CHAPTER 4 STRATEGY OF THE INTEGRATED WATER RESOURCES MANAGEMENT

4.1 Strategies for Integrated Water Resources Management

4.1.1 Strategies for Integrated Water Resources Management and Integrated Groundwater Management

The concept and direction of use and management of whole water resources in the Haouz Plain will be set up as the Integrated Water Recourses Management Strategy. The Strategy determines the basic policies on the water resources management which will contribute to the efficient and appreciate distribution and sustainable use of limited water renounces of the Haouz Plain.

The water use and groundwater management aiming to sustainable groundwater use will be set up based on the Strategy and they will be compiled into the Integrated Groundwater Management Plan (Master Plan).

The Master Plan is expected to be composed of the groundwater use plan, groundwater management plan, artificial recharge plan, and organizational and institutional strengthening plan. In the groundwater use plan, it is considered that the reduction of groundwater use is realized through water saving activity both in the surface water and groundwater use. The improvement of water use both in the surface water and groundwater, the introduction of best mix policy to water management, the examination of various activities foe water saving, etc. will be examined and necessary activities will be proposed.

The implementation plan of high priority projects and programs recognized in the Master Plan, including details of activities and inputs, will be established as the Action Plan for Integrated Groundwater Management.

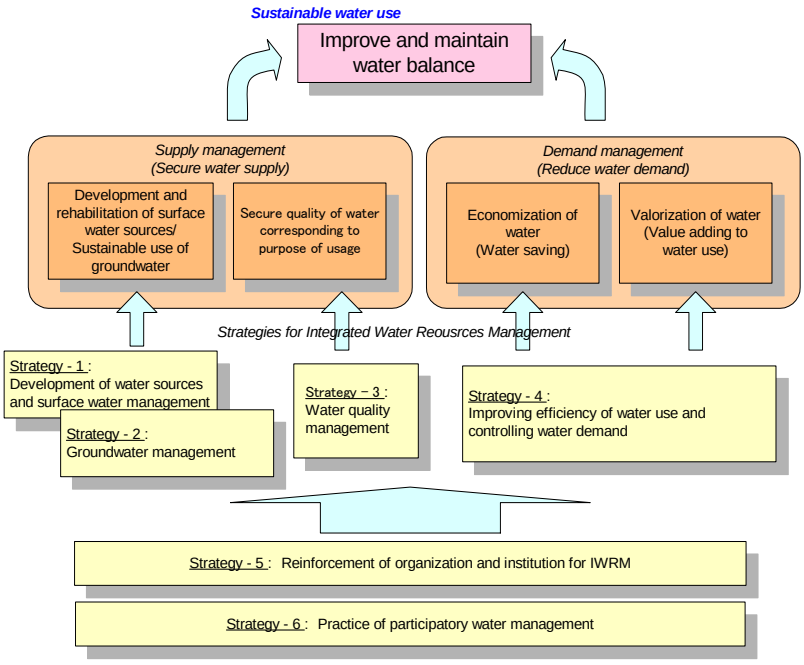
The policy of allocation of available water, which is one of the most important component of the Strategy, has been examined based on the effects of the water saving activities proposed in the Master Plan and the results were fed back to the strategies for integrated water resources management.

4.1.2 Basic Concept of Integrated Water Resources Management Strategies

(1) Basic idea of integrated water resources management strategies

The objective of the integrated water resources management is to realize sustainable water use in the Haouz Plain, where is severely limited in the water resources. In order to achieve that, it is considered that the recovering and maintaining the balance of water demand and supply, especially in groundwater, which is in the condition of over exploitation or very close to over exploitation at the moment, is indispensable. The approaches from both sides of the supply side (water resources) and the demand side (water users) are necessary to be applied to improve the present condition of the water balance.

From the aspect of water resources, it is required to make maximum and effective usage of water sources under maintaining the appropriate groundwater management. The usage



Basic Strategies of Integrated Water Resources Management

of water shall include both of maintaining existing water source and development of new source as well as reuse of wasted water. From the aspect of water users, it is necessary to manage and reduce the demand to meet the available water resource, as well.

In order to manage and reduce the amount of water use, all water users in whole sectors shall give full effort to economization of water use. Preventing ineffective use and loss will contribute to improve water balance through water saving activities. To compensate the cost for effort to reduce the demand, it is necessary to introduce aspect of the value adding and cost saving of water use (valorization) as well as the aspect of efficiency of water use. Both aspects of economization and valorization shall be considered as a combination to achieve realistic results of reducing water demand and use.

On the other hand, organizational and institutional strengthening of the agencies managing water resources as well as the formulation of a framework for participatory water resources management is necessary to realize the measures required to manage water supply and demand as stated above.

Figure 4.1.1 summarizes the factors related to water balance from the upstream to downstream of water resources.

Based on above idea, the 6 basic strategies are proposed to the IWRM as shown in the Figure above:

(2) Target year of the integrated water resources management plan

Now Moroccan Government started to prepare the National Master Plan of Integrated Water Resources, with the target year 2020. Therefore, the target year of the Integrated Water Resources Management Plan is set year of 2020 as same as the National Master Plan.

4.2 Strategy for Surface Water Sources Development and Management

The water resources of the Haouz Plain are dependent on limited input (estimated 668 Mm^3/y, as average of 1970 - 2002); mainly from precipitation in the High Atlas Mountains as well as the Plain itself, and water diversion from outer basin areas through the Rocade Canal. Part of the input is used in the form of surface water resources, while others are infiltrated into the ground, contributing to the recharge of groundwater. One of the answers in balancing the demand and supply of water is to develop new / existing water sources to increase the amount of input as well as the availability of water as in usable forms.

The hydro-geological “exit” of water from the Haouz Plain is in the North of Chichaoua, where the Tensift River passes Sidi Chiker and through the hills extending North-South formulating a natural barrier of the basin. A 154 Mm^3/y flow observed at Abadla gauging station (approximately 10 km upstream of Sidi Chiker, average of 1993/94 –2003/04), it means that a considerable amount of surface water is flowing out of the basin through the Tensift River. It is necessary to promote effective and maximized use of surface water in the Haouz Plain, so that such water flowing out will be reduced. In consideration of such waters use, it is required to examine possible social / environmental impact at the downstream reaches carefully.

In order to use water sources effectively, it is indispensable to grasp the available water sources and actual water use precisely and to clarify the control of water use.

4.2.1 Strategy for Surface Sources Development

(1) Rehabilitation/Enhancement of Existing Facilities

Because the possibility of development of new water resources is limited in the Haouz Plain, it is important to maintain the existing water resources adequately and use them sustainable.

Maintaining the function of the Lalla Takerkoust Dam: The Lalla Takersout Dam, which supplies water to the irrigation sectors of N’Fis area as well as Marrakech Water Supply, is considered as one of the most important water sources in the Haouz Plain. The Dam has lost approximately 20% of its storage capacity due to the sedimentation discharge from the upstream of the basin. The further sedimentation of the Dam is expected to be controlled by the effect of the Wirgane Dam which is under construction in the upstream of the Lalla Takerkoust Dam. However, the situation

of reservoir and catchment area shall be monitored carefully and maintenance work such as dredging is necessary to be conducted in case of need, so that the function of the Dam will be maintained adequately. From the view point of long term management, it is also necessary to promote aforestation to reduce sediment runoff in the cathcment area.

Effective use of river water: The seguia system, which take river water and supply to irrigation, has an important role in the water source of the Haouz Plain where available water source is limited. Through promoting effective and maximized use of surface water, it is expected that groundwater abstraction will be reduced its reliance in the water use. To promote effective use of surface water, it is required to consider two aspects, that is realizing effective water withdraw at the river and another is increase of conveyance efficiency from the intake to the field. In the purposes of them, improvement of malfunctioned intake facilities and modernization of canal system with concrete flume are anticipated.

(2) Development of New Water Sources

Even several dam projects were propose in the Integrated Water Resources Development Plan of the Tensift Basin (2001), only two dams, that is Wirgane Dam and Taskourt Dam, were decided to construct (or started to construct) due to most of proposed dam sites had a technical or socio-economic reason. Thus, improvement of water balance by developing new dam water other than above two dams is not expected in the Haouz Plain in the short and mid-term. The conditions of realized dams are:

- Wirgane Dam is under construction and its dam body is scheduled to be completed in September of 2007. The dam is expected to be put into operation in 2008. The regulation capacity of the dam is design as 17 Mm^3/year, which is planned to be used for Marrakech Water Supply.
- The construction of Taskourt Dam has started in the beginning of year 2007 and it is scheduled to be completed in 2010. The Dam will supply 24 Mm^3/year of regulated water source. Because the possible new dam site to be developed is limited in the Haouz Plain and the circumstance surrounding groundwater become serious year by year, it is important to implement the construction of the Dam without delay. The Dam will contribute to stable irrigation of the PMH area of the Assif El Mal river by supplying stable water source through modernized seguia system. It is necessary to formulate the detailed irrigation development plan of the area immediately along the construction work of the Dam.

