INECO

Institutional framework and decision-making practices for water management in the Oum Er Rbia Basin, Morocco

Towards the development of a strategy for increasing efficiency in irrigation water use

March 2009

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SIXTH FRAMEWORK PROGRAMME

PREFACE

Morocco is an arid to semi-arid country, with a fragile endowment of water resources. Water availability is greatly influenced by the pronounced inter-annual and seasonal variation of precipitation and the heterogeneity in its spatial distribution. This has a major effect on the national economy, where agriculture plays an important role. To address problems related to the increasing disparity between water supply and demand, the State undertook several actions, such as regulation of water flow, development of an extensive irrigation network, inter-basin transfers to ensure water supply in large cities, and engagement in a National Debate on water-related issues, with the aims to further promote the involvement of stakeholders and identify future policy directions for improved water management.

The Oum Er Rbia Hydraulic Basin, located in the mid-west part of Morocco is a River Basin of strategic importance for the country, which has already been the focus of important investments in hydraulic infrastructure. The Basin provides water to the strategic economic zone of Morocco (Tadla, Doukkala and the inshore zone Casablanca-Safi), sustains important economic activities (industry and agriculture), and hosts a significant share of the country's population. Currently, the Basin faces various natural and technical constraints, mostly concerning the sustainability and availability of water in terms of both quantity and quality. The most important of these comprise: (a) the overexploitation of groundwater resources, due to overpumping but also to reduction in precipitation; (b) water quality deterioration; (c) low efficiency in water use; and (d) increased requirements for flood protection. As the largest part of available water resources has already been exploited, there are limited alternatives for increasing water supply; in this regard, the Oum Er Rbia Hydraulic Agency focuses its efforts in regulating the demand for different water use sectors, and particularly in agriculture, which is the major water use.

This volume of the INECO publishable reports outlines the analysis of the institutional framework and decision-making practices for water management in the Oum Er Rbia Basin and in Morocco. It highlights the main water management challenges faced in the region today, and focuses on one water management issue that is considered of primary importance, the efficiency of practices in irrigation water use. Currently, losses in the irrigation distribution networks of the Basin are estimated at 20%; however, water losses due to the applied irrigation methods and practices are of the order of 50%, whereas the agricultural land equipped with advanced irrigation systems is estimated at only 10%. In this regard, it becomes evident that additional measures need to be implemented for water conservation, in order to foster changes in water use patterns.

This volume has been compiled by ISKANE Ingeniérie; its completion would not have been possible without the contribution and assistance of the Oum Er Rbia Hydraulic Basin Agency, and the personal involvement of its Director, Mr. Zerouali and his collaborators. Special thanks are also extended to the three Offices for Agricultural Development in the area, in the persons of Mr. Bellouti, Mr. Saaf, Mr. Sghir and Mr. Nassiri, and to the user associations which supported this initiative, especially Mr. Eddahbi and Mr. Riad.

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PART I: WATER MANAGEMENT IN THE OUM ER RBIA HYDRAULIC BASIN: SETTING THE SCENE

GENERAL CONTEXT

WATER MANAGEMENT IN MOROCCO

Morocco is an arid to semi-arid country, with a fragile endowment of water resources. The yearly average precipitation approximates 1000 mm. However the hydrological context of the country is greatly influenced by the pronounced inter-annual and seasonal variation of precipitation and the heterogeneity of its spatial distribution.

The economy of the country, where agriculture plays an important role, depends strongly on water availability. The evolution of the GDP between the 1970s and 2000 manifests the importance of climate and rainfall in economic growth. For example, during the decade 1990-2000, GDP growth was less than 3%, due to the frequency of droughts. According to the respective reports, the price of cereals and other agricultural outputs increased six-fold and four-fold during the agricultural campaigns of 1989-90 and 1998-99. Water quality deterioration is also becoming alarming, and its cost currently exceeds 15 billion Dh per year, i.e. 6% of the GDP.

Meanwhile, the average renewable water resources per capita is reaching the value of 1,000 m³/cap/yr, which is considered the critical threshold for water scarcity and water crisis. This indicator portrays that water shortage is becoming a fact-of-life, which should be taken into account in all future policies and water management strategies. Water management has been of concern since the 1960s, when Morocco initiated the implementation of large-scale hydraulic, economic and social programmes.

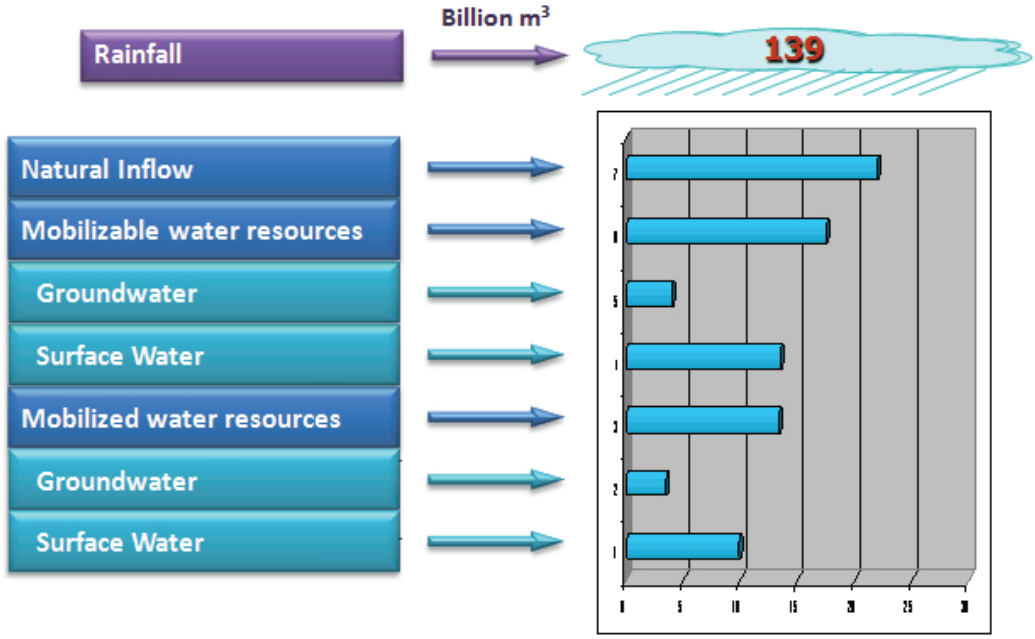


Figure 1: Water budget of Morocco (data for 2006)

While groundwater resources had already been subject to assessments and advanced exploitation schemes, surface water was still a weakly valued resource, until the decision was taken to launch a National Programme for the irrigation of 1 million hectares. After a period when water resources were developed only at the project level, planning evolved to regulating surface water at the watershed level. The goal was to identify supply enhancement al-

ternatives that would maximize benefits and provide water for potable water use, crop irrigation, hydroelectricity production, exploiting all possible dam and reservoir construction sites within the basins. The development of hydraulic infrastructure was followed by concerns over the allocation of available supply, particularly during drought episodes, when problems were more acute.

The fast growth of water demand led also to the exacerbation of water pollution issues, due to human pressures on the aquatic environment and the limited financial resources available. This in turn, raised the need for a global, coherent vision for water management, which would consider both quantity and quality aspects and where water management practices would be integrated with the general interests of the country.

Since 1982, public authorities introduced in their administrative practices the concept of water management at the watershed level. This resulted in the establishment of administrative divisions (DRH) with territorial planning expertise within the governmental department responsible for elaborating the national water policy. Each DRH corresponded to one or several watersheds, and was responsible for elaborating upon water management issues.

The prolonged and acute drought episode, experienced from 1981 to 1986, strengthened national awareness on the crucial and strategic importance of water management for the development of the country and on the necessity for reform in the institutional setting for water management.

WATER MANAGEMENT IN THE OUM ER RBIA HYDRAULIC BASIN

The Oum Er Rbia (OER) Hydraulic Basin (Figure 2) is a river basin of strategic importance in Morocco as:

- The water resources of the basin are extremely important, as they are used in the strategic economic zone of Morocco (Tadla, Doukkala and the inshore zone Casablanca-Safi);
- The area concentrates economic activities (industry and irrigated agriculture) and a significant part of the population;
- The OER basin has already been the subject of important investments on hydraulic infrastructure. The basin has the largest number of dams among Morocco basins.
- The region that includes the OER basin and the adjacent to the south region, which depends for its water supply on the OER resources, is under water stress. Therefore, the Basin Agency is mainly oriented towards water demand management issues.

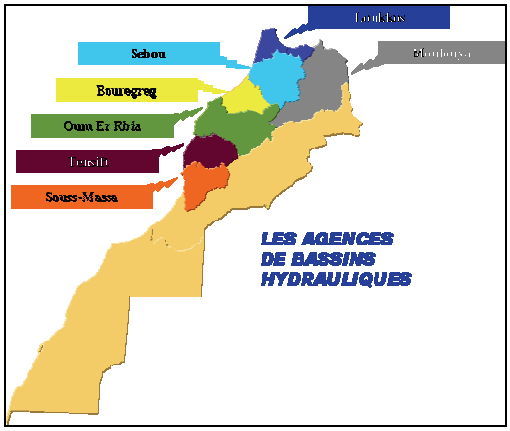


Figure 2: The location of the Oum Er Rbia Basin (marked in green)

In relation to the entire country, the Oum Er Rbia Basin represents 7% of the total area of Morocco (50,000 km² vs. 720,000 km²) and 14% of the population (4.5 million vs. 32 million). The water resources of the Basin account for 19% of exploitable resources (2,946 million m³ vs. 23,000 million m³) and 19% of the exploited resources (3,062 million m³ vs. 21,000 million m³) of Morocco (Table 1). Morocco is a country that relies mostly on storage reservoirs; in total, there exist 116 dams, with a total storage capacity of 15 billion m³. Fifteen (15) of these are located in the Oum Er Rbia Basin and have a total storage capacity of 5.09 billion m³.

Table 1: Water resources of Morocco and of the Oum Er Rbia Basin (million m³)

	Surface water	Groundwater	Total
Mobilizable			
Morocco	18,000	5,000	23,000
Oum er Rbia Basin	2,511	435	2,946
Mobilized			
Morocco	17,000	4,000	21,000
Oum er Rbia Basin	2,440	622	3,062

The Basin Agency of Oum Er Rbia was the first to be established in Morocco in 1999; the Basin Agencies of Moulouya, Sebou, Loukoss, BouRegreg, Tensift and Souss-Massa were established in 2002. Being the pilot Basin Agency for Morocco, the Agency benefited from continuous follow-up activities (e.g. twinning with the French Basin Agency of Adour-Garonne for training programmes, organization of seminars etc).

General features

As mentioned above, the Oum Er Rbia hydraulic basin extends over a surface of approximately 50,000 km² (Figure 3). The Oum Er Rbia River, with a total length of 550 km, originates from the Middle Atlas (altitude of 1,800 m), traverses the Middle Atlas chain, the Tadla plain and the Meseta area, and discharges in the Atlantic Ocean, at a 16 km distance from the city of El Jadida.

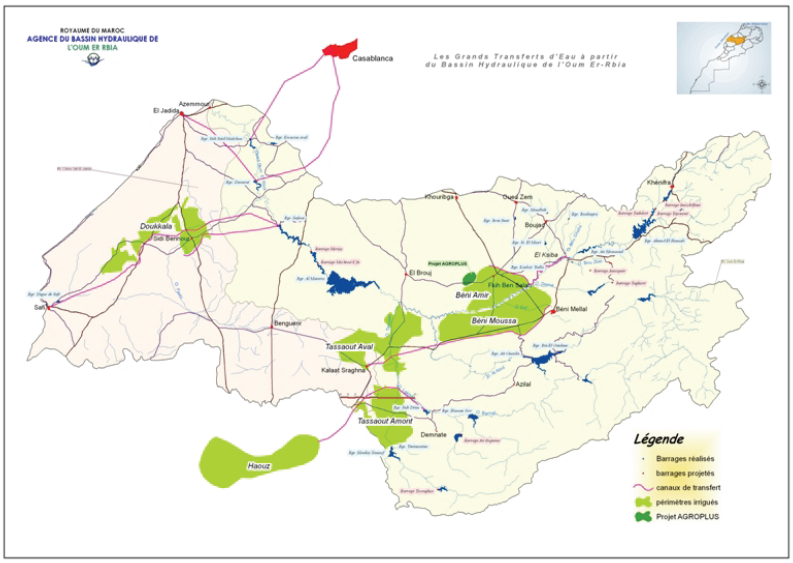


Figure 3: The Oum Er Rbia Basin – Area under the responsibility of the Oum Er Rbia Hydraulic Agency

The population of the basin is approximately 4.5 million, of which 65% is rural. Population density is higher in the central part of the region, near water sources and along river and stream courses. The basin sustains diverse economic activities, including irrigated and rainfed agriculture, mining, agro-food and numerous large manufacturing industries.

The yearly average precipitation is 356 mm, ranging between 1,100 mm in the Middle Atlas and 200 mm in the downstream zone of the river. On average, there is snowfall 20 days/yr in altitudes exceeding 800 m. Temperature ranges between 10 and 50°C and potential evapo-transpiration accounts for 1,600 mm/yr on average along the coast and 2,300 mm in the hinterland, reaching the maximum value of 300 mm in July and August. As outlined in Table 2, over the last decades, there has been a significant precipitation decrease in several parts of the basin, (High Oum Er Rbia, Central Oum Er Rbia, Low and Middle Oum Er Rbia, El Abid and the Tessaout).

Table 2: Precipitation decrease in the Oum Er Rbia Basin

Region	Mean annual precipitation (mm)		Average yearly decrease (mm/yr)
	1950-1970	1980-2000	
High OER	650	496	-4.8
Central OER	644	404	-7.5
Middle and low OER	431	367	-2.0
El Abid	649	397	-7.9
Tessaout	699	475	-7.0

Surface & groundwater resources

The basin's water courses comprise the Oum Er Rbia River and its main tributaries: Tessaout, Lakhdar and El Abid (Figure 4). The average surface run-off of the basin is estimated at 2,511 million m³, ranging between a maximum value of 7,710 million m³ and a minimum of 1,400 million m³. In addition to snowmelt, numerous sources contribute to surface run-off and sustain the flow of the Oum Er Rbia River.

