioned above, has been to promote the adoption of integrated water resources management (IWRM) strategies, trying to find a balance between the needs of different users meeting their water needs and ensure that water resources are not irreversibly depleted.

According to what has been said, the UN summarized in the following diagram the stages of design and development for the implementation of IWRM Objectives.

Fig. 1: Stages in IWRM planning and implementation



Source: UN-Water, Roadmapping for Advancing Integrated Water Resources Management (IWRM) Processes, GWP. 2007, p. 3.

This cycle includes four iterative phases as elaborated by the Global Water Partnership Technical Committee (UNESCO-IHP, WWAP & NARBO, 2009, p. 53):

- Phase I* - Assess the current situation, recognize problems, build governmental and public awareness, generate the incentives and capacity for action. Recognize and identify problems, threats, opportunities, and needs.
- Phase II* - Assess problems and identify potential solutions. Conceptualize at a broad scale so as to include all relevant participants and variables.
- Phase III* - Evaluate options in order to identify a plan. Coordinate and plan in detail.
- Phase IV* - Implement IWRM actions, monitor, and evaluate the results so as to start the cycle (plan) again with forethought and hindsight generated by evaluation and feedback.

It seems clear that 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. 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, this especially in North Africa.

### 2.1 Issues

The Dublin Conference was expected to formulate sustainable water policies and an action program to be considered by UNCED<sup>1</sup>. The conference reports set out the recommendations for action at local, national, and

International levels, based on the following five guiding principles<sup>2</sup> (ICWE, 1992):

- 1) Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment;
- 2) Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels;
- 3) Women play a central part in the provision, management and safeguarding of water;
- 4) Social and economic value of water;
- 5) Integrated water resources management is based on the equitable and efficient management and sustainable use of water.

The first principle, which focuses on fresh water as a resource in limited supply, implies the need to adopt of a comprehensive approach to planning and management, able to consider the water cycle as a whole along with its interactions with other natural resources and ecosystems. 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.

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<sup>1</sup> The United Nations Conference on Environment and Development (UNCED), also known as the Earth Summit, took place in Rio de Janeiro, Brazil, from June 2-14, 1992.

<sup>2</sup> ICWE, International Conference on Water and Environment. 1992. The Dublin Statement on Water and Sustainable Development. <http://www.unesco.org/science/waterday2000/dublin.htm>. Mar 12, 2014.

The third principle refers to Women's role in water management which provides for their full integration in policy making processes. Women are not often allowed to have an active role, because of gender disparities, yet their role is fundamental for the realization of sustainable policies.

The fourth principle of IWRM considers the management of water as an economic resource in opposition to the principle that water - and the renewable natural resources - can be freely usable because they are present in endless amounts.

The perception of water as a limitless need to be changed through the adoption of economics tools which can alter the behavior of consumers, encouraging water conservation and its sustainable use.

The fifth principle of the integrated management of water resources is based on the fair and efficient management and sustainable use of water resources. It recognizes that water is an integral part of the ecosystem, a natural resource, and a social and economic good, whose quantity and quality determine the nature of its utilization.

The Integrated Water Resource Management 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.

## *2.2 Policies and strategies related to water resources*

According to the bank policy on integrated management of water resources, there are two basic principles and one central objective as follows (AfDb, 2000, p. 21):

- The basic principles are that water should be treated as an economic, social and environmental good, and; policies and options that guide water resources management should be analyzed within an integrated framework;
- Its central objective is to promote efficient, equitable, and sustainable development through integrated water resources management.

These basic principles and the central objective of the policy should guide the development, management and allocation of water resources in Regional Members Countries. In accordance with the policy principles and to attain the stated objective, a number of strategies have been elaborated. These strategies apply to or stem from the economic, social, and environmental spheres of influence, or to the technical infrastructure and institutional framework.

The national policies are of fundamental importance because they provide the framework for legislation, strategic planning and operational management. The development and updating of national water policies based on IWRM principles is therefore of critical importance and should be high on the agenda of each government. Policy is the distillation of the current political, economic, social, environmental and technological perspectives in a country. Such perspectives are

always changing; therefore, policy should be dynamic and flexible in the medium term in order to adapt to new situations, and should be revised and updated regularly. Despite the need for flexibility, Policy must provide a firm basis for water resources planning, development and management. Other aspects that should be given important consideration in national policy development are the response strategies in emergency situations arising from natural or man-made disasters such as flooding, drought, earthquake etc. National water policies should provide for institutional mechanisms for the mitigation of such disasters when they occur or to take preventive measures to lessen their impact.