In addition to implement the decided dam project, it is necessary to clarify the possibility of the available new water resources in the long term aspect. In purpose of that, the examination of the water resources development which are under study by the Moroccan side as mentioned below shall be progressed immediately.

- Study on possibility of water resources development by dam in the Oum Er Rbia Baisn to increase supply to the Rocade Canal.
- Detailed study on interconnection of N'Fis-Lakhdar-Tessout Basins through extension of the Rocade Canal, which was proposed in the Study on Large Dam Connection Scheme among the Tensift, Lakhdar and Tessout Basin.
- Study on Scheme of Water Transfer of Lokous, Law and Sabou basins to South and Study on Water Transfer of Massira Dam, which is located in the Oum Er Rbia Basin, to Marrakech Water Supply.

4.2.2 Strategy for Maximum Use of Surface Water Resources

(1) Artificial groundwater recharge

The groundwater has an important role in the potentiality of the water resources in Morocco and it plays a main role in the plan of socioeconomic development in each region. However, since the year 2000 for 3 years, a small quantity of precipitations during several years and the increase of the quantity of use by the socioeconomic development of the country caused some problems such as depletion of the groundwater level, deterioration of the water quality and the salinization of the groundwater in the inshore region. Henceforth, in order to maintain the quantity and the quality of

groundwater which is insecure and vulnerable, it is necessary to control the water use severely and to manage in a complete manner the surface and groundwater.

In this context, the artificial recharge of groundwater, which consists in infiltration of the fluvial waters to restore the aquifer, is placed in the integrated water resources management of surface and groundwater. The objectives of the facilities of the artificial recharge are to restore the natural recharge of aquifer and to increase the groundwater level as well as to minimize the costs of construction at the time of the implementation of the development.

The location suitable for artificial groundwater recharge is strongly restricted by factors such as the situation of river flow. Moreover, the contribution of artificial groundwater recharge facilities to the total balance of groundwater I the Haouz Plain plays only a minor role. However, locally, artificial groundwater recharge is expected to effectively contribute to the recovery of groundwater levels. On this basis, artificial groundwater recharge facilities shall be installed in the rivers of Rerhaya, Ourika, Zat and R'dat.

Priority of Installation and Estimated Capacity of Artificial Recharge Facilities

River	Evaluation of Priority		Estimated Capacity
Rerhaya river	Significant contribution to recovery of Marrakech water supply well field capture zone	2	2.9 Mm^3/year
Ourika river	Contribution to z7 pump sector and risk area along Ourika river	3	3.8 Mm^3/ year
Zat river	Contribution to z7 pump sector and risk area along Ourika river	4	5.5 Mm^3/ year
R'Dat river	Abundant river flow: located upstream thus contributing to large area. (However presence of sedimentation)	1	2.1 Mm^3/ year
Chichaoua river	Located in downstream area where the decline of groundwater table is not a major issue. Low priority	-	-
Assif El Mal river	Not suitable because there will be only scarce flow after the completion of Taskourt dam	-	-
N'Fis river	Not suitable because there will be only scarce flow after the completion of Wirgane dam	-	-

In future, it is necessary to realize the results of studies and surveys conducted, so as to set up the adequate facility type and scale and so as to clarify the possible basins and sites, amount of the artificial recharge, and its impact of the artificial recharge. On the basis of it, it is required to execute it under the master plan in order to install the facilities of the artificial recharge as much as possible in the Haouz plain.

(2) Preservation of the Catchment Area

For the recharge of water resources, it is important that the watershed conservation in the upper part of the basins where the amount of precipitations is relatively large. The forests of catchment area have the functions to reserve water in soil and their plants, to level the discharge in the rivers, to relieve the floodings and to consolidate the river flow. When the pluvial waters pass in the forest soils, the quality of water will be purified, that means, the forests of catchment area have the functions to relieve the floodings, to reserve water resources and to purify water.

The preservation of the catchment area, in particular reforestation and terrace works to protect the slopes, will serve to maintain and to improve the capacity of the recharge of the groundwater as well as to level the flow discharge of flood. It is expected that the surface waters will be used efficiently through recharging the water to aquifer. Besides, this preservation will prevent the sediment discharge and it is indispensable to protect the functions of the existing dams.

The target area of the integrated water resources management strategy is defined as the Haouz plain, but for the preservation of water resources of the Haouz plain, it is necessary to collaborate closely with the activities of preservation in the catchment area including the mountains of the High Atlas and the intermediate heights.

For the watershed management, the unit basins are to be considered and it is important to practice the management with a conscience of the relation between the basins of downstream and upstream. That means, the improvement of the watershed conservation in the upstream basins shall be reflected to the watershed management. In order to increase the watershed conservation in the upstream of the urban or agricultural zones that require a lot of water, it is necessary to afforest and to practice a program of prevention for the erosion. It is important to examine the financial supports and the involvement to the projects for the preservation of the upstream basins by the water users of the downstream basins. In addition, it is necessary to examine the management of the catchment area in collaboration with the authorities concerned by the environmental preservation or the forest protection.

(3) Effective use of runoff water flow out of Tensift river

The effective use of surface water resources, through the activities as the maintenance of the functions of the existing dams, the moderation of the drains by the preservation of the catchment areas, the artificial recharge of the groundwater with the restraint of water on the river bed, etc., will result the reduction of flows out toward the downstream. This reduction of flow will play an important role in the maintenance and the improvement of the water balance of the Haouz plain.

(4) Water harvesting

As for countermeasures to increase the efficiency of the natural recharge of pluvial waters to the groundwater, it is possible to adopt the method of water harvesting by means of collecting channel such as dug shaft or tanks, as well as the artificial recharge of the groundwater and the preservation of the catchment areas. To this effect, pilot projects are proposed to be carried out as to examine the adequate process, the expected impact, the means of the involvement of the populations, etc. After the pilot projects, it is necessary to elaborate a plan to implement the water harvesting work effectively.

4.2.3 Development of Reclaimed Water of Sewage

(1) Estimated Sewage Generation Amount

Sewage generation amount in the Study Area is estimated by 80 % of the water demand and tabulated in the following table. In 2020, the sewage generation amount in Marrakech is estimated at 45.2 Million m^3/year or 124,000 m^3/day. If all the amount of generated sewage will be reclaimed, it will rise in expectation for new water resources.

Estimated Sewage Generation Amount (Mm^3/year)

Year / Place	2010	2015	2020
Marrakech	35.7	41.4	45.2
Water Supply Service Area of ONEP (11 communes)	2.0	2.3	2.7
Communes except for the ONEP Water Service Area	11.5	12.0	12.6
Total	49.2	55.7	60.5

A large number of golf course & resort development projects are taking place in the south suburbs of Marrakech. There are 11 golf course& resort development projects including existing and in application for the development permission. In addition, eight (8) other golf course & resort projects are listed. The required water demand of the golf course & resort will become 30 Million m^3 per year as all the 19 golf course & resort projects will be open.

(2) Reclaimed Water of Treated Sewage in Marrakech

Sewerage development project of Marrakech by RADEEMA schedules to start operation of primary sewage treatment in 2008 with the rated capacity of 90,720 $m^{3/}$day and start operation of the secondary treatment in 2010 together with the tertiary treatment to pump up reclaimed water of treated sewage to the Tensift riverside palm garden and the nearby golf course & resort areas for landscape irrigation water. According to the plan, the required water demand of these facilities is estimated at 52,600 m^3/day or 19.2 Mm^3 per year. Meanwhile, in case of all sewage inflow to the plant is reclaimed for the tertiary treatment water, the total treatment amount is estimated at 33 Mm^3 per year, which is equivalent amount to the water demand of all the prescribed golf course & resort areas.

In addition to the sewage treatment plant currently being constructed, RADEEMA is now planning another new plant in the southern areas of Marrakech. In this Study, the water treated in this new plant will be considered for new golf projects in the future and will not be included in the Master Plan.