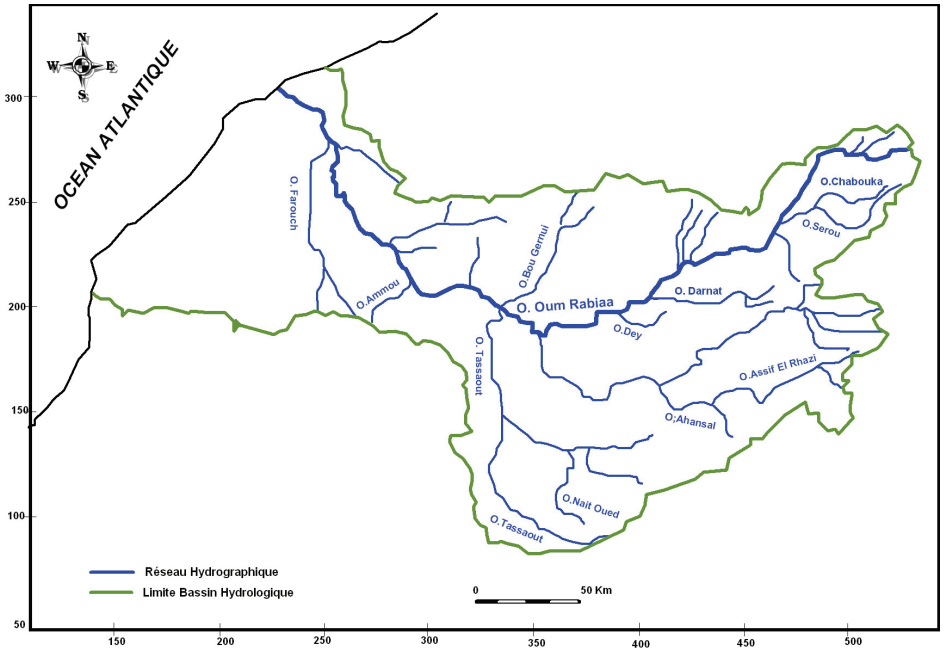


Figure 4: The Oum Er Rbia River and its tributaries

The groundwater resources of the Oum Er-Rbia basin are relatively important, distributed among several aquifer units (Figure 5).

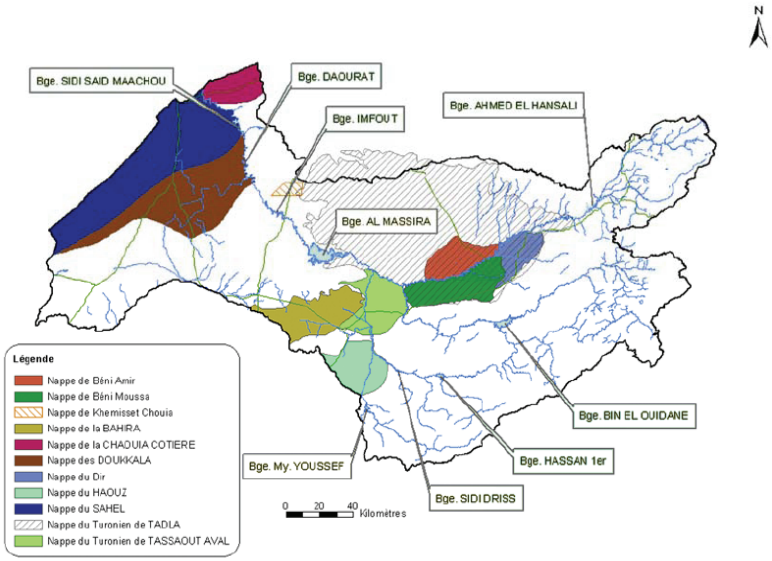


Figure 5: The Oum Er Rbia Basin aquifers

The Tadla aquifers form a multilayered system comprising 4 superimposed aquifers, separated by impervious or semi-impervious layers, and including: (a) the carbonated Turonien aquifer, (b) the Senonien aquifer, (c) the sandy calcareous Eocène aquifer, and (d) the alluvial aquifers of the Tadla and the downstream Tessaout (aquifers of Beni Amir, of Beni Moussa and of the Tessaout).

Water quality

The main water pollution sources in the region include discharges of untreated urban and industrial effluents, and diffuse pollution from agricultural activities, as a result of agrochemicals' use. These result in the deterioration of the quality of both surface and groundwater.

Surface water quality is generally good in the upstream regions of the basin, and gradually degrades downstream, as a result of urban and industrial discharge. The section of the Oum Er Rbia river between Kasba-Tadla and downstream of Ouled Zidouh is excessively polluted from the combined discharge of industrial and domestic wastewater. The situation is aggravated during the summer months, due to sugar production activities and the discharge of other untreated effluents.

Groundwater quality is continuously deteriorating. During the last 15 years, the measured concentration of nitrates has escalated to alarming levels, with concentrations exceeding 50 mg/l in the majority of monitoring points. This adds to the elevated salinity levels measured in some water tables (Beni Amir, Beni Moussa West).

Water resources exploitation and use

In view of its importance, the Oum-Er-Rbia basin drew the attention of water managers since 1929, when the Sidi Said Maachou dam was constructed. Since then, 15 dams were developed, of which 5 can be considered important. The current storage capacity is 5,090 million m^3, whereas the total regulated water volume is 3,604 million m^3/year, i.e. 33% of the total volume in the country (Table 3 and Figure 6).

Table 3: Existing hydraulic infrastructure

Dam	Operation year	Storage capacity (million m³)	Height (m)	Purpose[1]	Regulated volume (million m³)[2]
Ahmed EL HAN-SALI	2001	740	101	E, I	473
A.MESSOUD	2003	14	34	E, I, U	-
Kasba TADLA	1935	0.1	11	E, I	-
BIN EL OUIDANE	1954	1243	132	E, I	945
AIT OUARDA	1954	4	46	E, I	-
HASSAN 1st	1986	245	145	E, I U	346
SIDI DRISS	1980	1.3	42	I, U	-
MY YOUSSEF	1969	150	100	E, I	250
TIMINOUTINE	1979	5.3	45	I	-
AL MASSIRA	1979	2657	82	E, I, U	1590
IMFOUT	1940	17.3	50	E, I, U	-
DAOURATE	1950	7.7	40	E, U	-
Sidi Said MAA-CHOU	1929	1.5	28	E, U	-
Dam of Safi	2001	2	18	U	
Dam Sidi Daoui	2003	5	8.5	U	
TOTAL		5086.6			3604

Overall, surface water regulation is favourable in the area, mostly due to the existence of the large Al Massira dam (Figure 7), located in the downstream part of the basin. Water is primarily used for drinking water supply, crop irrigation and hydroelectricity production.

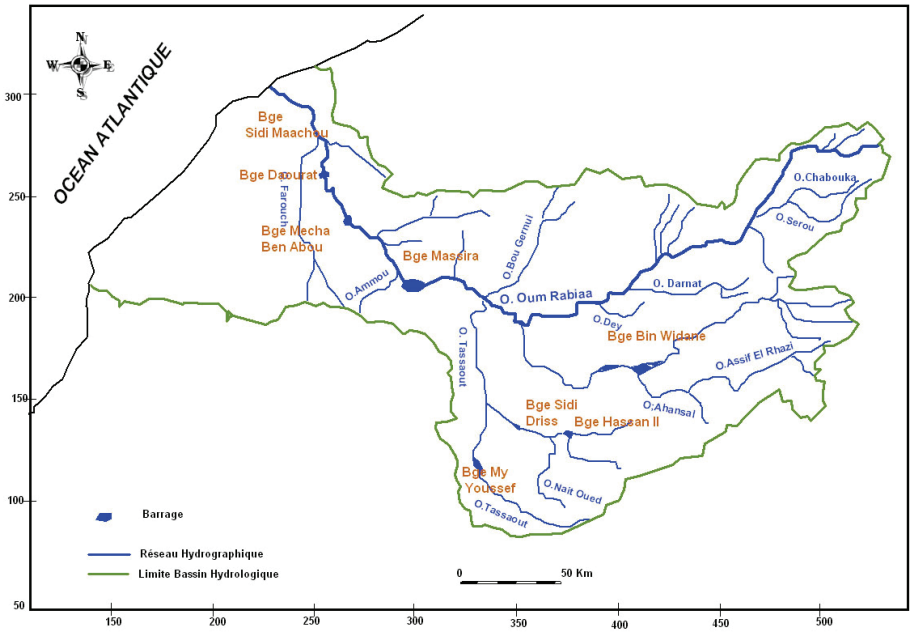


Figure 6: Large storage reservoirs in the Oum Er Rbia Basin

[1] E: Energy production; I: Irrigation, D: Urban (domestic and industrial water needs)

[2] According to the Master Plan of 1992

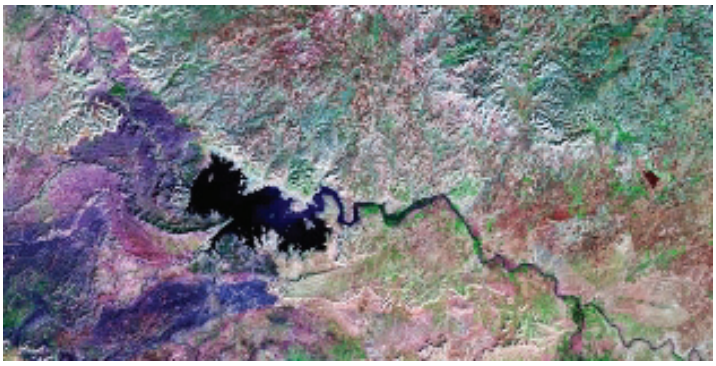


Figure 7: The Al Massira Dam

At the national level, the effort for exploiting groundwater resources currently offers a supply of 3000 million m³ per year, which represents 10% of the total mobilised resources. Annual abstractions from the main water tables of the Oum Er Rbia Basin are detailed in Table 4.

Table 4: Average annual groundwater extraction (million m³)

Use	Phreatic water tables	Eocène	Turonien	Tassaout Downstream
Drinking water supply	39.5	13	33.5	2
Irrigation	449	37	11	37
Total	**622**			

The volume of water used in the Basin escalates to 4,270 million m³. Of this amount, 91% originates from the exploitation of surface waters. This volume allows for the irrigation of more than 387,500 ha, the production of 1866 GWh of energy (on an average year), the provision of drinking water supply to 5 million inhabitants and a minimum release to ensure the environmental protection of water courses.

Table 5: Water demand and supply in the Oum Er Rbia Basin (million m³)

Use	Surface water	Groundwater	Total
Irrigation	3411	534	3945
Drinking and industrial water supply	72	88	160
Inter-basin transfer (urban water needs)	165		165
TOTAL	**3648**	**622**	**4270**

The total demand for drinking and industrial water, to be supplied from the water resources of the basin is approximately 325 million m³; of this amount, 35.5 million m³ accounts for water demand in rural areas, whereas 45 million m³ corresponds solely to industrial activities. The demand is met through the abstraction of 237 million m³ of surface water and 88 million m³ of groundwater. The major cities supplied from the basin's water resources include Beni Mellal, Khouribga, Oued Zem, El Jadida, Casablanca, Settat, Berchid Safi and Marrakech.

The industrial and domestic demand of cities of Casablanca (approx. 4 million inhabitants) and of Marrakech (approx. 1 million inhabitants) is also met through inter-basin transfers from the Oum Er Rbia Basin. The current volume of water supplied for meeting water needs in cities located outside the basin (Casablanca, Settat, Berchid and Marrakech) is 165 million m³/yr, broken down as follows:

- 120 million m³/yr for Casablanca, Settat and Berchid, supplied from the Al Massira complex;
- 45 million m³/yr for the Marrakech city from the Hassan 1er-Sidi-Driss complex.

Within the basin, crop irrigation needs account for 3,910 million m³/yr. Of this amount, 2,966 million m³ are supplied from the large hydraulic works and 475 million m³ are supplied from small and medium-scale infrastructure. As described above, the development of irrigated agriculture was boosted from the implementation of the corresponding hydraulic infrastructure. Currently, the total area irrigated from the large hydraulic works is equal to 323,000 ha, including the 31,700 ha currently equipped in the Central Haouz. Small and medium scale water works are used for the irrigation of approximately 64,500 ha.

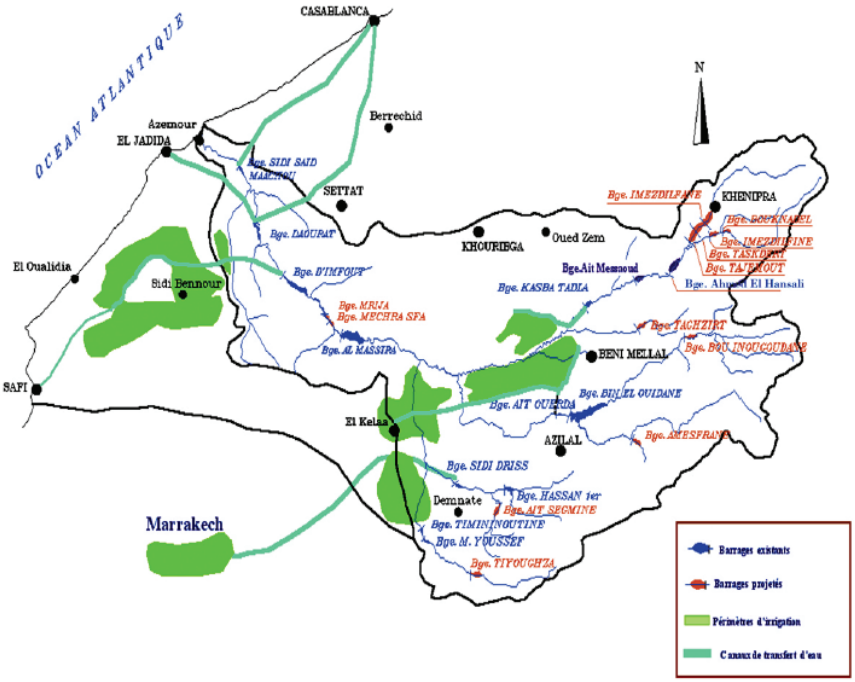


Figure 8: Location of storage reservoirs, canals for inter-basin transfer and irrigation perimeters

The Oum Er Rbia basin is the basin with the largest hydroelectricity power plants. The currently installed power, not including the plant of Afourer, is 623 MW (50% of the nationally installed hydroelectric capacity). On average, 1866 GWh/yr are produced, accounting for 60 to 72% of the total hydroelectricity production.