### *2.3 Implementation and action plan*

Integrated water resources management (IWRM) is practical and feasible. In order to achieve a proper functioning of the model, we need a planning of activities through pilot actions.

The planning should not be done in isolation but through practical action and learning. In order to achieve a real implementation of the model, it is necessary to develop and fund a number of river basins / demonstration projects that are going to put the IWRM principles into action.

Another aspect that should be considered is that of working in an adaptive way to deliver results on the ground and use the lessons to improve policies and plans with key stakeholders.

To this end, the implementation of IWRM requires that water management must be coordinated between the levels to facilitate the construction of the consensus. Create platforms for stakeholders to come together to agree on a transparent and define the rights and duties and ensure that the institutions are accountable to their commitments, while the decision-making process integrates the realities of the political process.

The implementation of IWRM funding must be sustainable; must use the concept of cost-benefit products. A useful tool would be to develop incentives that reward those who manage watersheds with a high degree of sustainability.

### *2.4 Monitoring and evaluation of progress*

In recent years, has become increasingly important the monitoring of the activities of the Millennium Development Goals (MDGs), adopted at the Millennium Summit in New York in 2000<sup>3</sup>, both at national and global levels. Through measuring the performance and impact of the feasible programs, it is

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<sup>3</sup> The Millennium Summit was a meeting among many world leaders lasting three days from 6 September[1] to 8 September 2000 at the United Nations headquarters in New York City. Its purpose was to discuss the role of the United Nations at the turn of the 21st century. At this meeting, world leaders ratified the United Nations Millennium Declaration.



possible to track the actual implementation of initiatives to promote and the integration of various activities into the overall development frameworks.

The monitoring activity is aimed to provide regular feedback in order to guarantee coherence, efficiency and effectiveness against the underlying objectives set at national and international levels. The achievement of these objectives will therefore not only stimulate support to the initiatives being implemented, but also improve the formulation of the subsequent programmes, through a “learning circle” informed by the lessons drawn from previous and ongoing activities. Appropriate monitoring activities, which will ensure the achievement of objectives through a programmatic approach that align and adjust the programs according to the circumstances, will be implemented.

Many institutions and organizations invest considerable efforts in monitoring water and water-related MDGs.

Efforts are needed to streamline existing initiatives, reduce overlaps, enhance coordination along partners and identify gaps for further action in water monitoring (UN Water, 2006).

As reported by the UN "goods and services provided by water play a central role in the achievement of the (MDGs)" (UN-Water, 2007).

Application of these activities within the IWRM model, were recorded in 2002 with the World Summit on Sustainable Development - WSSD - (U.N., 2002), in Johannesburg. At this meeting, 193 countries agreed on a strategy of efficient water management through the IWRM model, implementing development plans at both national and regional levels.

The first report about the study of the model after the Johannesburg conference was submitted by UN-Water (2008) to investigate the status of implementation of the IWRM globally.

Subsequently AMCOW (2012), supported by the EU Water Initiative Africa Working Group, commissioned an analysis to investigate the progress that has been made in Africa as a basis for future management actions, in order to promote more sustainable development and management of freshwater resources.

### **3. Discussion: Integrated management of water resources, the importance of water reuse in the Mediterranean area**

In the Mediterranean countries, wastewater is becoming a preferred unconventional source of water (Mubarak, 1998; Haruvy, 1998; Otterphol *et al.*, 1999; Angelakis *et al.*, 1999; Bahri, 1999; Hussain and Al-Saati, 1999; Pearce, 2008), whose supply is increasing, due to population growth and its relatively low cost. Water resources are mostly renewable, yet their availability can rapidly decrease with overexploitation; some publications by international organizations have confirmed how water scarcity is increasing and several studies have identified water scarcity as a serious issue in arid and semiarid areas (Raskin *et al.*, 1998; Gleick, 2000; World Bank, 2012; Who/Unicef, 2012).

Wastewater reuse is becoming therefore a reliable alternative resource, from which it is possible to implement a water resource management based on an holistic approach: integrated water management. Through this, this approach addresses both ends of the process: water demand and supply, wastewater disposal and environmental protection. These two aspects of water management are regarded as complementary, interacting strands for progress towards more sustainable development. (Lazarova *et al.*, 2001). As far as the Mediterranean regions, which are mostly arid and semi-arid regions and where current fresh water reserves are at a critical limit, the recycling of wastewater acquires a great importance, also in function of population growth and the relative water demand.

The implementation of IWRM in the Mediterranean area needs 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 taking into account the peculiarities of socio-economic and environmental aspects of the area. In particular, governing institutions will need to ensure that both urban and rural population have access to safe drinking water and sanitation services, considering environmental constraints, but not compromising the economic development.