It always put water quality in question for the new water resources because of reclaimed water of treated sewage. RADEEMA is promoting the plan to use rapid sand filters for the tertiary treatment and utilize, after disinfection, for irrigation purpose except for the crops and the plan can avoid the water quality issue. Installation of chemical sedimentation basins in the front of rapid sand filters will be able to have better reclaimed water quality. Clearer water will be obtained by this treatment processes together with the reduction of turbid loading to the sand filters and also with the advantages of operation & maintenance of the reclaimed water transmission & distribution facilities. It is worth to study about adoption of chemical sedimentation basins in the tertiary treatment processes.

(3) Sewage water treatment out of Marrakech

The scale of sewage treatment plant in development by ONEP in the rural urban areas is small and treated water quality will become an issue of sanitation as it is used for the reclaimed water. The sewage treatment plant of Chichaoua in construction for example, the treatment process consists of anaerobic ponds and facultative ponds and disinfection facility is not included. Furthermore, the construction of sewerage facilities of ONEP is implemented in the dispersed rural urban areas and it will not economical to formulate the plan for utilization of treated sewage intensively. Therefore, the utilization of treated sewage in rural area is excluded from the Master Plan Study. However, since there are possibilities of new plans for golf projects and greenbelts, examination for its possibility for irrigation purposes should be continued.

4.2.4 Water Resource Development from Desalination

There revealed higher salinity and hardness groundwater by the water quality analysis of wells in the Study Area. The concentration value exceeds the drinking water standards but it is still within the irrigation water quality standards for most of the cases. In the remote settlements where good quality water source is not available, desalination/demineralization will be the only alternative and the construction work will be implemented. Even in that case, it is assumed that the treatment water amount might not be more than 50 m^3/day and it does not mean that the water source is an alternative for the development of new water resources since the desalination/demineralization water is abstracted from the existing groundwater.

There is a discussion of sea water desalination for the new water resources. In the oil-producing countries where low price fuel is available, seawater desalination is an advantageous and the only alternative. In recent years, the large scale plants such as 100 Million m^3/day class plants have been constructed. Looking for seawater desalination for the new water resources of Marrakech located inland is very disadvantageous conditions in technical and economical point of views. In the Study Area, there still have such several alternatives as effective use of water resources, saving water, and inter basin water conveyance. The mega-project like seawater desalination must be studied under the development strategies of integrated national development plan. Accordingly, it will be an appropriate disposition to exclude the seawater desalination for new water resources development from the study objective item of the Master Plan targeted up to the year 2020.

4.2.5 Strategy for Surface Water Resources Management

(1) Reinforcement of surface water monitoring system

The main use of river waters are intakes by seguias as irrigation water. The usage of river water in the Haouz Plain by seguias is 201 Mm^3 (average of 1993/94 – 2003/4), which accounts for 28% of the total usage. Identifying the detail actual use by seguias is thus important for integrated water resources management.

The inventory of seguias are prepared by ORMVAH in the areas under the jurisdiction of ORMVAH, while DPAs are in charge for the areas under their jurisdiction. The inventory prepared by ORMVAH is relatively well maintained with frequent updates. On the other hand, though inventories are prepared by DPAs, updates for those are not sufficiently being done. In order to identify the actual use of water

by seguias and to understand the usage of surface water resources, it is required to update and systematic management these inventories, Furthermore, registration of not only agricultural water use, but also water use by for all purposes should be thoroughly done.

While water use by individual seguias in the ORMVAH areas are being done by ORMVAH, DPA does not have their information accumulated. A structure to collect and accumulate information of water use by, with the participation of AUEAs, shall be formulated also for the seguias outside the jurisdiction of ORMVAH, such as those in the rivers of Chichaoua and Assif El Mal. Further more, such data on water use shall be promptly shared with ABHT, the water resource management authority.

(2) Improvement of hydrological observation network

In order to obtain accurate understandings on the situation of the aquifer in the Haouz Plain, and to manage groundwater in an appropriate manner, it is important to conduct accurate observations of the discharge of the rivers, which are the sources of water to the aquifers. The current observation network of ABHT is sufficient for understanding the discharge at the level of small catchments, but this should be further strengthened through installation of new observation points and renewing of observation apparatus (introduction of automatic gauges).

4.3 Strategy for Groundwater Management

The primary objective of groundwater management is defied to establish an effective aquifer management to maintain sustainable and stable supply with righteous allocation of groundwater. In order to realize the objective, the expansion and enhancement of aquifer management will be carried out based on the following three schemes.

Scheme-1: Registration Management of Groundwater Intake Facilities
Scheme-2: Determination of Available Groundwater Volume through Scientific Means
Scheme-3: Establishment of Institutional Structures for Righteous Allocation of Groundwater

4.3.1 Registration Management of Groundwater Intake Facilities

On the premise that water is national property and share righteously to the people, ABHT shall have management obligation to collect and grasp all the information of water intake facilities and water users for fulfilling the duties. Approximately, 10,700 numbers of registered wells were confirmed in the Haouz Plain through the well survey conduced in 2001. Moreover, the sample survey revealed the existence of 31% of unregistered wells and the information of the increase ration of the number of wells in 2003 and 2004, the present total numbers of wells are estimated at in the range of 17,000 to 18,000. The current number of registered wells and the contents of the registration are not adequate to realize the effective groundwater management. Especially, the registration items shall include the information available to estimate the water consumption from the purpose of use of the well in addition to the registration items with regard to the well structures and the pumping capacity. It is an essential condition to grasp the state of groundwater utilization through the information of registration logbook of all the groundwater intake facilities (well, spring, river-bed water and *ketthara*) for the purpose to establish the effective groundwater management. Renovation and digging down of the well bring about the change of water utilization conditions and the renewal of registration log book shall be made. As the status of water utilization grasped from all possible improvement measures for the registration management, the conditions will be ready for executing the other strategies, such as pumping control, monitoring of water utilization, collection of administration fee, etc., under the overall groundwater management strategies.

The target of registration management will be to: Execute the processes of application, registration, renewal of registration and monitoring of all (100%) groundwater intake facilities (well, spring, river-bed water, ketthara) and the possessors.

4.3.2 Determination of Available Groundwater Volume through Scientific Means

In case the pumping control is enforced, the control groundwater level, pumping volume, control

period, control area, etc. must be determined based on the scientific means. For that purpose, the latest data shall be prepared always in carrying out the groundwater analysis. One of the data is registration database obtained from the works of Scheme-1, in addition, collection of the information of hydrogeology, groundwater level of monitoring wells, satellite image maps and/or aerial photos will be the basic conditions to structure the accurate groundwater simulation model. Furthermore, the close linkage with the relevant agencies will become important to obtain the information for estimation of water demand and recharge amount, structuring the case studies for water demand and supply balances, etc. for conducting the groundwater analysis. After obtained the available groundwater amount and control amount determined from the result of groundwater analysis, the test operation for pumping control area and the period will be arranged. Analysis of groundwater level changes will be made for the test period for adjustment of the pumping control as required and shit to the actual enforcement of pumping control. The most important element for the groundwater management will be the determination of available groundwater amount and pumping control level & amount and the outcome will depends on the plan and implementation formulated based on the strategies under here.

The target level of the strategy will be to: Determine available groundwater amount, pumping control water level and volume based on the result of accurate groundwater analysis conducted with adequate information and scientific means.

4.3.3 Establishment of Institutional Mechanism for Equitable Groundwater Distribution

The system will have to be established in order to ensure an equitable distribution of the ground waters which takes account of the type of water use. Concrete actions will have to be implemented to achieve this objective. The countermeasures from the legislative and institutional level are required for the ground water management system installation.

On the legislative level, the application texts has to be elaborated and be published so that can be finalized the legal basis of : the workers framing of the wells digging and the ground water use monitoring and control by the water police.

On the other hand, on the institutional level, a series of the action must be committed: the installation of the council framework together of the local concerned actors, the system establishment for the royalties collecting by ABHT, the progressive competences transfer to the local communities on the ground water management and local capacities reinforcement, and also reinforcement of the personnel of ABHT in charge of the ground water management.

Lastly, the conscience of the users on the ground water management is not always elevated. For the realization of the ground water management strategy including the control of water pumping up and the royalty collection, it is indispensable to obtain the participation and the co-operation of the communities and local authorities as well as of the users themselves. The efforts of the enlightenment of the users (the institutional capacities reinforcement in parallel) must be undertaken for obtaining their understanding on the ground water management.

The final target of the strategy will be to: constitute the legislative and institutional system aiming at the realization of the equitable ground water management.

4.3.4 Scenario for Implementation of Groundwater Management Program

The scenario for implementing the groundwater management program will be decided based on the prescribed schemes to establish the effective aquifer management and formulate the management plan for the normal year and the drought year.