GOVERNING WATER

THE INSTITUTIONAL SETTING

The legal basis of the formulation of water policies is the Law adopted in July 1995 (Water Law). The Water Law was introduced with the aim to address the challenges the country is facing, i.e. increasing water scarcity, significant demand pressures, increase of water supply and treatment costs, deterioration of water quality and of the environment. The main principles adopted by the Water Law are:

- **The public character of water resources:** All waters form part of the public hydraulic property, except for traditional water rights, whose property is either already established or recognized through a suitable procedure;
- **The uniqueness of the resource:** Water is unique, and the quantitative and qualitative aspects of surface and ground waters are inseparable;
- **The geographical entity for water management:** Water management is undertaken at the Hydraulic Basin scale, which is recognized as the suitable geographic entity for the development and management of water resources;
- **The recognition of the economic value of water:** The application of the user- and polluter-pays principles acts as an incentive rather than a dissuasive measure for water conservation through the regulation of water demand;
- **The national and regional solidarity:** The establishment of Basin Agencies aims at the reinforcement of solidarity mechanisms, particularly in water management processes, and among users, sectors and regions;
- **Dialogue in water management:** Water management issues must be discussed at all levels (national, regional and local) between authorities, decision-makers, users and elected representatives. Two major arrangements aim at permitting the initiation and finally the establishment of dialogue in water management:
    - The affirmation of role of the **High Council of Water and the Climate**, which is the forum that allows all national actors concerned by water issues to debate on the national policy and the main policy directions in water resource management.
    - The establishment of **Hydraulic Basin Agencies** that will permit a real decentralization of water management, implying that all parties concerned are involved in decision-making.

Institutions & responsibilities

The water sector draws its general management principles from the Higher Council for Water and Climate, and is organized through institutions acting at the national, regional and local levels (Figure 9).

Of these, the three institutions which have the strongest involvement in water-related issues are:

- **Local communities and municipalities**, which are responsible for the distribution of drinking water and for wastewater collection and treatment. They can provide these services on their own, through a utility that they can create, through a private concession, or through the National Office for Drinking Water Provision (Office National de l'Eau Potable-ONEP);
- The **Ministry of Territory Planning, Water and the Environment** (Ministère de l'Aménagement du Territoire, de l'Eau et de l'Environnement-MATEE), which includes two entities that are involved in water management:
    - The **Secretariat of State in charge of Water and the Environment** (Secrétariat d'Etat chargé de l'Eau et de l'Environnement- SEEE), who acts as the intermediary between the central government and Hydraulic Basin Agencies. The SEEE is the central authority responsible for the formulation of water policies, water exploitation and conservation, for the management

of the public hydraulic infrastructure and for water allocation among different uses.

- The **National Office for Drinking Water** (Office National de l'Eau Potable-ONEP), which is responsible for the planning and operation of infrastructure for drinking water production, for monitoring and controlling water quality of drinking water supply sources, for potable water distribution and sewage collection and treatment.

In this context, the MATEE is the central authority responsible for the implementation of water policies and for all issues relating to water exploitation, conservation and use.

- The **Ministry of Agriculture**, which has regional offices responsible for agricultural development. These are also involved in the management of water allocated for crop irrigation.

Other entities and ministries, involved directly or indirectly in water policy formulation and water management operations are:

- The **National Office of Electricity (ONE)**, as water used for hydroelectricity production is afterwards diverted for irrigation purposes.
- The **Ministry of Industry**, as industrial water requirements are usually supplied through the ONEP infrastructure.
- Departments of the **Ministry of the Interior**, responsible for the support of local associations, through the DGRSC and the DEA.
- Departments of the **Ministry of Finance** for the financial monitoring of water projects and the financial management of services provided.
- The **Ministry of Economic Affairs**, which intervenes in the definition of water tariffs.

Table 6 summarises the responsibilities of the main actors involved in water management, which are further elaborated in subsequent paragraphs.

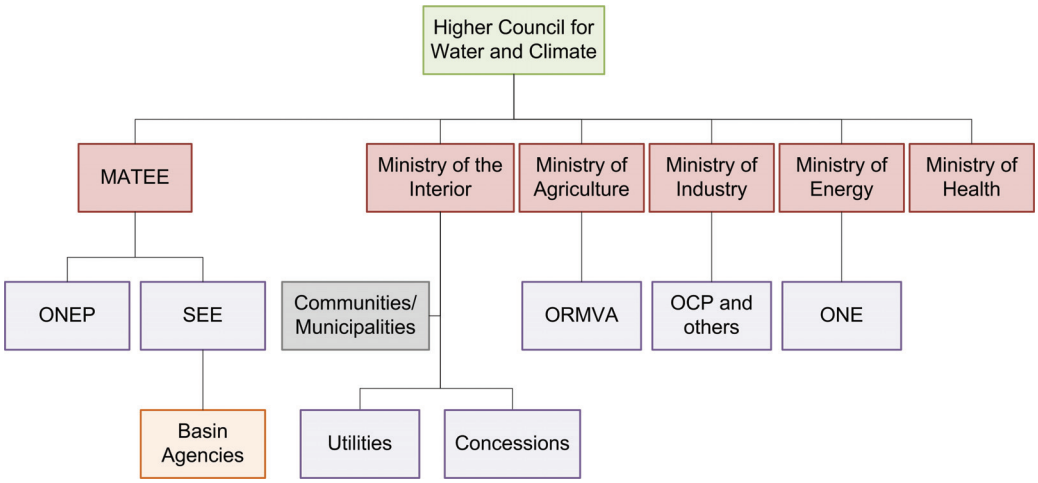


Figure 9: Organisation of the water sector

Table 6: Responsibilities in water management

AUTHORITY	RESPONSIBILITY
High Council of Water & Climate (CSEC)	Formulation of the general directions of the National Water Policy.
Secretariat of State in charge of Water and Environnement	Definition of the overall integrated policy (Water, Environment, Regional Development). Implementation of water resource management policies.
Hydraulic Basin Agencies	Maintenance and management of the public hydraulic infrastructure at the regional level.
National Office for drinking water (ONEP).	Planning of urban water supply in the Kingdom Assessment, implementation and management of drinking water abstractions throughout the country, with the exception of non-delimited rural areas, which are not subject to an agricultural development plan. Management of water supply and sewerage services in cities where this service cannot be provided by local authorities.
Water utilities (cost-plus contract)	Provision of drinking water supply and possibly sewage collection and treatment services. They are often responsible for electricity distribution as well, in order to ensure an adequate recovery of costs.
Concessionaires	Private operators, for providing water services in large agglomerations.
Regional offices for agricultural development (ORMVAs)	Assessment of agricultural development plans for irrigation perimeters, within the framework of hydraulic works' management, and monitoring and management of the perimeters' infrastructure.
Ministry of Finance	Control over the financing of water-related projects and of the financial management of water services.
Ministry of Economic Affairs	Involvement in the definition of water tariffs and charges for wastewater collection and treatment.

The **Higher Council for Water and Climate** was established in 1987, with the aim to formulate the general principles of the national policy concerning water and climate. Furthermore, it elaborates and formulates an opinion on:

- The national strategy for improving knowledge on climate conditions and the quantification of their effects on the development of water resources;
- The National Water Management Plan;
- Plans for the integrated development of water resources, and in particular the allocation of water among the different sectors and regions of the country or of the same basin, as well as measures for assessment, protection and conservation of water resources.

Half of the members of the Council are representatives of the State, whereas the other half is composed of representatives from socio-economic sectors. The Secretariat is provided by the SEEE.

The **Ministry of Territorial Planning, Water and the Environment** was established in November 2002. It comprises 5 departments/divisions (Figure 10):

- The State Secretary responsible for water;
- The Environmental Department;
- The Territorial Management Department;
- The ONEP;
- The Hydraulic Basin Agencies.

By regrouping the above, the establishment of the MATEE aimed at adopting an integrated, overall policy and at guaranteeing the prospects for the development of the country.

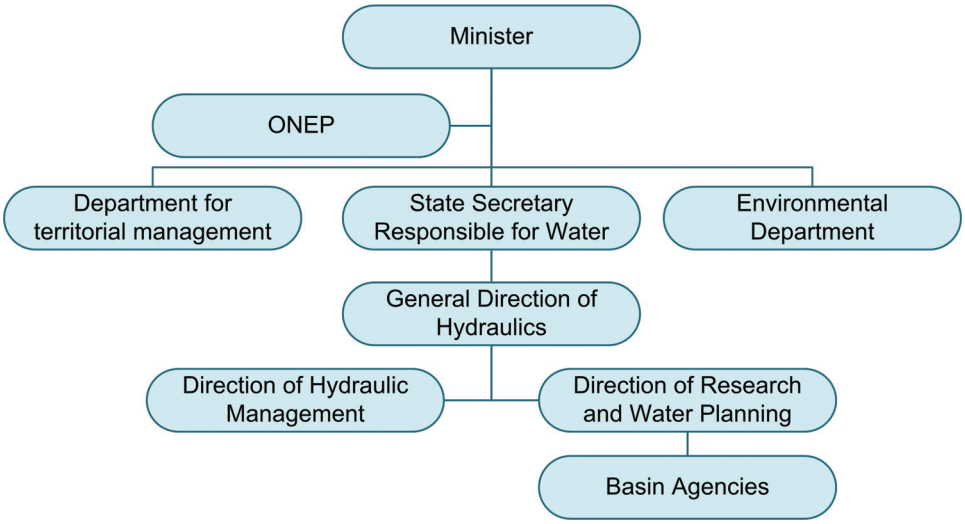


Figure 10: The organization of the MATEE

The ONEP and the Hydraulic Basin Agencies are the main public operators responsible for the implementation of the water policy, and are financially autonomous institutions.

The **Hydraulic Basin Agencies** are the key actors in regional water management. The 1st (pilot) agency, established in 1999, was the one of the Oum Er Rbia Basin. Six more were established in 2002: Moulouyas, Sebou, Loukoss, BouRegreg, Tensift and Souss – Massa.

The mandates of the Hydraulic Basin Agencies are to:

- Maintain the public hydraulic infrastructure and regulate its use and exploitation;
- Enhance the economic value of water;
- Provide financial and technical assistance for water management;
- Develop the local Integrated Water Resources Management Plan and pursue its implementation;
- Issue permits and authorize the use of the public hydraulic infrastructure;
- Provide the necessary support for water pollution prevention;
- Perform studies and assessments on water quantity and quality issues;
- Propose and implement regulatory measures, as appropriate;
- Maintain the inventory of water use rights, concessions and permits for water abstraction.

In the above context, the main responsibilities of the Basin Agencies are to: (a) develop water resources through water resource planning and management, assessment, exploitation, monitoring of quantity and quality, control of water use; (b) protect water resources and the national heritage by safeguarding the public hydraulic domain, preventing and managing exceptional situations, and operating, maintaining and exploiting hydraulic works; and (c) provide services towards third parties by offering technical assistance and receiving benefits for services delivered, develop partnerships and offer financial support.

The **National Drinking Water Office (ONEP)** is the most important actor in the production and distribution of drinking water, as it is responsible for approximately 80% of the total water supply and 25% of the distributed volumes.

The ONEP was established in April 3rd 1972, and its responsibilities include:

- Planning and management of drinking water supply in the Kingdom;
- Assessment, implementation and management of drinking water abstractions throughout the country, with the exception of non-delimited agricultural areas, which are not subject to an agricultural development plan;
- Management of water services in cities, where this service cannot be provided by municipal authorities;
- Provision of technical assistance on issues related to water quality monitoring, upon request of the public institution concerned;
- Control of the pollution of water intended for human consumption in collaboration with relevant authorities;
- Provision, upon the request of individuals, of technical assistance on the assessment, implementation and management of water abstraction and distribution systems;
- Implementation of relevant assessments, in collaboration with the Ministry of Public Health and other Ministries involved in relevant projects.

In the context of implementing a strategy for sewage collection and treatment, the State adopted Law n° 31-00 (Dahir n° 1–00–266 of September 1st, 2000). Through this Law, the ONEP has been designated responsible for the provision of sewerage services in communities and municipalities, following a relevant decision issued by the respective local Community Council. The Law had been preceded by similar decrees which transferred the provision of sewerage services from communities and municipalities to local, public water utilities (Regies).

Water utilities (regies) and concession contracts fall under the overall responsibility of the Ministry of the Interior. At present there are **13 water utilities (regies)**, established in large cities following the relevant decisions of the Local Municipal Councils. Their aim is to ensure the distribution of potable water, and potentially sewage collection and treatment. Often, and in order to assure an adequate recovery of costs, these utilities are also responsible for electricity distribution. In the Oum Er Rbia Basin, the only utility is the one of **Beni Mellal**.

Furthermore, approximately 35% of the total population and 50% of water needs are serviced through concession contracts. The main companies involved are:

- LYDEC, which is responsible for water supply and sewerage services in the city of Casablanca since 1997. The serviced population is approximately equal to 4 million persons.
- REDAL, which is responsible for water supply and sewerage services in cities of Rabat and Sale since 1999, supplying 2 million inhabitants in total.
- AMENDIS, which is responsible for water supply and sewerage services in cities of Tangiers and Tétouan, since 2001.

The **ORMVAs** (Offices régionaux de mise en valeur agricole - Regional offices for agricultural development) were first established in the 1960s with the aim of decentralizing irrigation water management. At present, the 9 ORMVAs have the mandate of promoting agricultural activities in the large irrigated perimeters of the country. In this regard, several laws and decrees have been implemented for specifying their status as financially autonomous public institutions, under the control of the Ministry of Agriculture.

Their main responsibilities are to:

1. Assess agricultural development schemes in irrigated perimeters, within the framework of the large hydraulic infrastructure management.
2. Monitor and provide assistance for the exploitation of irrigated perimeters, through irrigation scheduling, experiments in agricultural production, monitoring of irrigation and soil and drainage water quality, maintenance of irrigation networks and collection of the corresponding water charges.
3. Organize agricultural production.

Additional parties (user groups) with a role in water management are:

- The farmer associations that have water rights and manage interdependently their hydraulic infrastructure;
- Farmer associations established in irrigated perimeters for promoting the involvement of water users in the management of water distribution networks;
- The associations of users of agricultural land, which aim at facilitating the participation of end-users, the development of water distribution networks and the management and maintenance of hydraulic works.

Legislation

Since 1995, the water sector of Morocco is governed by **Law n° 10-95**. However, the first legal text dealing with water-related issues in Morocco dates back to 1914. After this date, legislation was progressively prepared, following the challenges faced in the management of the public hydraulic domain, which had to be regulated. These regulations involved the urban environment, the industrial and agricultural sectors and other issues. However, they could not respond to the increasing pressures exerted on water resources. They were used for the preparation of the Water Law, which regroups, modernizes, completes and collects all previous regulations in a coherent framework, following the principles of IWRM.

Law n° 10-95 is primarily focused on decentralizing water management operations and introduces integrated management and rationalization of water use for meeting the needs of all users concerned. The Water Law defines that the geographical setting for the management of water resources is the Hydraulic Basin, which constitutes the unit for the development and implementation of local integrated water management plans, which, in their turn, contribute to the development of the National Water Plan. The establishment of Hydraulic Basin Agencies in 1999 further fostered the implementation of recent trends in water management. The mission of the Basin Agencies is to evaluate, plan and manage water resources in the respective Hydraulic Basin. As they have access to their own financial resources (revenues from relevant levies), the Basin Agencies can grant loans, assistance and subsidies to all institutions and individuals for the management and protection of water resources. Through the introduction of the polluter-pays and the user-pays principles, the new law provides the means to finance protection and rehabilitation of water bodies. The application of these principles is in the process of finalization.