In the countries where it is possible to highlight a scarcity water context, solutions to be taken may be referred as following:

- developing any undeveloped water resource, including desalination of brackish or sea water;
- waste water treatment and reuse;
- inter-basin transfer;
- more efficient irrigation systems;
- minimizing water leakage;
- application of adequate charges for water;
- importing water from neighboring countries.

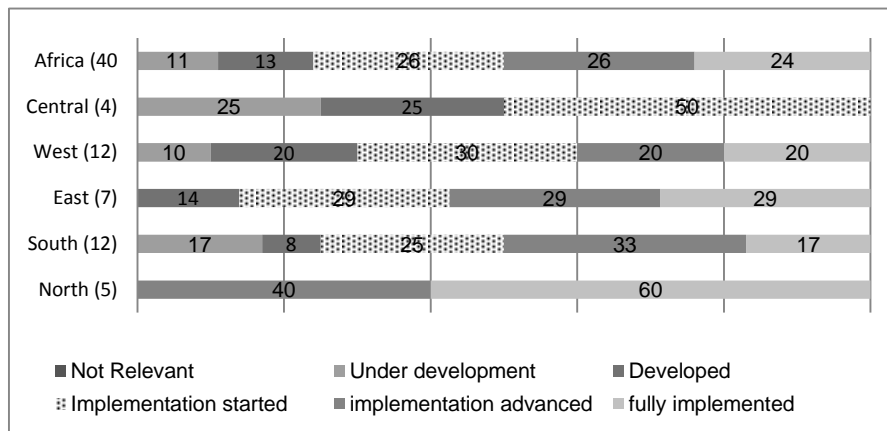
The reuse of wastewater and its treatment modalities have certainly an important role, but at the same time, it is necessary to focus on the efficiency of water use and the reduction of waste and losses in the distribution systems, as processes that do not involve wasteful investments.

### *3.1 The state of the application of the IWRM model in North Africa*

In this section we will analyze the current status regarding the integrated management of water resources in North Africa.

According to a survey conducted by Amcow (2012, p. 11) the North Africa reports the greatest progress on the implementation of the national and federal water law. In fact, 60 percent of the states of North Africa have fully implemented the legislation on water.

Fig. 2: National/Federal Water Law: the current status of the main water law by sub-region



Source: Amcow (2012), p. 11

Despite the legislation of the countries of North Africa that has implemented significant reforms concerning the manner of use of water, the results of the actual increase of usable water are still not relevant.

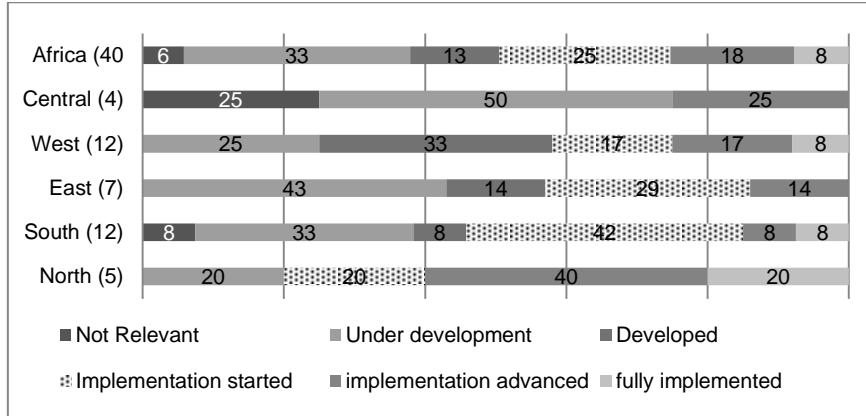
In order to complete the reforms on the regulation of water in North Africa and to accelerate the creation of a favorable environment for an integrated approach to water resources management, it would be appropriate to consider the following points:

- identify the barriers to legal and political reform in the countries lagging behind, especially those from difficult historical contexts;
- enhance political will for water reforms by conceiving and implementing specific programmes on information, sensitization, and advocacy to target decision makers;
- promote integration of water management across sectors;
- establish the survey as a monitoring instrument for Africa.

Regarding the strengthening of the institutional frameworks for water management, it is necessary to include the participation of key stakeholders at the table of decision as farmers, industries and most disadvantaged populations.

The basic principle of the model IWRM is that the water resource must be managed from the lowest institutional level. Moreover, it promotes an integrated approach, necessary to account for the different interests and to improve efficiency in investment decision. However, as you can see in the chart below, not all countries in North Africa have implemented mechanisms for the management of water resources in cross-sector.