Annual groundwater utilization plan for normal year will be prepared based on the preparedness of groundwater intake facilities resulted in the registration management, scientific mean groundwater simulation, estimation of available groundwater amount, righteous water allocation, appropriate pumping control level & amount, annual groundwater management policies, etc. prescribed schemes to establish the effective aquifer management and formulate the management plan for the normal year and the drought year. The annual groundwater utilization plan will be implemented through basic acceptance of the relevant agencies, water users association, the representatives of farmers and other water users. Observation for the approaching to the predetermined draught year groundwater level will

be carried out from the information of groundwater level of the monitoring wells. The draught year measures will be taken for the enhancement of pumping control or suspending pumping and the control area based on the status of observation. The groundwater management manual will be prepared by ABHT in accordance with the framework proposed in the Master Plan Study.

Effective groundwater management will be achieved with preparation of implementation system. Enhancement of organizational and institutional setup is a must along with the organizational restructure, expansion and procurement of additional staff of the implementation agency, ABHT. As the pumping control is enforced, consultation and coordination will be required among the relevant agencies, groundwater users, water users associations. Enhancement of the linkage with those groups must be considered under the framework of groundwater management in order to obtain smooth agreement for the groundwater utilization plan.

4.4 Strategy for Water Quality Management

4.4.1 Basic Concepts of Water Quality Management Strategy

According to the data of water quality analysis of surface water and groundwater, they are within the irrigation water quality criteria, but they are not suitable for drinking on salinity and colon bacillus shown in potable water quality criteria. It is necessary to avoid the contamination by drainage and wastewater and conserve the water quality.

Based on these problems of the water quality, major objectives of strategy for the water quality management is to maintain water quality for the purpose of use for water supply, irrigation and ecological system

Strategies

- To reduce water pollution loading through construction of wastewater treatment plants,
- To reduce water pollution loading through non-construction measures,
- To establish water quality monitoring system in linkage of the administration sector and water polluter sector

4.4.2 Promotion of Construction Work of Wastewater Treatment Facilities

Water pollution shall be controlled through the construction of appropriate facilities based on the water pollution sources grouped as follows.

- Domestic Sewage (residential house, commercial area, school, institutional buildings, etc.)
- Factory & Business Wastewater (Factory, Hotel, Restaurant, Resort Facilities, etc.)
- Other Wastewater (Storm-water, Flood, Construction Site, Waste Landfill Site, etc.)

4.4.3 Construction of Facilities for Domestic Sewage

(1) Actual situation of domestic sewage

In urban area where domestic sewage is generating, the effluent water standard was enforced since August 2006 under the Decree No. 2-04-553, Bulletin No. 5448. According to the Decree, it is obligated that wastewater drain from the buildings in new urban area must meet with the effluent water standard, for example, BOD5-120 mg/L. Further more, the Decree stipulates that other level of effluent water standard will be enforced for the existing urban areas within 7 to 8 yeas. It is expected to structure the system for the water polluters to follow the rules of the Decree through adequate monitoring activities by the competent officers.

(2) Water treatment of domestic sewage by RADEEMA and ONEP

Development projects of sewerage facilities in urban area are being implemented by RADEEMA and ONEP respectively. The first sewage treatment plant of Marrakech is under construction by RADEEMA and scheduled to start operation the primary treatment in 2008 followed by the operation of secondary treatment by biological treatment start in 2010. Upon the operation start for the sewage treatment plant, the sewage flow 90,720 m^3/day, the rated plant capacity, will be treated. Hereafter, the

sewer connection area will be expanded and the expansion project of sewage treatment facilities will be implemented by RADEEMA at an appropriate timing ascertained. Also, the drainage from the facilities and buildings out of the sewage collection area and from the housing projects in construction in the suburbs shall be applied with the prescribed effluent standard in urban area and required to construct the primary treatment facilities for the measures to reduce the pollution loads.

ONEP is implementing the sewerage facility development projects in the rural areas. As described earlier in the section of sewerage in the main report, ONEP is implementing the construction project of 10 sewerage facilities in the urban areas in the Haouz Plain including the urban area of Tahanaoute, Tamesloht, etc. The sewage treatment plant constructed by ONEP in Sidi Moktar has started operation since November 2006 and the plant is operated with low influent flow without meeting with the design flow due to the low ratio of sewer connection to the houses. The sewerage development projects in the future shall be implemented by studying carefully the case of the Sidi Moktar. In addition, the field survey shall be conducted in the other higher populated urbanized area other than the on-going urban area for promotion to implement the sewerage development projects in the rural area.

4.4.4 Construction of Facilities for Factory & Business Wastewater

(1) Treatment of wastewater from industrial facilities

The Factory List obtained from ABHT shows 28 factories the wastewater of which shall potentially cause of water pollution problem in the Tensift River Basin. Among them, nineteen (19) factories are in operation in Marrakech and the rest 9 factories are in Al Haouz and El Kelaa provinces. With regard to the type of factory, there are eight (8) tannery factories, thirteen (13) olive factories and seven (7) other types of factories. The total effluent from those factories is estimated 800～1,000 m^3 per day.

The statistical data of Department of Tourism as of September 2006 shows the numbers of 194 hotels and 425 mansions for long-stay tourists exist in the Marrakech-Tensift-Al Haouz Region and most of the tourist lodgings are operated in Marrakech. RADEEMA's data in 2003 indicates the water consumption of hotels accounted for about 5% to the total water consumption or 4,800 m^3 per day.

Drainage from the restaurants as the other type of business activities cause of probable problems and the drainage from every factory and business establishment including hotels as prescribed will be obligated to meet the receiving wastewater quality standard determined for connection to the sewer system through the preliminary treatment facilities equipped by themselves. Factory effluent standards are in force only for sugar factory, pulp factory and paper & cardboard factory as of today and the effluent standards for the other type of industries have not yet been enforced. Urgent legislative measure is required toward prohibiting the factory and business establishments without equipped with the preliminary treatment facilities to discharge drainage to the public water receiving body. Survey shall be carried out hereafter to investigate for the actual status of drainage from the factory and business establishments to promote stipulation and enforcement of the effluent standards. For the provisional measures, the current effluent standard being enforced under the Degree No. 2-04-553 will be applicable to comply for the development of the facilities in newly urbanized area and the resort & golf course facilities in suburbs to construct the preliminary treatment facilities intended to reduce water pollution loading to the public water courses.

(2) Wastewater treatment in other commercial facilities

There is draining from the restaurant as the facility which has the possibility draining the other business affiliation becoming problem includes draining from the above-mentioned factory and the hotel, and the like as for draining from the factory it is connected to the sewer of RADEEMA & the office where preliminary treatment to the water quality which satisfies the acceptance effluent standard of the sewer, it means to be able to require the fact that it drains

4.4.5 Construction of Facilities for Other Wastewater

(1) Wastewater treatment in the land developpement zones

Water use and drainage from the development projects will increase pollutants. Environmental impact assessment shall control the developers to construct the facilities causing of deterioration to the environment. In evaluation of the environmental impact assessment report, the key factor for

evaluation shall be made it for the construction plan of preliminary treatment facilities to minimize water pollution loadings to comply with the rules and regulations of the relevant laws.

Land development projects bring about increase of run-off factor and cause of increase of storm-water flow in the area. Outflow of excavated earth during the construction work will cause of increase of turbidity in the rivers. The measures by means of constructing a retardation pond for controlling of flood flow and settling of turbidity element in the pond is a considerable factor for discussion as the land development projects will be implemented. Influence of rainfall to water quality in the study area located in arid land will be a minimal but the influence is not a negligible factor since the flood damages occurs from time to time in the area. Accordingly, it is worth to study the issues mentioned above in the implementation of land development projects.

(2) Preventives measurements for the water contamination in the waste disposal site

Existing waste disposal site of Marrakech locates in the north river terrace of Tensift River at the section crossing the bridge for Safi. Leaching of wastewater is feared in rainfall season although leachate was not observed in the field reconnaissance. Marrakech municipality is implementing the construction of new waste disposal site at Qayd Jilali in Habil located far away from the river terrace. In the plan, the new waste disposal site was scheduled to start operation from the beginning of 2007 but the construction work of the disposal site has delayed. The new waste disposal site is planed to take measures for leachate to store all the amount of leachate in the pond having 20,000 m^3 locate in the lower area and treat by evaporation. The possibility of leaching wastewater from landfill site causing of water pollution of the Tensift will be negligible as the on-going plan will be implemented. Meanwhile, the heavy machines for landfill operation are not mobilized nor the daily earth covering is not practiced in the existing landfill site. Daily earth covering operation shall be implemented immediately since the earth covering layer is considerably useful for decreasing leachate flow and improvement of leachate water quality.