The **Communal Charter** assigns to local communities and municipalities the responsibility of providing public water services, such as drinking water distribution, electricity distribution, sanitation, transport, sewage collection and treatment, waste management etc. It is subject to regular updating and refinement, so as to ensure its adaptation to the evolution of the political and socio-economic context. The new Charter, issued on October 3rd 2002, entered

into force in 2003, after the official announcement of local election results. The main modifications concerning water management concern the prerogatives of the President of the Community Council for employing the help of the civil police force for issues that have a direct impact on the provision of drinking water supply and sanitation services.

Law n° 31-00 (Dahir n° 1–00–266 of September 1st, 2000) was adopted within the context of implementing the strategy for the development of sewerage services. Through this Law, the ONEP has been designated responsible for the management of sewerage services in communities and municipalities, upon relevant decision of the Local Community Council. The Law was preceded by similar decrees, allocating the provision of sewerage service to local utilities.

Other important laws and regulations, particularly dealing with environmental and water resource protection are:

- **Law n° 11 - 03 on the protection and the enhancement of the environment in Morocco.** Its principles and regulations aim at:
    - Protecting the environment from all pollution sources, and preventing environmental degradation independently of its origin;
    - Ameliorating living conditions;
    - Defining the technical and financial legislative framework for environmental protection;
    - Implementing a specific accountability framework for ensuring the mitigation of environmental damage and the compensation of victims.
- **Law n° 12 - 03 on Environmental Impact Assessments**, which defines the relevant application framework and content of environmental impact assessments, and the corresponding responsibilities of regional committees.
- **Decree of October 17, 2002 on water reuse for irrigation purposes**, which defines standards for reusing reclaimed wastewater for crop and landscape irrigation, focusing on:
    - Agricultural products that are consumed raw;
    - Cereal production;
    - Garden and sport field irrigation;
    - Orchard irrigation.

  The set standards concern the wastewater treatment process, concentrations which should not be exceeded for each crop type, and quality standards for irrigation water that can be mixed with treated wastewater.

Further legislation on direct and indirect discharge standards is at the stage of elaboration.

Regulation over the provision of water services

Regulation over the provision of water services aims at encouraging public and private enterprises to provide water services of suitable quality at least cost. Entities which can undertake the task can comprise a Ministerial Department or an independent regulating authority. The overall goal is to enhance the institutional setting, by establishing an Agency for the water sector, which would encourage integration. While the establishment of an independent entity is pending, regulation is performed by the different ministries, according to legal provisions on quality standards, enforcement, hygiene and security, etc. The relevant frameworks vary, according to the status of the water service provider (public or private).

Private operators are monitored by a Committee, which ensures that the operator abides to its contract, and monitors the evolution of tariffs, as well as technical, administrative and financial management. The issues that are not directly monitored by the Committee are:

- Water pricing, as water tariffs are revised according to previous agreements with the Government;
- Drinking water quality standards, which are defined by law.
- Water rights and water allocation.

Committees operate under the supervision of the Direction of Regies and conceded services (DRSC) of the Ministry of the Interior.

Similarly to above, in the case of **public operators** (ONEP and Regies), Committees do not intervene at the definition of water tariffs, which are decided by the Prime Minister, and drinking water quality standards and water allocation, which are decided by the MATEE.

FINANCIAL FRAMEWORK

The financing of water supply and sewerage services in Morocco is performed through the following mechanisms:

- Cost recovery through the set water charges and tariffs,
- Loans, subsidies, grants, etc.

During the recent years, the recourse to the external financing is becoming more and more important, given the financial mounting of the ONEP investment program. Two types of financing are distinguished:

- Priviledged financing, characterized by interest rates lower than 1%, repayment period of a maximum of 30 years and a 10-year maximum grant period. This type of financing is generally reserved for projects of social character (i.e. drinking water for rural areas, sewage treatment schemes).
- Banking-type financing, characterized by an average interest rate of 3%, repayment periods of 15 to 20 years, and a grant period of 5 years. This type of financing is usually reserved for projects in urban areas, and is much faster in obtaining.

The financial contribution of municipalities is fixed to cover 30% of the cost of sewage treatment projects and 20% of projects for rural domestic water supply. For the latter projects, the local population also contributes, bearing a small share (5%) of the total cost.

Still, state subsidies concern:

- Grants provided for the implementation of rural water supply and sewage treatment projects.
- Subsidies granted to non-eligible municipalities for covering their share of investment costs. They can cover up to 30% of the cost of the project.

It is important to note that the annual state subsidy towards the ONEP, equal to 300 million DH/yr was eliminated in 1995.

VALUING WATER – WATER PRICING ISSUES

With regard to **drinking water provision**, the recovery of costs is effected through:

- A water supply (or royalties) charge, calculated according to water consumption.

- A contribution to the 1st implementation (PPE - Participation au Premier Etablissement) , aimed at recovering the corresponding investment costs;
- A fixed charge to cover connection costs;
- A fixed charge for the recovery of costs for surveys and assessments;
- A pollution charge, for which the pertinent legislation is under approval.

Water supply charges in urban areas vary among regions and comprise two parts: a fixed charge, and a volumetric charge, which depends on the volume of water consumed. The maximum rates are those of Casablanca, whereas the minimum are those of Meknès.

The water bill depends on the type of use:

- For residential users, the water tariff follows the Increasing Block Rate structure, dividing water consumption into four blocks:
    - 1st block: 0-6 m³ - rate lower than cost;
    - 2nd block: 7 to 20 m³ - rate equal to cost;
    - 3rd block: 21 to 40 m³ - rate higher than cost;
    - 4th block: > 40 m³ - rate much higher than cost.
- Preferential tariff, for boundary-marked fountains, where the price is uniform and equal to 2.18 DH/m³.
- For industrial users, the price is also uniform, and equal to 2.23 DH/m³.

In rural areas, the water is generally delivered to the user through an intermediary at the cost of 7 to 12 DH per m³. This intermediary buys water from the ONEP at a reduced price of 2.18 DH/m³.

Charges for sewage collection and treatment comprise two parts: a fixed and a variable charge. The fixed charge varies according to the type of use:

- For residential users, it ranges between 36.00 and 55.68DH;
- For commercial establishments it ranges between 144.00 and 242.04 DH ;
- For public buildings, administration offices etc., it ranges between 72.00 and 121,44 DH.

The variable charge is estimated according to the volume of water consumed, and also follows an increasing 3-block rate structure:

- 1st block: 0-6 m³/month;
- 2nd block: 7-20 m³/month;
- 3rd block: >30 m³/month

It should be noted that water billing is performed on a monthly basis in both the case of municipal water utilities and private operators.

Furthermore, a tax concerning the implementation of the 1st establishment (PPE) is also implemented. This tax aims at the recovery, from households and building owners, of the cost required for extending the public sewerage network. This objective is evident by the formula for the calculation of the PPE, which depends on the type of the building, making a distinction between apartment blocks and individual houses. Connection charges depend on the pipe diameter and on the façade. Charges for assessments and surveys depend on the size of the project, and can exceed even 10% of the project costs.

In spite of the above, water tariffs alone cannot ensure an adequate recovery of costs, due to the limited ability-to-pay of the users. This is particularly true in small villages and towns,

where costs are higher. In this case, the contribution of local authorities, through subsidies and grants is required. Furthermore, it should be noted that delays noted at the investment level contribute significantly to the overall financial balance.

Irrigation water supply sources comprise:

- Surface water, regulated by dams which are financed by the State budget and other foreign sources of financing;
- Groundwater either distributed by the ORMVA or directly pumped by the farmers.

Cost recovery is effected through the setting of a simple volumetric rate (not differentiated according to the overall consumption), which varies according to the region. With regard to groundwater, two water charges are applied:

- The first concerns water delivered by the ORMVAs at the entrance of the farmer's field (parcel), which is generally equal to 0.50 Dh/m³.
- The second concerns water pumped by farmers using their own equipment. In this case, a charge of 0.02 Dh/m³ is paid to the ORMVA.

The low tariff for groundwater individually abstracted by farmers (0.02 Dh/m³) results in the irrational use of water by agricultural users and to the overexploitation of groundwater resources.

For surface water, the tariff varies among basins. In the Oum Er Rbia Basin, the price is equal to 0.24 Dh/m³.

Furthermore, it is worth noting that water losses are extremely high (more than 60% of the water is lost in the irrigation networks), whereas water-intensive crops, such as bananas, melons etc., are still being cultivated, even in areas under severe water stress. Overall, it is estimated that cost recovery in the agricultural sector is low, and does not exceed 30%.

WATER MANAGEMENT CHALLENGES IN THE OUM ER RBIA BASIN

PAST WATER MANAGEMENT POLICIES

The Hydraulic Basin of the Oum Er Rbia faces various natural constraints, mostly concerning the sustainability and availability of water in terms of both quantity and quality. Water availability is subject to the large variation of precipitation in both space and time. This is due to several factors, and most importantly to the overall climatic conditions. It should be noted that in the drought episodes experienced from 1980 and onwards, the reduction in the volume of water available was about 15 to 20%.

Furthermore, the Oum Er Rbia Basin is located between two other Basins of high socio-economic importance, which face significant water management issues:

- The Tensift Basin, where Marrakech is located, experiences a widening gap between supply and demand;
- The Bouregreg Basin, where Casablanca and Rabat are located, cannot depend on its own water resources, and inter-basin transfers had to be implemented. It is worth noting that the Atlantic zone, with 7 million inhabitants is the most dynamic region of the country in socio-economic terms.

In order to address the aforementioned regional and inter-regional issues, the State undertook several actions, such as:

- Regulation of water flow;

- Development of an extensive irrigation network;
- Inter-basin transfers to reinforce water supply in the above metropolitan areas;
- Engagement in a National Debate on water-related issues.

The above policies are detailed in the following paragraphs.

Regulation of water flow

As mentioned above, surface water resources in the Oum Er Rbia Basin are estimated at 2,511 million m³/yr, varying between the maximum of 7,710 million m³/yr and the minimum value of 1,400 million m³/yr. The State plans for dam construction in the Basin were initiated in 1929, reinforced during the 1950s and accelerated thereafter.

Flow variability was regulated through the construction of 15 dams, with a total storage capacity of 5.1 billion m³, and storing, on average 3.6 billion m³. The three larger dams are:

- The Al Massira dam, constructed in 1979, with a capacity of 2.657 billion m³;
- The Bin El Ouidane dam, constructed in 1954, with a capacity of 1.243 billion m³
- The El Hasanli dam, constructed in 2001, with a capacity of 740 million m³ of which 473 are regulated.

At present, dam construction can be considered economically viable for only a few remaining sites.

Development of an extensive irrigation network

The total area irrigated by the Great Hydraulic Works is approximately 385,500 ha, and corresponds to 70% of the irrigable area of the basin. This area is divided into 5 Irrigation Perimeters:

- **Beni Amir**: The perimeter, with an area of 35,000 ha is supplied from the Kasba Tadla dam and from groundwater resources, used for the irrigation of 6,000 ha. The total water demand is 390 million m³/yr.
- **Beni Moussa**, with an area of 69,500 ha and an estimated water demand of 740 million m³/yr. The perimeter is supplied almost exclusively from the Bin El Ouidane dam (710 million m³/yr). Groundwater contributes to the supply of 30 million m³/yr for irrigation purposes.
- **Doukkala - Bas Service**, a perimeter of 61,000 ha, irrigated from the Al Massira Dam, through the smaller reservoir of Imfout. The total water demand is 550 million m³/yr.
- **Doukkala - Haut Service**, a perimeter of 64,000 ha, also irrigated from the Al Massira Dam, through the reservoir of Imfout. The total water demand is 554 million m³/yr.
- **Tessaout amont**, with a total area of 52,000 ha. The perimeter is supplied from water regulated by the Moulay Youssef Dam (250 million m³/yr) and from irrigation return flows (40 million m³/yr on average).
- **Tessaout aval**, with a total area of 48,500 ha, where a network of séguias was constructed and supplied from the Tessaout River (oued). The area equipped for irrigation is 6,500 ha and is irrigated from the Lakhdar-Tessaout system.

Inter-basin transfers to enhance water supply in large cities

Water from the Oum Er Rbia Basin is used for meeting water needs in the regions of Marrakech and Casablanca. More specifically:

- A volume of 300 million m³/yr is transferred from the Oum Er Rbia Basin to the region of Marrakech. Of this amount, 260 million m³ are used for irrigation purposes and 40 million m³ for meeting urban water needs.
- The annual supply provided by the Basin for meeting water needs in the Casablanca metropolitan area is equal to 120 million m³.

Drinking water was transported in 1995, through tankers, to the city of Tangier, which experienced serious problems as a result of the 1993-94 drought episode. During 4 months, water was transferred from the city of El Jadida to the harbour of Tangier, providing 30,000 m³/d (3.6 million m³ in total).

Water hauling in 1995

Engagement in a National Debate on water-related issues

The National Debate on water-related issues was officially launched by the Prime Minister in November 2006. The debate continued through the publication of Regional Proceedings in 2007, and aims at raising awareness among water users on the need for conserving and protecting water resources.

EMERGING PROBLEMS

In spite of all the aforementioned efforts, there are still technical issues that need to be resolved, the most important of these being:

- The overexploitation of groundwater resources, due to overpumping but also to the reduction in precipitation,
- Water quality deterioration,
- Inefficiency in water use,
- Protection from floods.

These problems are further aggravated by deficiencies of the current institutional framework and perceptions of consumers towards water use.

Groundwater overpumping

Groundwater overexploitation has resulted in an alarming decrease in water table levels, especially in the plains of Abda and Doukkala. In certain areas, extracted volumes are almost doubling every 15 years, as a result of well construction and borehole drilling for irrigation purposes. The situation is further aggravated by the current practice of pumping from deep water tables, which are considered strategic reserves, to be used only under exceptional circumstances. At present, the decrease of water table levels is observed throughout the Basin, and reaches alarming values, which often exceed 2 m/yr. Furthermore, the coastal aquifer, located between Azemour and Safi, and used for the irrigation of high-valued crops, faces

the risk of sea intrusion. A survey is currently in progress, with the aim to assess the situation and study the impact of elevated chloride levels.

Similarly to other Mediterranean countries, climate change is expected to impact severely on the water resources of Morocco. The corresponding assessments, undertaken by the Environmental Department of the MATEE, have estimated a reduction in precipitation of 15% during the last few years.

Alarming water quality deterioration

Approximately half of water resources of the Oum Er Rbia Basin are being polluted by the discharge of industrial and domestic wastewater, by agrochemicals and by sea-water intrusion. Water quality deterioration is further aggravated by the delay in implementing sewage treatment schemes and the enforcement of the pertinent legislation on pollution prevention and the application of sanctions for environmental violations.