Fig. 3: Mechanism established for cross sector management water resources

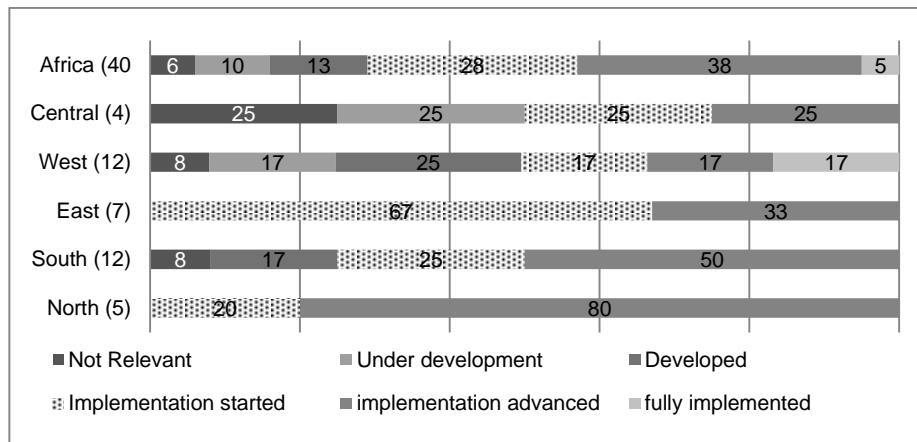


Source: Amcow (2012), p. 17

The model will be able to function properly, only when all stakeholders will have the opportunity to express their needs.

Another aspect to secure relief and needs to be considered, concerns the monitoring of water resources at the regional level, as it is possible to see from the table below.

Fig. 4: Status of monitoring systems for water quality at a sub-regional level



Source: Amcow (2012), p. 25

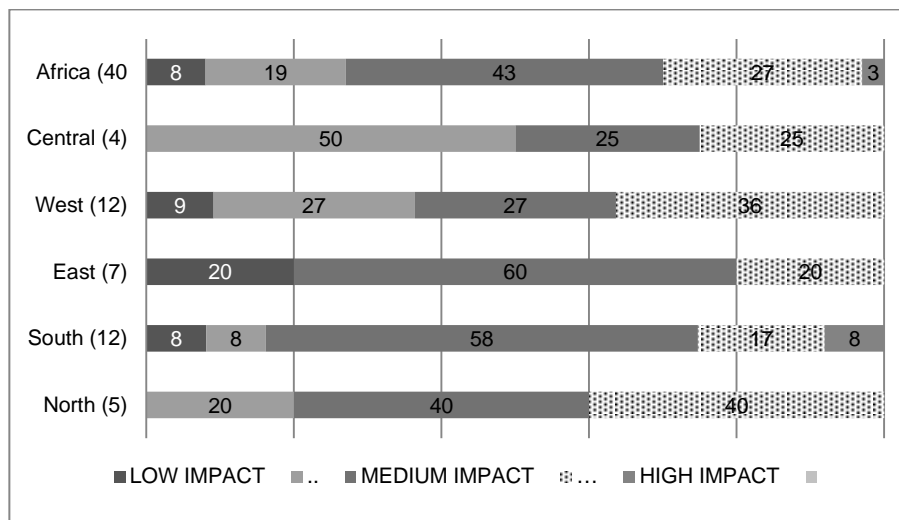
As can be seen from the previous table, eighty percent of the nations of North Africa have introduced monitoring systems at the regional level, finding an advanced implementation in most of these countries.

### 3.2 Focus on the socio-economic and environmental aspects

Implementing the above analysis, it is necessary to analyze how an improved water management influences the socio-economic development of the African countries, focusing on MENA (Middle East North Africa) regions.

The next figures show the degree of impact that water management has had over the last 20 years in the African sub-region.