4.4.6 Reduction of Water Pollutants by Non-structural Measures

It is recommendable to control generation of water pollutants and reduce water pollution loading in the river basin. In other words, the above method means to ask the polluters for practicing environment-friendly life and business activities. Listed below are the major items for examples.

- No waste damping into the public water course,
- Remove oil before washing dishes, dispose oil together with garbage, save dish washing cleanser,
- Avoid excessive use of detergent for washing clothes,
- Reduce drainage flow by saving water consumption,
- Reduce water pollutants and save water consumption through reviewing the production processes,
- Avoid excessive application of fertilizer and agricultural chemicals and simultaneously reduce the amount of chemical fertilizer and agricultural chemicals by substituting organic fertilizer,
- Routine work for removal of settled sand and sludge in the storm-water drains and manholes,
- Control of earth work to avoid generated earth to enter to the storm-water drains and to the rivers,
- Designation of water source conservation forests and prohibition of felling and reforestation at the deforested areas,
- Education by the government sector and NGOs for promotion to structure a environment-friendly society,

Further reduction of water pollutants will be expected by implementing the issues above in parallel with the development of wastewater treatment facilities.

4.4.7 Formulation of Water Quality Monitoring System among Supervisory Agencies, Water Polluters and Residents

The system for water quality monitoring and measures for water pollution in the river basin shall be structured with the enhancement of linkage among the relevant government agencies concerned with conservation of water environment, municipalities and water users, namely water polluters.

Followings are the major issues to study for materializing and practicing the system.

- Enactment of Water Pollution Control Law, Designation of Sections for Environmental Water Quality Standard, Promulgation of Effluent Standards, etc.
- Clarification of the responsibilities for water quality monitoring for drainage from the existing facilities (Appointment of water quality monitoring officer of the administrative agency(s) and municipalities),
- Clarification of the responsibilities for water quality monitoring for new development projects in application for approval including the environmental impact assessment, during construction stage and operation stage,
- Designation of water pollution control factories and business establishments and enforcement for submission of quarterly water quality monitoring report,
- Structuring the water quality monitor system by the representatives of the residents
- Enforcement and enhancement of rules and regulations for the violators to warning, arresting and penalizing,

4.5 Strategy for Improving Efficiency of Water Use and Controlling Water Demand

Besides from the efforts in increasing the amount of available water and for sustainable management of groundwater resources, demand control is a crucial issue for realizing the balance of water demand and supply. The current supply of water (estimated 942 million m^3/y as average of 1993/94 –2003/04) does not fulfill all the demand for water, while the constant increasing of new wells (estimated 4%/year, of which 2%/year is assumed to be newly development) indicate the presence of further need for water. Both economization and valorization of water will be done with the involvement of all water users, and in coordination with relevant government authorities.

4.5.1 Strategy for Improving Efficiency of Water Use and Controlling Water Demand in Agricultural Sector

It is important that reducing water demand for irrigation shall be proceeded in consideration of users' acceptability, with maintaining the productivity and profitability of agriculture.

The decrease of irrigation water demand will be realized through: improvement of water management by improved irrigation canals, reducing water requirement in the field by improving irrigation method and practice (improvement of application efficiency), realizing effective water use by adequate distribution of water as well as reducing crop water requirement by improving cropping system and changing crop/variety (valorization of water).

(1) Improvement of water management and irrigation canals

1) Improvement of traditional seguia system

There are more than 1,000 km length of traditional seguia network in the Haouz plain, and the 94% of total length is equipped by earth canal of which percolation loss is significant do that the average conveyance efficiency is estimated to be approximately 50% at present. The conveyance efficiency of the canal system is possible to increase up to 80~90% by improvement of the canal with concrete flumes. The increase of the conveyance efficiency will contribute to the effective use of surface water which is limited in the area. However, it is important to notice that the percolation along the seguia canals is considered to have a role of natural recharge of the aquifer, and the reduction of water use by reducing the percolation in canal will not fully contribute to improve the aquifer balance.

By reduce the percolation loss by improving the seguias, the dependency on groundwater for farmlands located in the end of the cannals can be decreased. This may benefit the farmers in reduced cost for irrigation. On the other hand, the improvement of the seguias will result in increased quantity of available surface water resources. If conventional groundwater usage is continued after seguia improvement, it may have the risk of negatively impacting the regional water balance. The improvement of seguias should be done avoiding such negative impacts to the water balance. In order to do so, the function of seguias for groundwater recharge should be clarified through carefull examination, and seguia improvement should be carried out together with strict control of groundwater

exploitation.

In regard of the importance of seguias for groundwater recharge, the use of traditional seguias should be continued. For this reason, the capacity of AUEAs, which are in charge of operation, maintenance and repairing of branch canals, should be strengthened for appropriate management of improved seguias.

- Understanding the actual function of groundwater recharge from main seguias
- Strengthening of operation and maintenance of seguia by water users associations

2) Extension of Secondary Canal in GH Sector

Even though the canal system is modernized in the GH sector under ORMVAH, the loss after the division work of the main canal is significant due to the unimproved secondary canals. Thus, it is necessary to improve canals in the distance of secondary and tertiary canals from the division work to the inlet of the field. Especially for the N'Fis Right Bank Sectors (N1, N2 and N3 Sectors) which are equipped by the pressurized pipeline network, the advantage of the pressurized system, that is pressure of water and small loss, is not fully utilized because the distance after the division work is generally equipped by open channel. The undeveloped secondary and tertiary canal is cause by the facts that the development of this distance is owned by users and it is difficult foe them to invest, and that one outlet of the main canal is equipped for numbers of individual and scattered parcels and the coordination between users who share a outlet is rather difficult. Because the improvement of the secondary and tertiary canal by extension of pipelines in the beneficiary area of pressurized system is considered as a precondition of expansion of drip irrigation in those area, it is necessary to be carried out in combination with the program of spread of drip irrigation in order to maximize the effect of reduction of irrigation demand.

- Land consolidation by grouping the small parcels in the beneficiary area of pressurized system
- Extension of pipeline for the distance of secondary and tertiary canal

Target area: N'Fis Right Bank Sectors where pressurized system is equip med. (N1-1, N1-2, N2 and N3 Sectors, approximately 16,000 ha in the total area of 21,100ha.)

(2) Increase of application efficiency by expansion of drip irrigation

1) Introduction and spread of drip irrigation

Drip irrigation is possible to save 20~30% of irrigation water by minimizing evaporation loss and percolation loss in the field. At the same time, it is possible to manage crop growth adequately by precise control of irrigation water and by introducing liquid manure technique. To reduce irrigation water will contribute to reducing irrigation cost as well as to improving regional water balance by reducing water demand for irrigation. Drip irrigation shall be promoted actively as a measure of reducing irrigation water demand in the Haouz plain.

Drip irrigation shall be introduced by users by themselves while the administration has a role to develop the circumstance that users can introduce easily. The expected intervention of administration is that: a) subsidy to equipment of drip irrigation and support for procedure of application, b) expansion of pipelines to grouped parcels, c) technical extension and enlightening of water saving irrigation and farming practice, d) administrative guidance through licensing for well construction.

The priority area of introduction of drip irrigation is set as described below:

a. GH irrigation sector equipped with pressurized system

   Users will install drip irrigation by themselves using subsidy by the government in irrigated field equipped peculiar outlet of pipeline. In the small parcels which are not equipped peculiar outlet of the pipeline, the administration will organize group of parcels and develop the extension of pipelines and prepare outlet to the grouped parcels while users will install drip irrigation by themselves using subsidy by the government.

b. PMH sector using groundwater

   In the groundwater irrigation area, drip irrigation will be promoted at the newly development or

replacement of well. Especially at the new construction of wells, installation of drip irrigation is to be set as a condition of licensing. Users will install drip irrigation by themselves using subsidy by the government. As for the existing wells, it is necessary to be consider to set drip irrigation as a condition of licensing for groundwater irrigation as well as promoting registration of wells.

c. Other GH sector equipped with open channel

To promote drip irrigation installed by users using subsidy by the government while selection of priority crops for drip irrigation.

d. Establishment of priority area for installation of drip irrigation

In areas with significant drawdown (and dry up) of groundwater level due to the use of groundwater for irrigation, maximum efforts shall be made for immediate installation of drip irrigation by establishing priority areas for the installation of drip irrigation. The left bank area of N'fis river (N'fis ZR sector and N'fis left bank PMH) can be pointed as the area with most significant drawdown (and dry up) of the groundwater level within the priority areas discussed above. Through prioritized installation, 100% installation of drip irrigation will be aimed in this area, including the existing PMH sectors.