Overall, it is assessed that the water resources of the Basin are extremely vulnerable to pollution, due to both natural reasons and to human pressures. Pollution issues are similar to those of the entire country and are the result of all types of human activity (domestic, industrial and agricultural sectors).

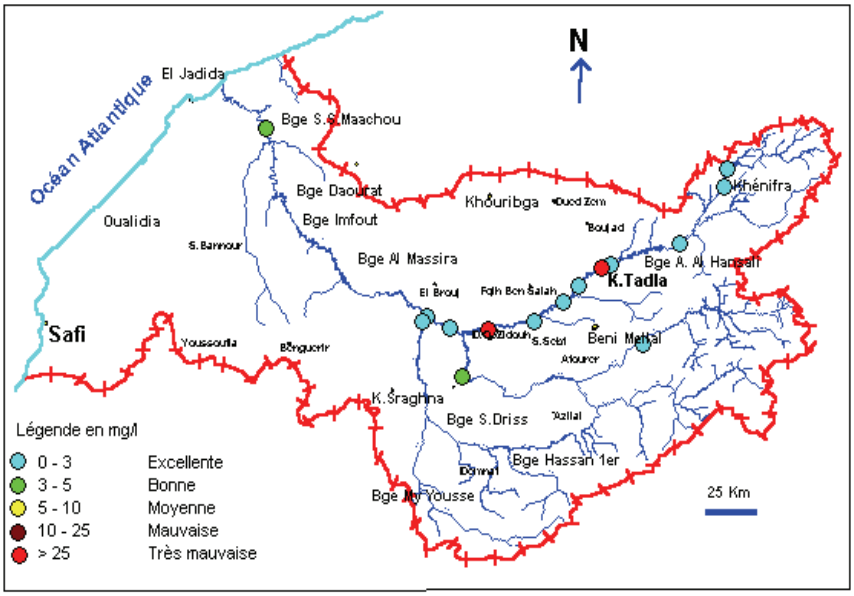


Figure 10: Water quality in terms of BOD_5 in the Oum Er Rbia Basin (1999-2000)

In the area under the authority of the Oum Er Rbia Hydraulic Basin Agency, **domestic pollution** originates from 70 cities and agglomerations. The total annual pollution load generated by these areas is estimated at 21,500 tons of BOD and 42,000 tons of COD. The total annual volume of collected sewage is 40 million m^3/yr, and there are 16 sewage treatment plants, of which only 6 are operating (Khouribga, Beni Mellal, Boujâad, Boujniba, Hattane and Ben Guérir).

Unfortunately, the Oum Er Rbia River constitutes the main discharge point of all inhabited areas in its vicinity. It is therefore necessary to prioritize the implementation of treatment plants for these regions within the framework of the corresponding National Plan.

The **quality of surface waters** is generally good in the upstream parts of the basin (i.e. upstream of Khénifra) and becomes degraded downstream, as a result of urban and industrial

discharges. The section between the downstream Kasba-Tadla and the downstream discharge point of Dar Ouled Zidouh on the Oum Er Rbia River is significantly polluted by the combined discharge of industrial and domestic effluents. This river section experiences an excessive deterioration during the summer months, as a result of sugar production activities and other types of industrial wastewater discharged to the river without prior treatment.

The main **industrial pollution** sources are located in the areas of Beni Amir and Beni Moussa. Especially canneries and oil industries have a significant contribution to the increase of nitrate and organic matter concentrations. The annual volume of industrial discharge is estimated at 16 million m^3, whereas the annual organic pollution loads generated by the agro-food industries, which are the main source of pollution, are estimated at 11,000 tons of BOD and 21,500 tons of COD.

It should be noted that pollution generated from these industries is practically of the same magnitude as the one of the domestic sector, and represents 65% of the total COD load, which is not readily biodegradable. In this regard, industries should at least foresee a pre-treatment stage, which will allow a reduction of organic pollution by at least 40%, by adopting simple technologies, such as lagoons.

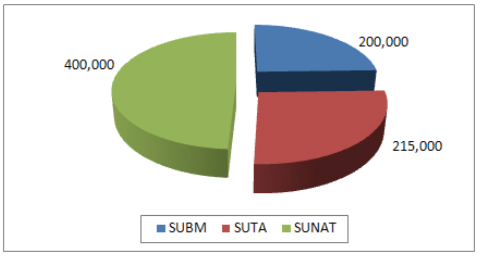


Figure 11: Pollution generated from the sugar industries (in equiv. inhab.)

Agriculture contributes to groundwater pollution due to the application, at times excessive, of manure, fertilizers and pesticides. In the area controlled by the Oum Er Rbia Agency, the quantity of nitrogen leaching towards aquifers or streamed towards water courses is estimated at 10% of the quantities applied. Therefore, approximately 3,500 tons of nitrates, originating from manure application reach the Tadla aquifer as a result of leaching. Furthermore, the pollution originating from pesticides is estimated at 2.2 tons/yr.

The aforementioned uses impact negatively on the quality of both surface and groundwater. Various surveys led by the Oum Er Rbia Agency and the establishment of a monitoring network for water quality have allowed the assessment of the current water quality status in the Basin.

Groundwater quality experiences a continuous degradation. Over the past 15 years, the measured concentrations of nitrates have escalated to alarming levels, reaching values higher than 50 mg/l in the majority of points sampled. Since the 1980s, the problem of nitrates has become particularly acute in the Tadla plain, where concentrations exceed the acceptable norm of 50 mg/l in the largest part of the area (Figure 11). At present, more than 60% of the water table surface area (80,000 ha) is polluted, and if no action is taken, the entire aquifer will shortly become contaminated. For assessing and addressing the issue, the Agency has established a monitoring programme in the Tadla, where measurements are performed twice per year, through a network of 92 sampling points. According to these measurements, over the past 10 years, nitrate concentrations present a yealy average increase of 5 mg/l.

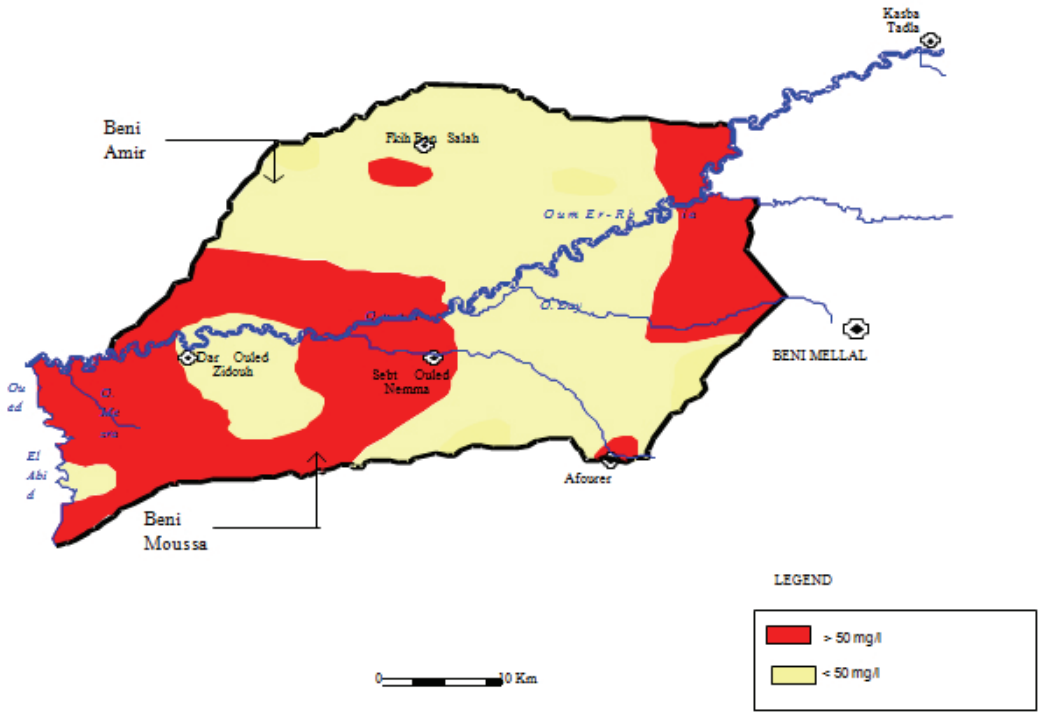


Figure 11: Nitrate pollution in groundwaters

Water losses and low efficiency in water use

Water losses in the agricultural sector are extremely important. Losses in irrigation distribution networks are estimated at 20%, whereas losses within the fields (in crop irrigation) are estimated at 50%. The situation is aggravated by the small share of agricultural land (10%) equipped with advanced irrigation systems. In the domestic sector, distribution losses are approximate 35%.

With regard to **dam siltation**, measures taken are aimed at addressing the transportation of sediments in the corresponding watersheds (Table 7). In total, the volume lost in regulation dams (Al Massira, Bin El Ouidane, Moulay Youssef, Hassan the 1st), is currently estimated at 350 million m³. Dam siltation has direct impacts on the regulated volumes, dam performance, dam security, required supplementary works, downstream infrastructure and water quality.

Table 7: Siltation in major dams

Dams	Operation start year	Initial capacity (million m³)	Present capacity (million m³)[3]	Loss of capacity (million m³)	Yearly siltation (million m³)	%
Bin El ouidane	1954	1500	1243	257	5.14	0.34
M. Youssef	1970	197	150	47	1.38	0.70
Hassan 1er	1987	272	245	27	1.59	0.58
Al Massira	1979	2785	2657	128	5.12	0.18
A. El Hansali	2001	740	740			
Total		**5494**	**5035**	**459**	**13.23**	**0.24**

[3] Date of last measurement: 2004

Flood protection

Hourly rainfall often reaches levels that can incur floods, which in turn cause problems to the overall economy and the safety of citizens. The dams of the Oum Er Rbia basin can attenuate such effects, in combination with models capable of forecasting precipitation volumes and estimating the volumes that should be released. However, cities such as Settat, Beni Mellal and El Jadida are still vulnerable, mostly due to the uncontrolled urban development, particularly in vulnerable areas.

FINANCIAL, ADMINISTRATIVE AND INSTITUTIONAL ISSUES

Financial constraints are mostly related to the difficulty of the population to respond to the increasing costs of water supply provision. The State finances investments for the construction of dams, irrigation networks in the irrigated perimeters and the upgrade of urban water-related infrastructure. Consumers are charged with all other costs and the overall policy of introducing IBT charges in drinking water supply, ensures that low-income households have access to water services. However, the overall increase of water tariffs is causing some social turbulence, mostly due to the insufficient provision of background information.

Furthermore, the State began, in November 2006, the procedures for mobilizing a fund of 44 billion DH with the aim to reduce by half wastewater treatment problems in the next 15 years.

The overall administrative and institutional setting suffers from the delay in the implementation of the Water Law. This delay is actually preventing more rational water management, and the application of the polluter-pays principle. Delays in implementation mostly concern the water charges that will constitute the financial resources of the Basin Agencies, which permit them to provide financial assistance for the development and protection of water resources.

CONCLUDING REMARKS

The water management problems presently faced in the Oum Er Rbia Hydraulic Basin can be framed in three levels: (a) problems associated with the “sharing” of available water resources; (b) valuing issues, and (c) problems associated with the “governing” dimension.

With regard to water sharing, problems are associated with water shortage and pollution; issues impact both on the water uses of the Basin itself, but also on water uses in other Basins supplied by the Oum Er Rbia hydraulic works. Currently, there is a widening gap between supply and demand, due to the decrease of precipitation levels and demand growth. Water availability per capita does not exceed 600 m^3/cap/yr and there is no possibility for further hydraulic infrastructure development, as more than 90% of available water resources have already been exploited. In addition, there is a significant decrease of the piezometric levels of water tables due to overexploitation. Poorly maintained irrigation networks, which exhibit high losses, add to the problem. On the other hand, water quality is constantly deteriorating, and there is significant delay in the development of wastewater treatment projects due to the lack of financial resources from the operators’ side.

On the valuing side, water prices are generally low, especially with regard to agriculture. In addition, it is reported that users and customers do not sufficiently respond to the water tariffs set.

Problems associated with water governance are firstly related with the overall organization of the water sector, where the multiplicity of intervening parties has not allowed the development of a global, coherent vision. Although significant progress has been made, there are still delays in the implementation of the Water Law, and in building the required capacity. These issues can inhibit the effective and immediate implementation of required actions. Additional difficulties concern water management operations at the user-level, as there is difficulty in setting-up contracts on groundwater management. In irrigated agriculture, farmers lack knowledge and expertise in efficient water use practices, and the selection of crops is often not based on economic criteria.

However, the new framework for water management introduced in the country offers significant opportunities for dealing with existing problems and emerging challenges. The establishment of Hydraulic Basin Agencies and the development of open fora at national, regional and local level is expected to enable the enhanced implementation of demand management policies and the early identification of local constraints that can limit the effective uptake of incentives by individual users and water service providers.

PART II: THE INECO MOROCCO CASE STUDY: EFFICIENCY IN IRRIGATION WATER SUPPLY AND USE IN THE OUM ER RBIA HYDRAULIC BASIN

BACKGROUND AND MOTIVATION

The increasing water stress experienced in the Oum Er Rbia Hydraulic Basin calls for a shift in water management policies, from the traditional, supply-side approach to demand management. As agriculture is the main water use, priorities set out for future water management policies concern the enhancement of efficiency in irrigation water supply and use. Currently, there are significant losses in irrigation networks, which, combined with low-efficiency in irrigation practices, lead to the waste of significant amounts of freshwater. Past policies have targeted the increase of supply through surface water mobilization, the construction of irrigation networks to cope with the increased agricultural demand and the enhancement of the knowledge base on water resources and their use. However, the increasing disparity between supply and demand and the deterioration of water quality in surface and groundwater bodies has motivated recent policies for the wide adoption of advanced irrigation systems and wastewater treatment.