*Fig. 5: Impact of improved water resource management on social development objective in the past 20 years, by sub-regions.*

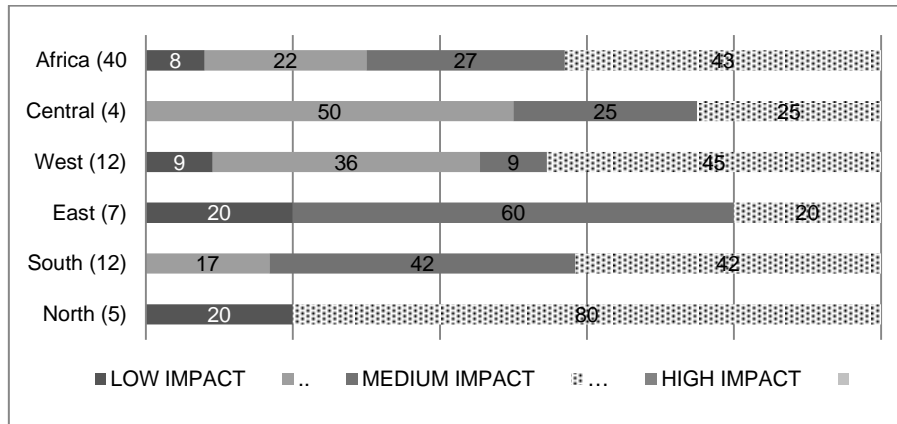


Source: Amcow (2012), p. 44.

Figure n. 5 clearly shows that North Africa carryovers higher values than the average across the continent, which seems in line with the development policies adopted (as shown previously with regard to social, economic and environmental data).

Over the past 20 years, the economic development of North Africa stands at excellent values, which means that the application of the IWRM model has been driving significant results.

Fig. n. 6: Impact of improved water resource management on economic development objective in the past 20 years, by sub-regions



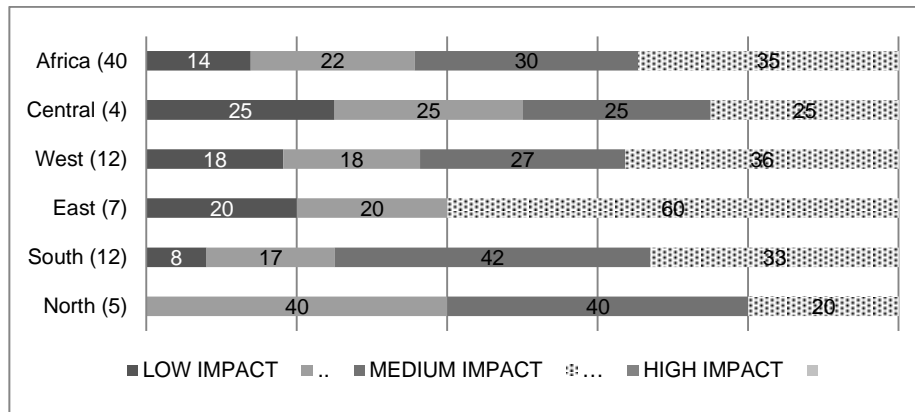
Source: Amcow (2012), p. 44.

The previous table shows that eighty percent of the North African countries have achieved, over the past twenty years, a medium-high economic impact.

It is also necessary, in order to correct socio-economic analysis, considering the environmental impact that proper water management has on the environment in which it is implemented.

In the next figure the impact of a proper water management in each African sub-region, considering the last twenty years, will be represented.

Fig. 7: Impact of improved water resource management on environment development objective in the past 20 years, by sub-regions



Source: Amcow (2012), p. 45.

In this case, the environment development objective in North Africa shows a lower percentage compared to the other sub-regions of the continent, as opposed to the impact produced related to socio-economic aspects.

#### 4. Conclusions

A clear imbalance between the water resources and the growing global pollution in the African continent makes the integrated water management a necessity. Water has always played a key role to economic development.

The African continent, by not applying a real policy of water management, has always demonstrated difficulties in socio-economic development but, as demonstrated in this paper, after twenty years of applying the IWRM model is possible to see growing improvements.

As it has been highlighted from the analysis of the data provided within the paper, a proper management of the water resources initiates from a careful planning legislation, both in national and regional level, involving always the stakeholders of the interested sectors.

In order to achieve high levels of efficiency within a water management strategy, it is considered appropriate to develop water reuse systems such as constructed wetlands or desalination, that as recently highlighted by many studies on this issue (Witters *et al.* 2011, Zhang, 2010), have been shown to be an important alternative.

The efforts that must be supported in order to achieve a proper water management in North Africa, can be traced back to the development of efficient tools for a complete planning and monitoring, through which the Integrated Water Management model (IWRM) will develop its full potential in order to achieving goals. For this purpose, particular attention should be geared also to a proper financial planning and adequate economic analysis, taking into reference all the benefits that derive from the model.

The ability to be accessed equitably and rationally by all African countries, water resources should constitute a benefit both in local and global level, because the water resources must not be considerable a privilege for the few.

Concluding, it can be stated that if the nations of North Africa will continue to apply in a timely manner the pattern of integrated water management, there will be an increasing opportunity to achieve the goals set from the Africa Water Vision 2025.

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