2) Accumulation/distribution of technical information for water saving irrigation

With regard to the techniques of irrigation and farming practice for water saving, the information will be distributed extensively, especially for small and middle scale farmers, to make know the merits, the means of the introduction and the cultivation techniques for the drip irrigation in order to motivate the users to introducing drip irrigation system. Besides, the relative organizations conduct the technical development and the accumulation of the relative technical information of the water saving irrigation as well as the extension and enlightening to the users.

The activities of the accumulation and the distribution of the technical information for the water saving irrigation are charged by the ORMVAH and each DPA in their zones. In collaboration with the regional universities, the National institute of the Agricultural Research (INRA), etc., the information should be shared. For the extension of the techniques among the users, ORMVAH, CMV, CTE and DPAs have a role of main actor.

(3) Value adding to water use (Valorization of water use)

1) Selection of water saving crop/variety

To carry out selection and adaptation of crop/variety and development of cultivation techniques.

2) Distinguishing irrigation crops and non irrigation crops

To concentrate irrigation into the high economic value crops and to promote rain fed cultivation of cereals and feed crops.

3) Irrigation planning based on the available water resources / adequate water distribution in the filed level

In case of necessity from the view point of water balance, the water deficit (water stress) of crops shall be allowed in farming practice. For example, the field applied drip irrigation will be supplied 100% of water demand and the field without water saving irrigation, 10% to 20% of the water deficit is adopted for the suppleness of the water distribution.

4.5.2 Strategy for Water saving in Water Supply Sector

The main issue for water saving in the water supply sector is the efficient operation of water supply facilities. Thus prevention of leakage from water pipes and active efforts for water saving by water users are to be encouraged. The framework for water saving in the water supply sector are as follows.

Water leakage shall be regarded as a priority for water saving in the water supply sector. The situation shall be improved by a combination of emergency measures for cases requiring urgent care, and regular survey / works for leakage prevention funded by the annual budget of the relevant authority.

Reducing the water pressure for water supply is another possible measure to realize efficient operation of water supply facilities. This can be done by controlling the valve of the main supply pipe, and will result not only in improvement in leakage, but also in reduced amount of water supply to the users. By implementing both of the measures, it is aimed to decrease the current leakage of 40% down to 20% in 2020, and finally to 15%.

Water saving shall also be approached by cutting down the actual use of water by raising the consciousness of water users. To enable this, a change in the society as a whole will be required. The awareness of individual users on the surrounding environment will make them refrain from activities consuming water, and will lead to water saving. Campaigns and seminars on water saving shall be frequently held to raise the consciousness of water users. The main target for water saving in the water supply sector are urban water users including housings and government facilities, which consume nearly 90% of the water supply. However, tourist industries such as golf courses and hotels, as well as factories and the rural population should also participate to realize water saving by the society as a whole.

(1) Water Leakage Control of Water Supply Facilities

Under this section, the strategic study is made to have effective use of water supply facilities for the intention to reduce the water intake quantity.

Regarding the efficiency of water supply facilities, very high water loss ratio due to unaccounted water and water leakage is pointed out for the water service to Marrakech by RADEEMA and to the urban rural areas by ONEP. Following table was prepared for showing the water loss ratio in Marrakech and 11 communities of ONEP for the period of 2003-2005.

Water Loss Ration in the Last 3 Years

Item	2003	2004	2005
Marrakech : RADEEMA			
Population (x 1,000)	821.69	840.18	859.51
Annual Water Consumption (Mm^3/year)	32.70	34.17	34.59
Annual Water Production (Mm^3/year)	49.47	52.01	56.12
Estimated Unaccounted Water (Water Leakage) Ratio (%)	34%	34%	38%
11 Communes: ONEP			
Population (x 1,000)	91.5	94.9	97.6
Annual Water Consumption (Mm^3/year)	1.62	1.68	2.10
Annual Water Production (Mm^3/year)	2.60	2.71	3.30
Estimated Unaccounted Water (Water Leakage) Ratio (%)	38%	38%	36%

Data Source: RADEEMA and ONEP, processed by the Study Team

From the table, about one third of water is estimated for the unaccounted amount from 2003 to 2005, which is equivalent to 17.8 to 22.7Mm^3 water loss per year for the total of RADEEMA and ONEP water supply systems. Presumably, the very high 40 % unaccounted water ratio is caused by the distribution pipe network, service pipes, water meters, water taps, etc. It will be a very effective scheme to reduce water purification amount and water intake amount as well by decreasing the water leakage ratio to a half through the implementation of effective water leakage control m

(2) Saving Water in Water Supply

Under this section, the strategic study is made for water saving scheme by the various type of water users to expect their positive participation to the saving water campaign for decreasing water consumption to bring the effective reduction of water demand.

The following table shows the status of water use by the type of water users of RADEEMA in 2003.

Status of Water Use by the Type of Water Users of Marrakech Water Supply (2003)

Water User	No. of Connections	Water Consumption (Mm^3/year)	Ratio of Water Use Amount (%)
Domestic-Institutions	139,576	29.19	89.3
Factory	38	0.96	2.9
Hotel	196	1.75	5.4
Public Bath-Fountain	398	0.80	2.4
Total	140,208	32.7	100.0

Source: RADEEMA, processed by the Study Team

According to the table, water use by the group of domestic and institutions including schools, government & municipality offices, etc. is overwhelmingly account for the majority of water consumption at 29.2 Mm^3/year or 90% to the total water consumption in Marrakech. Targeting the reduction of water use mainly to the group of domestic & institutions users will be the most effective in the water saving scheme.

Statistical data of Department of Tourism in 2006 indicates the total number of 13,000 rooms in 91 hotels in Marrakech. Estimating from the number of rooms, the daily average water consumption by the hotels reaches in the range of 10,000-12,000 m^3/day, which is equivalent approximately to 10% of water consumption in Marrakech. Considering the current tourism boom of Marrakech, the increase of water use by tourists will not be denied in the future. Saving water campaigns at the hotels will become important. There are 10 hotels in Marrakech of which number of hotel rooms are more than 300 rooms as of 2006. The water consumption of these middle-large scale hotels is estimated at 300 to 400m^3/day per hotel. If these hotels positively construct the tertiary treatment facilities and use the reclaimed water for landscape irrigation within the hotel compound and the neighboring street garden, water consumption amount decrease considerably. For the water management administration side concerned, the financial special measures shall be considered as the hotels and other water users construct the water reclamation facilities.

Water supply demand predicted in the Master Plan Study reach at 57 Mm^3/year in 2020. If the water saving can be achieved for example by 10%, the reduction amount of water will become considerably large amount.

4.5.3 Water Saving of Other Sectors

In Marrakech city, there are city parks, green zones, street trees belt, etc. as about 400 ha (ABHT, 2006), and these are the relaxing places for the residents. The City (Commune Urbaine Marrakech) has taken charge of management for these. It is said that the wells (groundwater) are used for watering of the plants mainly. In the city park and the green area, the following various roles and functions are provided.

1) Maintenance and improvement of the city environment: Regulation of the city climate, purification of the atmosphere, habitat of flora and fauna, etc.
2) Space of recreation and health: Sports, recreation, rest and stroll, relax and mental sufficiency, etc.
3) City landscape: Formation of beautiful landscape, symbol of the city, sightseeing spots, etc.
4) City disaster prevention: Shelter area, shelter road of disaster, prevention of spreading, base of disaster emergency response etc.

At the time of plan and management operation of the city park and the green area, it is important to consider the installation of the water saving type equipment for the design of facilities and to promote the water use method of water saving and circulation type. However, it is in the range where original role and function of the city park and the green area are not damaged. Owing to the multilayer gardening design with different height trees, the selection of drought resistance plants and the increase of the covering rate of topsoil by grasses and shrubs, the decrease of the evaporation from the ground surface can be expected a little. However, from the viewpoint of water saving it is judged that the method of reduction for the excessive water supply by the execution of effect watering is much more effective.

The consideration of excessive watering on the city park and green area / garden plant is basically similar to the agricultural production. It can be said that the water is saved by the watering with drip and sprinkler compared with furrow irrigation, flood irrigation and watering by hose. To achieve the watering, it is necessary to execute the guidance of an efficient watering technology to the manager of the charge department of the city park and green area and the staffs of the site. Furthermore, in the future, it is important to utilize positively the reused water such as sewage.