Strengths	Weaknesses
➢ The existence of the Water Law defining the Hydraulic Basin as the unit for water management. ➢ The establishment, since 1999, of the Hydraulic Basin Agency in the OER. ➢ The existence of efficient operators: ONEP, Municipal Utilities (Regies), ORMVAs, private companies, etc.	➢ Communities and municipalities have often been not as efficient in managing water, sewerage and electricity services. They had to resort partly or completely to professionals, who were able to reduce costs and ensure the sustainability and quality of the services provided. ➢ There is difficulty in setting up contracts for the management of water tables. The multiplicity of users makes necessary the implementation of such contracts, co-managed by the Hydraulic Basin Agency and professional associations. ➢ There is insufficient level of knowledge and expertise of farmers towards irrigation water use. Farmers should reduce or abandon the irrigation of water-intensive, low-value crops, which are irrigated using groundwater, and apply new techniques for irrigation and pumping, so as to increase agricultural output. ➢ The price signals towards water users are rather weak. The State provides a subsidy between 1.5 and 3 DH/m³ for the cost of mobilizing water resources through dams and for the maintenance of irrigation canals. It will also subsidize wastewater treatment. ➢ Water transfers from the OER should be performed only towards the Tensift basin, and other, external to the basin, water demands should be backed up by the Hydraulic Basins of Sebou and Loukkos. ➢ The efficiency of drinking water distribution networks has to be improved.
Opportunities	**Threats**
➢ A regional debate is organized by the Water Basin Authorities in 2007 on water-related issues. ➢ The State contributes in the financing of the sewage treatment program whose budget is 44 billion DH . The program aims to reduce by half the relevant pressures within a timeframe of 15 years. ➢ The ONEP has undertaken the program for rural water supply since 2004. ➢ Subsidies of 60% are given to farmers for implementing drip irrigation systems. ➢ Public authorities are encouraged to integrate water supply and sewerage services in regions and to assign their management to operators. The OER Agency is also considering this approach. ➢ There are State Programmes for developing "satellite" cities around large urban centres. ➢ The tertiary sector is under development and will possibly alleviate pressures exerted by agriculture.	➢ Pollution is increasing as a result of nitrates, pesticides, sewage and industrial wastewater discharge. ➢ Coastal water tables are threatened by sea intrusion. ➢ Droughts have significant impacts on water quantity and quality, and flood risks are increasing. ➢ Water is used inefficiently. ➢ There are several polluting industries, which discharge their effluents without prior treatment (e.g. OCP, sugar, dairy etc.) ➢ There is delay in the implementation of Law 10 - 95, particularly with regard to the polluter-pays principle.

Figure 12: SWOT analysis for water management in the Oum Er Rbia Basin

Figure 12 summarizes the result of a SWOT analysis for water management in the area. The Figure depicts significant opportunities for dealing with current problems and emerging water management challenges, but also several weaknesses, which portray potential goals for future policies. Examples include the lack of awareness in the agricultural sector, the limited impact of pricing policies and institutional weaknesses that inhibit effective groundwater management.

In the above context, and within the framework of the significant efforts undertaken for the modernization of the agricultural sector in Morocco, the relevant INECO Case Study, formulated in collaboration with local decision-makers, focused at fostering engagement among water managers and users on ways to improve efficiency in irrigation water use. Emphasis was placed on institutional weaknesses, on constraints faced at the user level and on economic instruments that could strengthen the implementation of current policies.

DISCUSSING SHARED PROBLEMS – THE APPROACH

The INECO approach towards the development of a participatory process for discussing alternative institutional and economic instruments to address water management issues was based on the Objective Oriented Project Planning method (Figure 13).

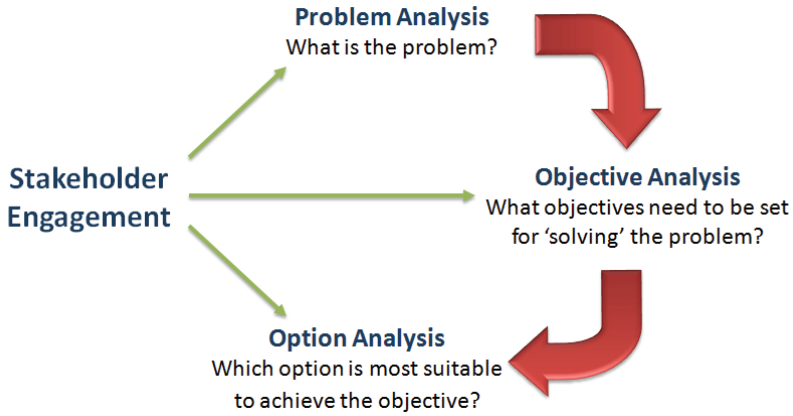


Figure 13: The framework for public participation and engagement in INECO

The method, which is similar to the Logical Framework Approach, has been suggested as a tool to support urban participatory decision-making. In INECO, this method has been used to frame discussions with stakeholders, focusing on a water management problem that is commonly perceived as significant (focal) in the region of interest. The followed approach is divided in three stages:

1. The first stage, **Problem Analysis**, involved the identification of stakeholders and the mapping of their key problems, constraints and opportunities, and the definition of the key water management issue in the region of interest. Furthermore, this stage included the identification and analysis of cause and effect relationships between threats and root causes of the issue at hand;
2. Next, the **Analysis of objectives** concerned the development of policy objectives from the identified problems, and the identification of means-to-end relationships;
3. The final stage, **Option analysis**, concerned the identification of different options that can contribute to the achievement of the agreed objectives. Options were sub-

sequently evaluated by stakeholders to formulate the most suitable strategy for problem mitigation.

The overall process was articulated through individual (preparatory or consultation) meetings with key stakeholders (decision and policy makers, representatives of key water users), workshops and public meetings open to stakeholders and all citizens concerned, surveys, discussion fora, and dedicated questionnaires. Emphasis was given to the openness of the process; special care was given to inform stakeholders of all outcomes and replies of other parties, whereas all information collected was made accessible to the public through the distribution and web uploading of material.

The following paragraphs describe the implementation of this approach for deriving regional policy recommendations for increasing efficiency in irrigation water use in the Oum Er Rbia Hydraulic Basin.

PROBLEM ANALYSIS

The first stage of the developed process concerned the identification of key stakeholders, with a role or interest in irrigation water management, these being:

- Authorities involved in the management of water resources at the River Basin level and at the local level, for the management of irrigation perimeters.
- Representatives of important users, such as farmer associations, and major industries.
- Professionals dealing with various issues related to irrigation water management.

The first workshop, open to all parties, was held in Afourer, near Beni Mellal, on March 21st 2008, in close collaboration with the Oum Er Rbia Hydraulic Basin Agency. The event brought together representatives from all institutions dealing with water management in the area, including representatives from the Local Offices for Agricultural Development, from the ONEP and from local farmer associations. The workshop's primary aim was to elaborate on the problem, through the development of a "Problem Tree", describing the causes and effects of the issue at hand in a qualitative way. The event also offered the opportunity for a first exchange of views on policy objectives and potential options, whereas through a dedicated questionnaire, participants expressed their views on the relevant significance of the problem, and the importance of its effects and primary causes.

Photos from the INECO Morocco Stakeholder Workshop on "Efficiency in irrigation water management and use", Afourer, March 21st 2008

During the workshop, stakeholders were first asked to validate a preliminary "Problem Tree", drawn by ISKANE Ingeniérie on the basis of consultations previously held with the Oum Er Rbia Hydraulic Basin Agency (Figure 14).

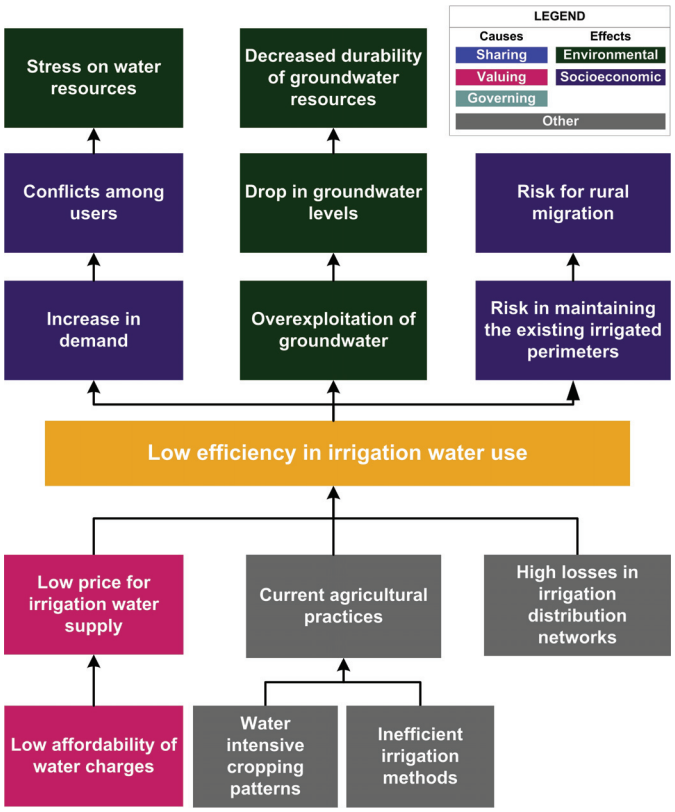


Figure 14: Problem tree analysis of the causes and effects of low efficiency in irrigation water use in the Oum Er Rbia River Basin

According to the qualitative "Problem tree" analysis, the focal problem analysed in the Oum Er Rbia Basin is related to the limited efficiency in water use in the agricultural sector. The problem stems from increased demand, combined with high losses, especially in irrigation distribution networks and through the current irrigation and agricultural practices (non-efficient irrigation methods and water intensive, non-economically sustainable cropping patterns).Furthermore, discussions during the workshops revealed the following dimensions for irrigation water management and use:

- **Sharing dimension:** Water available for irrigation is shared with municipal uses and is also used for hydroelectricity production. In the latter case, the intermittent nature of flow for hydroelectricity for meeting peak energy demands causes problems in downstream irrigation, where stable flows are required. In this regard, and as the value of water in hydroelectricity is higher, it is necessary to make sure that the operational rules of the dam are known and understood by farmers, so that they can appropriately schedule irrigation programmes.
- **Economic dimension:** It became evident that the current economic incentives provided by the State for the installation of modern irrigation systems are not adequate.

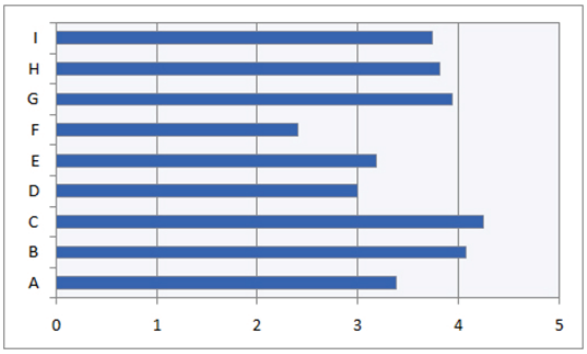
- **Governing dimension:** Current obstacles to policy implementation can possibly be overcome through the reinforcement of water user associations, which can act as intermediaries between users and decision-makers.

In addition to the above, replies to the dedicated workshop questionnaire were also a helpful tool for revealing preferences on key objectives for reversing current trends and in identifying possible options for problem mitigation. The main results of the survey can be summarized in the following:

- The vast majority of participants believes that the currently experienced water stress is a very important issue, which demands immediate action.
- The most important factors that contribute to low efficiency in irrigation water use are the limited application of advanced irrigation methods (93.8% of replies) and high losses in irrigation distribution networks (81.3% of replies).
- All respondents perceive that public participation is a key factor for successful policy implementation. The sharing of planning and decision-making responsibilities through joint policy boards is perceived as the most effective method (87.5% of replies).

Subsequently, nine (9) main policy instruments were discussed for addressing the problem; these were further ranked by the respondents of the survey, using a scale ranging from 1 (least effective) to 5 (most effective). Proposed options included technical measures for supply enhancement, but also soft responses, relating to financial encouragement, training and demonstration, and enhanced participatory management of irrigation networks.

Ranking results are presented in Figure 15. The results highlight the emphasis placed on soft measures for water saving and capacity building in the agricultural sector, as well as the need to encourage farmers towards advanced irrigation methods and new cropping patterns in an effort to enhance efficiency in irrigation water use.



Option A: *Technical measures for supply enhancement*
Option B: *Grants and soft loans for the installation of efficient irrigation systems (e.g. drip irrigation)*
Option C: *Training of farmers on appropriate irrigation practices*
Option D: *Introduction of legislation on maximum allowable withdrawals for irrigating specific crops*
Option E: *Introduction of higher abstraction charges for surface and groundwater withdrawal*
Option F: *Increase of volumetric rates for irrigation water supply*
Option G: *Development of demonstration projects on advanced irrigation systems*
Option H: *Subsidies for change of cropping patterns*
Option I: *Wider development of collective irrigation*

Figure 15: Ranking of instruments and approaches for enhancing efficiency in irrigation water use

Subsequently, the outcomes of the "Problem Analysis" stage were used for the definition of policy objectives and the formulation of proposals on instruments that could be applied to attain these. Process outcomes are described in the following paragraphs.

DEFINITION OF POLICY OBJECTIVES

Following from the validation of the "Problem Tree" of Figure 14, workshop participants discussed on key policy objectives that should be pursued for enhancing efficiency in irrigation water supply and use, on the basis of the preliminary "Objective Tree" of Figure 16. As de-

picted from the Objective Tree, the main goal requires application of advanced irrigation methods, potential change of cropping patterns and rehabilitation of existing irrigation networks of facilities. Furthermore, reform of water pricing policies needs to be examined, taking into account affordability constraints and wider societal implications.

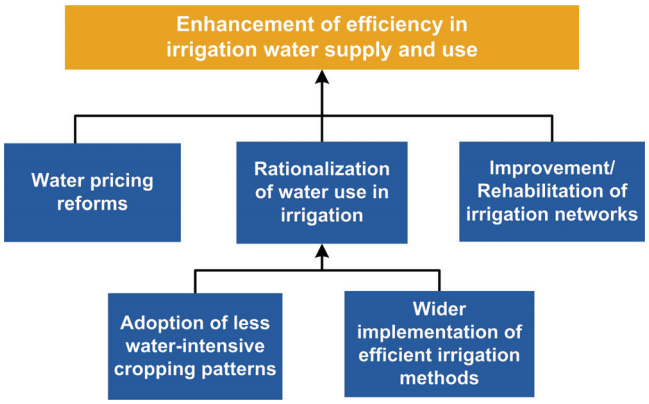


Figure 16: Objective tree for the enhancement of efficiency in irrigation water use in the Oum Er Rbia Basin

According to the views of local stakeholders, users and authorities, these preliminary objectives are inherently linked to:

- The strengthening of economic incentives already provided to farmers for implementing modern irrigation methods and rehabilitating irrigation equipment (**Objective A**);
- The strengthening of the overall framework for water management in the area, addressing empowerment and capacity building of farmer associations, to facilitate technology uptake and participation in decision-making processes (**Objective B**).

In the above context, the next section of this report outlines "soft" responses that were suggested by stakeholders for achieving these objectives, , taking into account constraints and outlining ways of overcoming deficiencies of already adopted policies towards water conservation.

IDENTIFICATION AND ANALYSIS OF OPTIONS

The work towards deriving policy recommendations focused on the identification of alternative (institutional and economic) options to achieve the agreed objectives. These suggestions, subject to evaluation, were used to formulate a roadmap for strategies for achieving enhanced efficiency in irrigation water supply and use. Identified options were grouped in two categories, according to the two main objectives defined by stakeholders, and are further described in the following paragraphs.

WATER SAVING IN IRRIGATED AGRICULTURE

Water conservation in all sectors, but primarily in irrigated agriculture is the backbone of any effort for demand management in the Oum Er Rbia Basin, and in Morocco in general. Currently, important subsidies have been put in place to encourage shift towards modern irrigation methods, but their effectiveness has been rather limited. Potential options that would be further explored to address the issue at hand are summarized in Figure 17, and concern required changes in the funding programme already in place, as well as the overall strengthening of water saving programmes in the Hydraulic Basin.

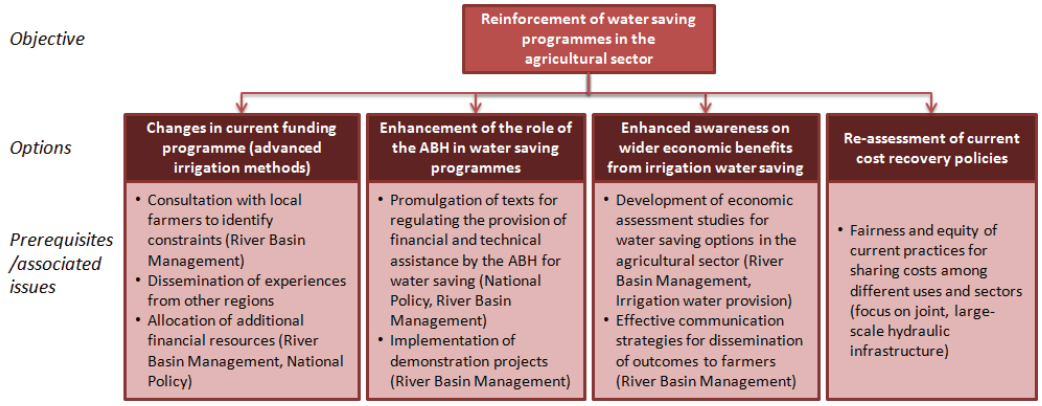


Figure 17: Suggested options – Reinforcement of water saving programmes in irrigated agriculture

Overall, decision-makers argue that the impact of policies targeting the agricultural sector can be exteremly significant. Irrigation demand can be reduced as much as 30% through rationalization in scheduling, implementation of advanced methods for irrigation water delivery and field application, and change of cropping patterns. As mentioned above, despite the important grants already in place, the funding mechanism cannot be easily accessed by small-scale farmers, due to problems faced at the initial funding stage (i.e. before the grant is received). In this regard, stakeholders propose to direct the 60% grant foreseen by the Agricultural Development Fund to those who install the equipment, instead of individual land-owners to reduce delays and enhance effectiveness.

Further to this, there is need to strengthen the role of the Hydraulic Basin Agency in the implementation of water conservation programmes, taking the Hydraulic Basin of Souss as an example, where water saving programmes are carried out as partnership between the State (60% of funds) the ABH (20% of funds) and the Regional Assembly (20% of funds). In this regard, it is proposed to initiate the promulgation of texts that regulate the provision of technical and financial assistance by the Agency for the implementation of water saving programmes.

In addition to the strengthening of financial incentives, there is also need to inform farmers, as well as decision-makers on the wider economic benefits from improved water use practices.There is need to undertake studies for assessing the economic value of water in irrigated agriculture and avoided costs from programme implementation, particularly with regard to infrastructure development. Outcomes on economic benefits for farmers should be effectively communicated to water users, so as to facilitate the uptake of incentives offered.

Finally, it is also pointed out that economic and particularly cost recovery policies need to re-examine the issue of cost allocation among different users and regions that share the same hydraulic infrastructure (storage reservoirs and conveyance networks). It is pointed out that costs relating to the maintenance and rehabilitation of existing infrastructure need to be shared more equitably among water users, taking also into account the wider economic, environmental and social benefits of the different uses involved.

STRENGTHENING THE SOCIO-ECONOMIC AND INSTITUTIONAL ENVIRONMENT

The significant progress of the water sector is manifested by the enhanced effectiveness of water management operations at all functions. However, deficiencies still exist at local and regional level, requiring the implementation of further initiatives for capacity building and

enhanced participation. Suggested options for achieving the above are portrayed in Figure 18.

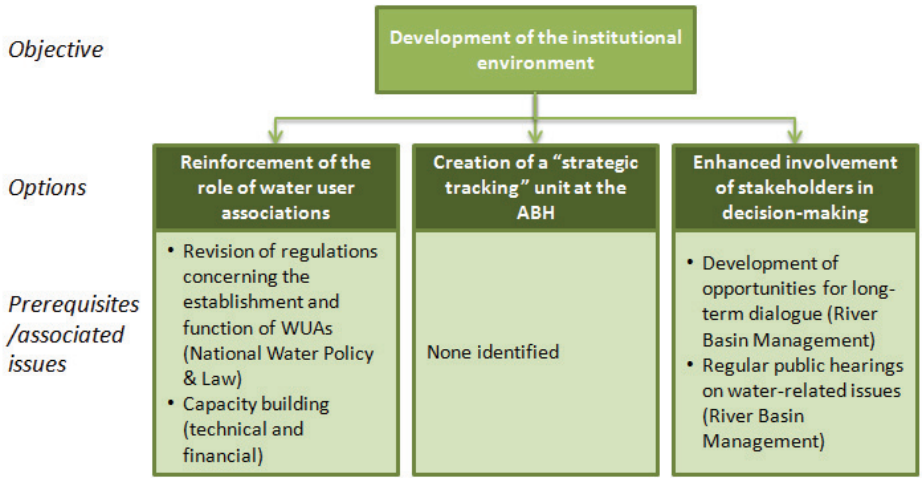


Figure 18: Suggested options – Strengthening the institutional environment

The establishment of the Basin Agencies provided a boost in water management in the country, helping at better coordinating water management efforts at regional level. Stakeholders perceive that the role of the ABHs must be strengthened in order to avoid overlaps between institutions and agencies and help alleviate conflicts over water allocation and use. In addition, public participation and stakeholder involvement in decision-making need to be fostered in two ways:

- Through the **strengthening of water user associations**: Their role is considered extremely crucial, as they can develop the capacity required among farmers through training, education and increased awareness. Furthermore, water user associations can act as intermediaries between individual farmers and public authorities, also ensuring their representation in the decision-making process. In this regard, it can be proposed to revise regulatory texts that concern agricultural water user associations, introducing processes that allow for more immediate and effective action.
- Through the **enhanced involvement** of politicians, researchers and users (farmers, ORMVAs, ONE, professional associations, etc.) in the design and implementation of demand management policies, so as to ensure commitment from all parties to decisions taken.

Additional means to improve the overall water management framework concern the building of the capacity required to ensure technology uptake and introduction of new plans and methods for demand management. The positive experience gained in the provision of urban water services points out the need to further encourage public-private partnerships. Other proposals concern the development of a "strategic tracking unit", for assimilating experience from practices adopted in other areas and transferring these to the local context and particularities.

FURTHER CONSIDERATIONS TOWARDS OPTION IMPLEMENTATION

The evaluation of policy approaches for water stress mitigation was implemented through a last step, aimed also at investigating prerequisites and implications of alternative (regulatory and incentive-based) approaches towards water conservation. The process was articulated

through individual interviews with local authorities and major water users, including representatives from:

- The Oum Er Rbia Hydraulic Basin Agency (ABHOER),
- The local Regional Offices for Agricultural Development of Tadla (ORMVAT) and Haouz (ORMVAH),
- The National Office for Electricity (ONE),
- The National Office for Potable Water Supply (ONEP),
- The Regional Directorate for Agriculture (DPA) of Beni Mellal, and
- The Agency of the neighbouring Souss-Massa Hydraulic Basin.

The outcomes of this step are presented in the following paragraphs, which elaborate on issues relating to: (a) incentives towards water saving and water conservation in irrigated agriculture; (b) cost recovery and cost sharing; (c) approaches for the regulation of groundwater abstractions; (d) framework for water management, and (e) ways of enhancing stakeholder involvement and public participation in decision-making.

Incentives towards water saving

Means employed to provide incentives for the adoption of improved water use practices could entail the enhanced application of volumetric charges, the development of financing mechanisms to provide aid to those who decide to invest in new technologies, and also the introduction and enforcement of mandatory technology standards for new buildings and irrigation schemes.

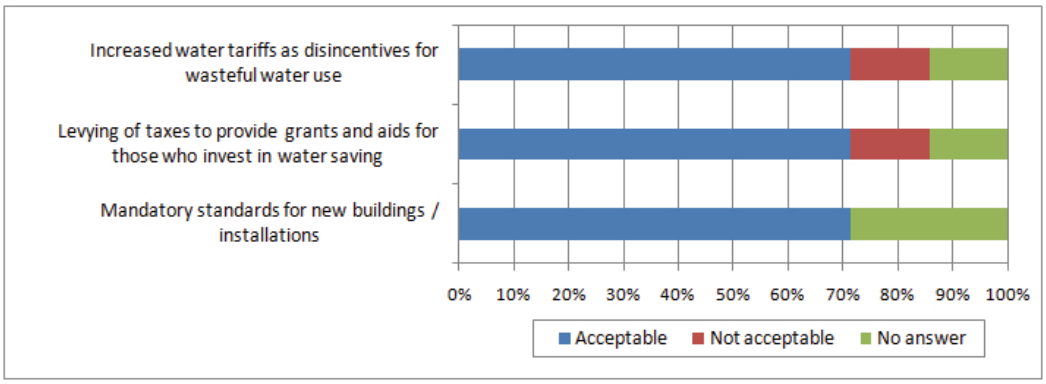


Figure 19: Stakeholder views on mechanisms to provide incentives towards water saving

As depicted in Figure 19, all approaches proposed are favourably viewed by the majority of stakeholders. An increase of water charges, even in irrigation, would be supported, provided that it would be at "logical" levels. Interviewees further underline the role of the State in the reform of pricing principles and policies. Grants and financial aid towards those who invest in water saving are already applied for the change of irrigation methods. Stakeholders note that this effort needs to be strengthened, as small-scale farmers, who constitute the majority, cannot afford the cost for the installation of new systems, even with the important subsidy of 60%. On the other hand, there are also supporters of the view that grants and subsidies should not be the primary mechanism for water saving, and that users need to be encouraged towards water conservation through other policy approaches. Mandatory technology standards are also favoured, particularly for new irrigation projects, but also for new buildings and urban developments.

Water conservation in irrigated agriculture

The enhancement of efficiency in irrigation water supply and use is the main policy objective that is inherently linked to sustainable water management in the Oum Er Rbia Basin. In this regard, questions set forth to the interviewed stakeholders concerned the following topics:

- Possibilities to further enhance efficiency in water use;
- Adaptation of crop choices to water availability;
- Ways of promoting a more efficient way of sharing available water supply among the different water users; and
- Social equitability of water conservation programmes, especially with regard to small-scale, subsistence agriculture.

A summary of replies is presented in Figure 20. Overall, and as expected, all contacted parties agree that there are significant margins for improving efficiency in irrigation water use, focusing on irrigation methods, systems and distribution network efficiency, choice of crops and water reuse. Representatives of the local ORMVAs further underline that research has already demonstrated that there is significant potential for enhancing the added value of water used for crop irrigation, and that water saving can result in a reduction of the volume of water allocated to agriculture.

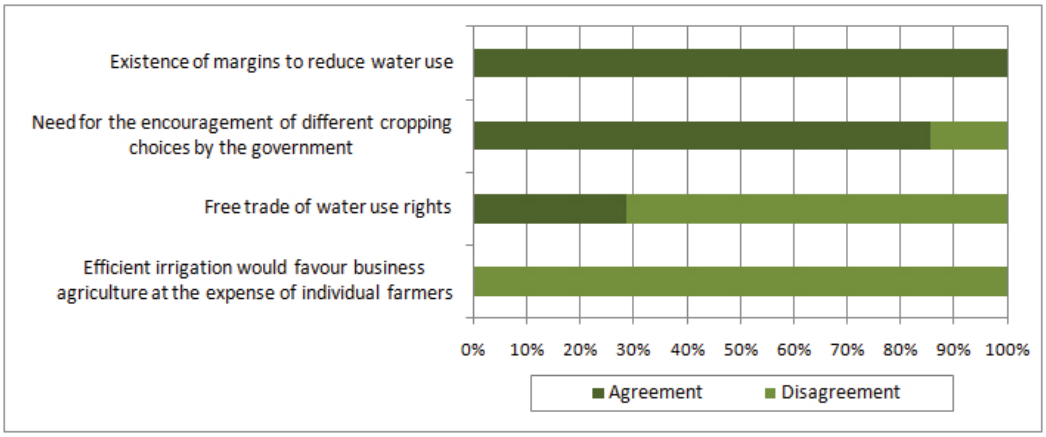


Figure 20: Stakeholder views on issues relating to water conservation in irrigated agriculture

The majority further perceives that different cropping choices need to be encouraged by the State, under the broader perspective of national policies and taking into account market conditions, profitability for the farmers and the need to preserve water resources. However, they further point out the need to convince and educate farmers to that direction. Illustrating the pertinence of this approach, the representatives from the ORMVAH underline that past efforts demonstrated that local farmers needed to be educated in order to replace alfalfa with other, similar crops with significantly lower water requirements.

The free trading of water use rights among farmers is controversial. Stakeholders in support of this alternative underline that any similar framework needs to be integrated with national policies and legislation, respecting the fact that water is a public good, and that access to the resource needs to be guaranteed at all times. Prerequisites towards any endeavour to enhance efficiency in water allocation concern the training of farmers, the establishment of Water User Associations and the building of the capacity required to sustainably manage water resources at the users' level.

In general, interviewed stakeholders consider that there is limited or no risk that efficient irrigation would favour business agriculture. It is however pointed out that in irrigated areas developed by the State, the allocation of irrigation water from the dams is performed proportionally to the irrigated area. In this regard, farmers who decide to invest in converting their traditional irrigation systems will be able to meet the needs their crops. On the other hand, farmers who have limited financial means will find themselves with lower allocations than crop water requirements, and in case that they do not have access to groundwater resources, they will be compelled to reduce the area they irrigate. However, the promotion of water saving programmes through State aid guarantees that even small-scale farmers have access to the resources required for investing in water saving.

Regulation of abstractions and discharge of industrial effluents

Although the rapid decline of groundwater tables and the alarming water quality deterioration in the Oum Er Rbia Hydraulic Basin are not directly associated with the focus of the IN-ECO Case Study, they constitute issues that receive significant attention from local stakeholders, as part of the overall effort to design and implement integrated water management strategies for the area.