4.6 Strategy for Reinforcement of Organizational and Institutional Framework

4.6.1 Clarification of the Roles and Responsibilities of the Stakeholders and Reinforcement of Consultation Frameworks

The use of the water resources in the Haouz plain is multiple and complex. Actors concerned with the water use and management such as the governmental services, the local communities, the irrigation associations, the farmers, the agro-industrial companies, the tourist sector, the research institutes, projects and ONG, also their participation degrees on the water resources management are much diversified. Indeed, for the sustainable management and the rational use of the water resources in the Haouz plain, all stakeholders concerning water will have to take part in the water management with its various aspects, in particular the framework installation for follow-up and monitoring of the water resources, the enlightenment activities for awareness-raising to water saving, the introduction or the reinforcement of the water users organizations and the dissemination of the water saving techniques.

Thus, to carry out the sustainable management and the rational use of the water resources with participation of various stakeholders, stakeholders themselves at the beginning have to clarify and recognize their role and responsibility for these resources management. Then, a mechanism to concert, to make the decision and to implement concrete actions of the water resources management should be established on the basis of the role and the responsibility of each stakeholder.

The principal stakeholders on the water resources management and use in the Haouz plain and their roles are summarized in Table 4.6.1.

The consultation frameworks of water resources management in the Haouz plain by participation of all stakeholders are proposed in the Master Plan of the Integrated Ground Water Resources Management. These consultation frameworks are consisted the commissions as below.

1) Tensift Basin Committee: A consultation framework or the stakeholders in the Tensift Basin. The Haouz plain is comprised in this framework. A circular note for create of the Basin Committee finalizing in the central level;

2) Thematic Commissions: They are constituted by the direct concerned actors, they examine and plan the countermeasures and the actions on the transversal technical themes and support to the decision of the Basin Committee. The themes for this master plan are proposed as follows, and also the another themes must be examined according to their importance and urgency ;

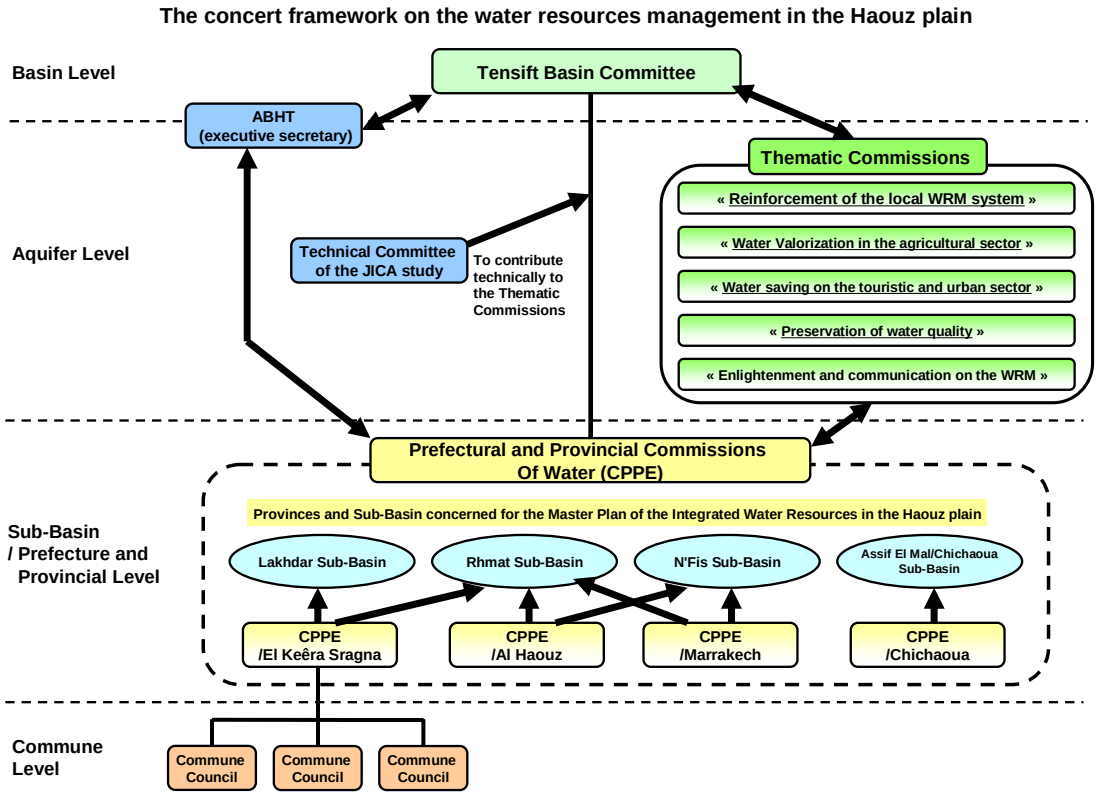
   - Reinforcement of the local water resources management system ;
   - Water Valorization in the agricultural sector ;
   - Water saving in the touristic and urban sector ;
   - Preservation of water quality ;
   - Enlightenment and communication.

3) Prefectural and Provincial Commissions of Water (CPPE): The Consultation frameworks of the stakeholders at the provincial level. Concerned provinces for the Haouz plain are Province of Marrakech, Al Haouz, Chichaoua and El Keêra Sragna.

By taking account of the importance to plan and implement actions on the Sub-Basins (to unify from the upstream to the downstream) scale for the effective management of the water resources, the CPPE will be grouped at the Sub-Basins level.

Sub-Basin	CPPE	Number of concerned communes
Lakhdar	El Kelâa des Sraghna	15
Rhmat	Al Haouz	13
	El Kelâa des Sraghna	9
	Marrakech	2
N'Fis	Al Haouz	18
	Marrakech	15
Assif El Mal / Chichaoua	Chchaoua	15

4) Communes and Commune Councils: Planning and the implementation of the management plan and the water user by the administrations, the inhabitants, farmers etc at the communal level.



The Consultation framework of the water resources management in the Haouz plain (Project)

If the consultation frameworks of the water resources management at the local level are established, with participation of the actors of provinces and communes, in particular the water users, the opinions and ideas of the Associations of Agricultural Water Users (AUEA) and the farmers could be taken into account in the local decisions for the water resources management and use. Also, these local consultation frameworks give to the local actors the opportunity to share information and to edify relating to the water resources management.

In particular, the Prefectural and Provincial Commissions of Water (CPPE) must play the focal point of the planning and the implementation for the management and the use of the water resources at the local level. To achieve this task, the establishment and the dynamization of CPPE are awaited. Also it is necessary to study the possibility of the commune participation which are envisaged only 3 communes in the Water Law and the representatives of water users who are not envisaged in the CPPE.

Also, the communes which are the basic administrative units have the roles important in the water resources management, such as the realization and the development of the hydraulic installations, the protection of the riverside and the sources, the protection of the water quality in particular for drinking water and the sanitary (articles 35 to 44 in the communal Charter). However, the current communes

are not able to plan and implement concrete actions of the water resources management due to the insufficiency of the institutional, technical and financial capacity. To carry out the competence transfer to the local communities for the water resources management, it is necessary to reinforce collaboration with the administrative structures concerned in particular the ABHT, to set up a communal scale water management system (Communal Committee of Water Management), to reinforce the implementation capacity of the actors at the communal level.

4.6.2 Activation of the Prefectural and Provincial Committees of Water

The Water Law and the decree No 2-97-488 of February 4 are envisioned the creation of the Prefectural and Provincial Commissions of Water (CPPE) and their compositions and operations. Indeed, the roles of CPPE are as follows: 1) to participate to the establishment of the plans of integrated water resources development plan, 2) to encourage the action of the communes for the water saving and water resources protection against pollution and 3) to undertake publicity campaigns to the public to the protection and the preservation of the water resources.

Thus, the CPPE were never organized since September 18, 2001 at the Al Haouz Province, although the CPPE are assured the legal basis by the law for its implementation. Some reasons can be quoted as follows: the importance of the water resources management was not taken enough into account by the actors at the province level, the publicity campaign to the local authorities in particular the governor was not sufficiently carried out by the ABHT and the attribution and its term of reference were not precise.

It is very important to establish the water resources management system with the participation of the local actors as well as the local communities (at the provincial level) to the planning and the implementation of the water resources management, the action of the management system establishment at the provincial level will be undertaken through the organization of CPPE and its activation.

4.6.3 Reinforcement of the Implementation of the Water Police and the Competence Transfer to the Provincial Level

The water police carry out the monitoring and control the illicit and inadequate water use for realize the equitable water use by the users as well as the protection of the water quality.