In this regard, during the final evaluation step, relevant questions were set forth to the interviewed stakeholders, with the additional aim to facilitate the exchange of views on the effectiveness and deficiencies of existing regulatory and incentive-based approaches for managing groundwater abstractions and discharge of industrial effluents. In particular, stricter enforcement of regulations was examined in terms of:

- Feasibility, applicability and effectiveness of bans on water abstractions and police control of discharges;
- Empowerment and political willingness of the Government to strictly enforce legislation on the above issues;
- Compensation for environmental damage through the setting of relevant environmental taxes and charges, and ways through which these could be defined;
- Development of collective schemes for wastewater treatment and water supply, so as to prevent individual abstractions and discharges, and ways through which the costs for the development of such systems should be recovered.

Strict enforcement of legislation is favourably perceived by all stakeholders, who point out the significant efforts undertaken by the State for enabling the police control over the discharge of industrial effluents, and the delegation of power to River Basin Authorities through Law 10/95. However, several stakeholders also note that regulation is not enough; there is need to also invest in informing potential violators of applicable sanctions and in raising awareness among water users, polluters and the civic society on water conservation, in recognition of the need to focus on preventive rather than post-reactive policies. Stakeholders further underline the manifested willingness of State authorities to enforce all relevant legislative provisions, and update these as required to respond to new challenges. The “polluter-pays” and “user-pays” principles, as advocated by Law 10/95 and implemented in the Hydraulic Basins are considered both socially fair and necessary, as they allow the raising of revenues which are further used to fund activities relating to water resource monitoring and water conservation.

Interviewees also underline the pertinence of developing collective systems and fostering capacity for community-based management, as means to regulate individual abstractions. The solution needs to be analysed on a case-by-case basis, focusing mostly on areas that currently face significant groundwater degradation or quality problems, such as the Tadla aquifer system. Connections of individual users to such systems are bound to be progressive, and incentives need to be provided through the partial socialization of costs for their development, so that users are incentivized to join, at least at the beginning.

Cost recovery and cost sharing issues

Alternative ways of sharing costs relating to the provision of water services and possibly further infrastructure development receive increasing attention, given the advocation of the user-pays and polluter-pays principles in the recent Water Law, but also the increasing water stress faced in certain areas. In this regard, different questions were set forth to user groups and decision-makers in order to map opinions on:

- Ways of distributing costs among different consumer categories (households, industry, tourist sector and agriculture);
- Transparency, fairness and equity of the current tariff system, and ways through which these can be improved;
- Water pricing as means to achieve recovery of costs for water service provision and the financing of the water system;
- Willingness to accept an increase of the applied water rates, provided that this would mean provision of improved water services or sustaining of current water service levels, despite increasing water stress;
- Potential differentiation of water tariffs according to the type of use, with the aim to generate cross-subsidies among different water user categories, taking into account their relative ability to pay for water services.

Responses received from the interviewed stakeholders are summarized in Figure 21.

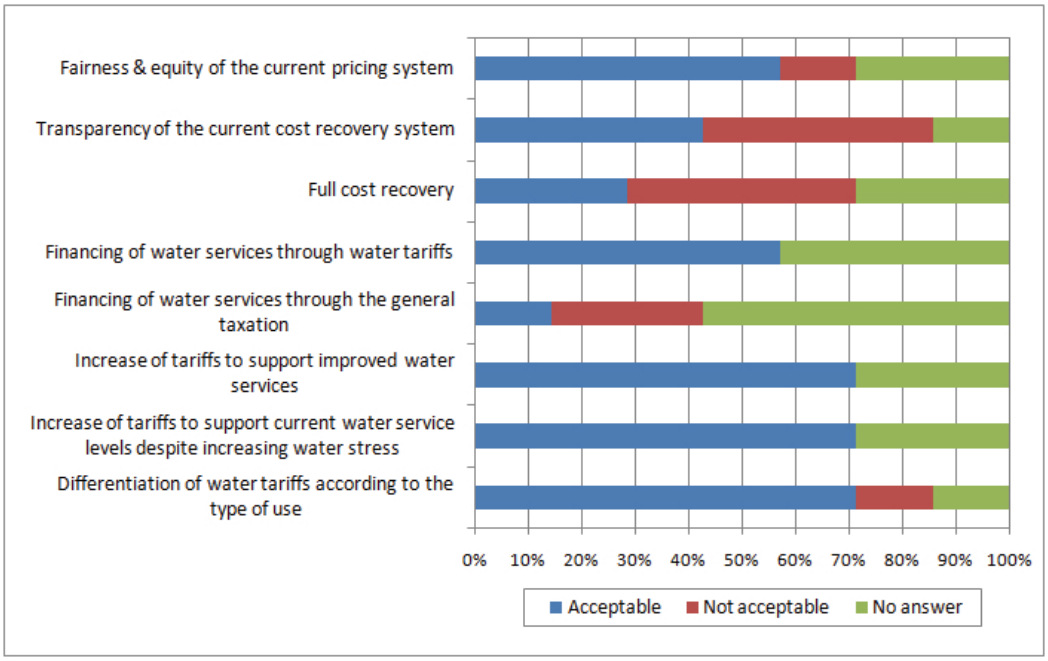


Figure 21: Stakeholder views on cost recovery and cost sharing issues

Stakeholders, in their majority, support the view that operation and maintenance costs for all water-related infrastructure should be recovered by the users, according to the overall costs they incur to the system. However, capital intensive projects, such as additional hydraulic infrastructure or significant network expansions and rehabilitation programmes, should be funded by the State. Mechanisms to that end can involve direct funding, through dedicated programmes or use of revenue from water-related charges. The different use sectors should be approached differently, depending on the income they generate and their relative ability to pay. In particular, it is supported that water for tourist establishments and for the irrigation of golf courses needs to be charged differently from water used in other, primary economic sectors, such as crop irrigation and energy production. Even in the agricultural sector, a distinction would be preferable, depending on the type of crop, but also on the outputs (farming vs. cultivation of high-value export crops). In general, however, the sharing of costs on the basis of the quantity consumed is perceived as the more equitable alternative.

Views concerning the fairness, equity and transparency of the current cost recovery systems are diverse: the current framework for drinking water supply and sanitation is considered both equitable and fair. However, overall, the system is perceived as partially transparent: users know which expenses are covered by each tariff component, but have limited knowledge on how the different charges are in fact calculated, in relation to the condition of infrastructure and water consumption. The overall framework can be improved, if effort is invested in sharing information among decision-makers, water service operators and the users. Particularly in the case of agriculture, several stakeholders, including ORMVA representatives, note that it is very difficult to accurately meter the volumes used by individual farmers; however, the situation has much improved from the past, as in several areas (e.g. the Tadla) farmers are charged with almost the actual cost for water service provision. All stakeholders would be willing to pay more for improved water services and for maintaining current water service levels in case that water stress increases.

As summarized previously, full cost recovery is not accepted by several stakeholders, who consider that partial financing of water services through the general budget is required, particularly for supporting infrastructure development in basins that face more difficult water stress situations than others. Others, however, stress the important subsidies provided to irrigated agriculture and underline that these need to be lessened as much as possible, as the approach is not equitable for the other user categories that bear the largest part of the cost, either through their respective water-related charges or through general taxation.

Framework for water management

Morocco is a country with significant involvement of the private sector in the provision of water services, especially in metropolitan areas. Existing concession contracts and the devolution of responsibilities for water supply and sanitation to financially autonomous institutions, as well as the existence of a regulatory framework, are evaluated positively by all interviewed stakeholders (Figure 22).

Overall the current level of water supply and sanitation services in the domestic sector is perceived as high, in the cases of areas served through concession contracts or the ONEP. Nevertheless, in other smaller towns and villages, where the task still remains in the hands of the local administration, there is need for more professional management. In this case, it is highlighted that there is strong need for providing the technical and human capacity and

the financial assistance required for the modernization of the water sector or for expanding private sector involvement.

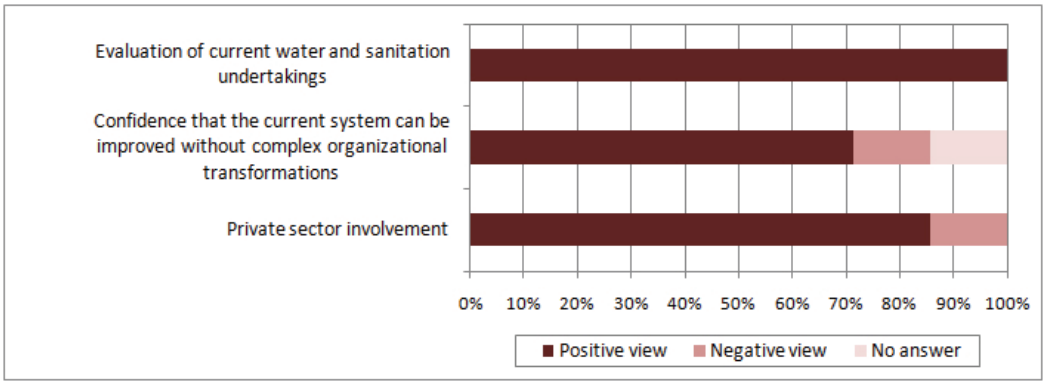


Figure 22: Stakeholder views concerning the framework for water management and provision of water services

Representatives from the ONEP note that the intervention of the national water utility has in many cases resulted in significant improvement of water services. Examples include the town of Ksiba, where the expansion, rehabilitation and real-time monitoring of the water distribution network resulted in high quality services for 6,000 subscribers. Previously, the local community was able to service only a few hundred connections, with several problems and difficulties. The outsourcing of water services to the private sector is generally well accepted, as it is considered that private firms, with long experience in the field, have the managerial skills and know-how to modernize drinking water supply systems, as manifested through the numerous public-private partnerships. Nonetheless, stakeholders underline that private sector involvement needs to be examined on a case-by-case basis. Furthermore, the involvement of the private sector in irrigation water provision is generally not accepted, as it is perceived that the solution lies in the stronger cooperation of authorities with water user associations and the allocation of responsibilities for the operation and maintenance of the corresponding facilities to the latter.

Public participation and stakeholder involvement

Current efforts for improved water management at the regional and national level, stress on the need to involve all those with a role or interest in water management in the planning and decision-making process. Pertinent initiatives are diverse, comprising support for the representation of farmers in processes, also through the establishment of water user associations, pursue of education and training initiatives and awareness campaigns to reach the general public. In the above context, and focusing primarily on the role of decision-makers and farmers in the overall process, potential issues that were considered critical for further analysis included:

- Perceptions of stakeholders on public participation and joint decision-making;
- Ways through which water users could be further involved;
- Willingness of decision-makers to consider the outcomes of participatory planning processes;
- Actual accessibility to information on water management issues of common interest;
- Impartiality and objectivity of decisions taken, as water allocation issues are often subject to political pressure from specific user groups.

In response to the above issues, all parties underlined the importance of public participation in achieving good governance and integrated water management and for commitment from all parties to ensure the success of undertaken efforts. Public participation is broadly perceived as open and transparent dialogue on all aspects concerning water management, among users and their associations, decision-makers, elected representatives, and the general public. Involvement is envisaged not only for a specific subject/project, but also during the planning process, the elaboration of new legislation, the definition of levies and water-related charges. In the case of agriculture or rural supply, it further extends to the development of partnerships for the management, service and maintenance of facilities, and also entails the organization of users through associations (professional and civil), so as to ensure their representation in the decision-making process.

Overall, respondents are rather confident that the outcomes of participatory processes would be considered by decision-makers, stressing the role of the Basin Agencies for the strengthening of means to ensure successful representation of all user groups. They further note that participation processes need to become more inclusive, integrating farmer associations, trade associations and groups that have not been yet consulted. The representation of farmers receives much attention: ORMVA representatives point out that the floor needs to be opened also towards land owners and farmers who live from agricultural activities, and not limited to higher level decision-makers or representatives.

Access to information on water-related issues seems rather problematic (Figure 23). Representatives from the Hydraulic Basin Agency point out that the sharing of data and information is not satisfactory, particularly with regard to social and economic indicators, the rate of adoption of water saving options, the economic output of water use etc. Other participants also stress that emphasis needs to be placed on the dissemination of information: data and indicators need to be made available and effectively communicated to all parties involved, if the overall effort towards more democratic water management is to be successful.

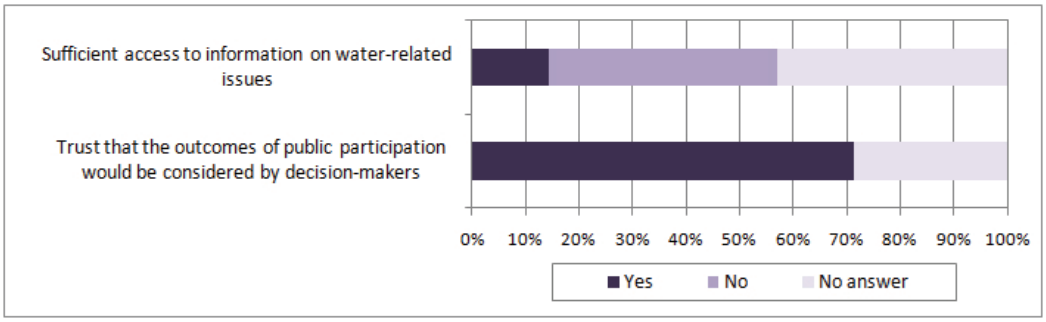


Figure 23: Stakeholder views on major inhibiting factors to public participation

CONCLUDING REMARKS

The significant water stress faced in Morocco has motivated a shift towards Integrated Water Resources Management, encouraging a global vision that integrates technical aspects, policy coordination and diverse interests and opinions among the different players. Demand management is currently the main pillar of water management policies, with particular focus on irrigated agriculture, which is the main water use and a significant production sector, both in terms of economic output and employment.

The Oum Er Rbia Hydraulic Basin, which is the area where the first Hydraulic Basin Agency was established, has been in the focus of many research and demonstration projects dealing

with agricultural water use. The recognition of the significance to better coordinate decisions and regulation of flows, and primarily to foster water conservation in irrigated agriculture has dominated water management decisions taken at regional level. Efforts to strengthen the role of water user associations and to develop fora for debate on water management plans are gradually starting to yield important results for future policies for agriculture and public participation.

In INECO, the developed open forum managed to bring together decision-makers from all important institutions of the area and farmer representatives. Results portrayed that stakeholder engagement needs to be further pursued, by providing an open floor to farmers to express problems they face in the day-to-day reality in order to arrive to an effective implementation of water management decisions and programmes. Within the effort to promote water saving, further attention needs to be paid to bureaucratic issues and to effective communication in order to facilitate uptake of initiatives, ensuring that farmers receive the background information required to engage into similar programmes. In this regard, and as pointed out during various events and research efforts, the role of water user associations as intermediaries, but also as representatives of individual farmers, is a crucial intermediate step towards more inclusive participatory processes.