However the water police can not carry out the actions envisaged in the Water Law. Several points which have to solve for the reinvigoration and the implementation of the actions of the water police are as follows:

- Insufficiency of human resources: The ABHT has only five technicians who received the water police licenses. The transfer of competence of the water police to the local communities in particular the people who are in charged of water at the province level (water service) is not yet operational. Considering the extent of the vast action zone and the significant number of the water users, the reinforcement of the human resources is essential to ensure the water use control activity in the whole of the zone;
- All of the stuffs in charge of the water police of the ABHT cumulate the important daily service of the agency. For this purpose, the activities of monitoring and control by the water police are not undertaken sufficiently;
- The insufficiency of material means like the vehicles and the transport expenses is one of the major constraints for implementation the effective of the water police;
- It is difficult to denounce the illicit uses because information depends on other organizations such as the ORMVAH;
- Weak effectiveness of the implementation because the people in charge of the water police is not at the disposal in the provincial or communal level;
- Inexistence of the texts of application relating to the mission and the attribution of the water police;
- The understanding on the missions and the attributions of the water police are insufficient by the local actors, in particular the local authorities. For this purpose, the inhabitants still have an aversion important to the water use control by the water police.

To realize the control of illicit water use by the water police, the ABHT should firstly provide the necessary human and material means and proceed to the implementation of the actions of the water police in the whole of the action zone of the agency.

Taking account of the human and the financial capacity of the ABHT and also its wide action zone, it is not realistic that the ABHT carries out alone the actions of the water use control. To achieve the goal of the actions of the water police, such as the prevention of the illicit water use and the water resource protection, a close cooperation with the local communities (Region, Province and Commune) and the gradual competences transfer of the water police to the local communities are indispensable. Also the active participation of the Association of Agricultural Water Users (AUEA) to the actions of the monitoring of the water use will be able to protect their rights and interests and to respect by themselves the equitable water use. It is prospective that the illicit water use will be reduced by the establishment of control networks through the actions of the water police at the communal level and also organization of the AUEA.

For the establishment of the control networks quoted above, it is necessary to show to the local actors, in particular the local authorities, the current state of the water resources and the importance of its managements, to propose the concrete control system of the illicit water use and to edify the activities of the water police. Also, the traditional organizations called “Mouquadam or Chieikh”, which assume a role of the decision-making and the mediation between inhabitants at the Douar level. These organizations and the AUEA will make it possible to facilitate the Community management of the water resources, if they understand the importance of the water management and of the water saving, participate to the illicit water use control activities and edify to the inhabitants on the adequate water use.

For the transfer of competence and implementation of the water police at the local level, the countermeasures such as the drafting of the application texts by clarify the mission and the act of the water police, the reinforcement of the capacities of the local actors through the formation and the creation of the budget must be applied.

4.6.4 Adequate Water Pricing and Royalties Collection

Water is a public property and cannot be the subject of private appropriation described clearly in the Water Law. All users using the surface and underground water resources in the hydraulic public domain have the obligation to pay a royalty for water use. However, the excessive and often uncontrolled pumping are the principal causes of the important lowering of the ground water. The efforts for the control and the intake volume saving of the groundwater by the royalty collecting must be made.

The adoption of the tariffication to the water resource, particularly the underground resource intake, will have to be considered in an equitable way and differentiated according to the criteria defined such as the volume of water intaken, the effort for the water saving introducing the adequate technique or the type of water use developed. For example, new tariffcation of use of groundwater will be applied initially to the large scale water users (large farms and tourist sector). The possibility of extending tariffication application to the other users will be applicable gradually. Also the large water consumers will have to be penalized in the tariffication. And the farmers who make the efforts for the economy of water introducing the drip irrigation technique will have to be encouraged through a less penalizing tariffication.

The tariffication of water and the method of collection will be examined in the thematic commissions described above and will have to be concerted sufficiently by the stakeholders included the water users and to be approved after the consultation.

With regard to pumping particularly, the majority of the owners of the wells and is opposed to the ground water royalty collection. Because they think that the pumping facilities are their own goods and they invest for the digging, the realization of the pumping facilities as well as the cost necessary for pumping. Also the large scale farmers who invest for the realization and the operation of the wells oppose more than the small farmers who wish to ensure stable volume and the equitable use of the

irrigation water[1].

Thus, the big aversion of the users to the royalty payment in particular of ground waters is foreseeable, it is necessary circumspect discussion and efforts to obtain the comprehension and the approval of the water users by the communication and publicity campaigns. Also the approval and the support of the local communities (Region, Province and Commune) and of the local authorities are indispensable.

The royalty collection will have initially to be carried out by the initiative of the ABHT through actions of the water police, competence on the water management and the water use will be gradually transferred to the local communities (provinces and communes) by reinforcing their management capacities.

Also, the royalty collection will have to be used as the principal financial resources for the implementation of the concrete activities for the water resources management. For realize this vision, the water resources management funds is proposed. This funds will have to be mobilized for the concretization of the actions for the sustainable management and the rational use of the water resources such as the promotion of the drip irrigation technique, the maintenance of the hydraulic equipments, the introduction of some technologies for the water saving in the tourist sector, the periodic follow-up-monitoring of the water resources. These water management funds will be established by the financial participation of the users in the form of royalty and will have to be managed by a transparent and equitable system.

4.6.5 Financial Strengthening of ABHT

(1) Financial strengthening program

In the water law, the financial resources of ABH are composed of the royalties to collect from the water users and DPH users, and public debt, state subsidy, donation, and so on. ABHT is expected to be managed to operate self-sustained organization as an independent administrative organization in the future. Securing of the income source becomes even more important to strengthen a financial base. At present, ABHT gets various royalty incomes and half of that is from extraction permission of construction aggregate material. Regarding the surface water, the water fee charge is being collected from ONEP and enterprise as potable water, and also, it is being collected from ORUNVA and privet sector as irrigation water from 2004. On the other hand, the irrigation water of DPA isn't made an object of charge. And, the water charge is not collected about pumping of groundwater from wells in the internal and external of the irrigated areas of ORMVA and DPA.

Therefore, it is necessary to examine the possibility of collection for the part where the water charge isn't being collected and is omitted about the surface water. And also the examination of the possibility of the collation of the water charge about the groundwater is need. These increase the income from royalties, and financial base will be strengthened much more. In the water law, the water resources are public properties and it doesn't consider to become individual possession except for the right received legally.

The annual water use in the study area is estimated that the surface water including inter-basin water diversion is about 440 Mm^3 and the pumping volume of the groundwater from wells is 500 million m^3 (average of 1993/4 - 2003/04). The water resources of 940 Mm^3 are using in total and the rate of dependence to the groundwater is about 54%. When DH 0.02/m^3, which is the water charge of irrigation water is applied for the surface water of over 200 Mm^3 and the ground water of 480 Mm^3 which are not made the object of the levy at present the new royalty income is about DH 14 million can be expected. But, concerning with the groundwater it can be said that the charge to well unit is more realistic than the installation of the water volume meter for the small and medium scale farmers at first stage. If the number of wells is assumed about 20,000, the water charge that is equivalent to the water volume of pumping as about 500 million m^3 becomes to approximately DH 500 per well as ABHT income.

[1] Results of the investigation to the AUEA and farmers by the JICA study team

(2) Execution framework

It is considered that the execution of the following activities is necessary to reinforce the financial aspect of ABHT as measures for the institutional and regal improvement.

- Arrangement of full-time water police to reinforce the use regulation of groundwater.
- Promotion of the diffusion activities of the water saving enlightenment to the industrial sector such as tourism facilities, golf course and inhabitant (including execution of the campaign, use of the mass media and stakeholders meeting).
- Construction of water fee collection system and training of specialists.
- Strengthening of the function for monitor and evaluation of the water resources.

Furthermore, to construct the water fee collection system, it is necessary to be carried out gradually as follows:

1) Execution of the inventory survey of using wells.
2) Organization of well users.
3) Construction of the water fee collection system.

However, concerning with the water fee collection system, the repulsion from the user (especially, farmer) is expected. Therefore, it is necessary to make the countermeasure of ABHT to farmers, to construct the suitable fee collection system and to raise the necessary human resource as soon as possible.

4.6.6 Capacity Development of ABHT on Water Resources Management

The ABHT must play a role of federator of the water resources management in the Haouz plain. However, by taking account of the importance of its missions and the number of its tasks, certain institutional weaknesses and insufficiencies of the technical capacities quoted in the table must be improved and reinforced (Table 4.6.2).

For the sustainable management and rational use of the water resources in the Haouz plain, the establishment of the water resource management system under the close collaboration with the various stakeholders is indispensable. Also the function of the ABHT must be operational as the federator of the water resources management. Administrative system improvement and reinforcement for the water resources management, through the actions for the capacity reinforcement of the ABHT in the technical and institutional level, must be done as soon as possible.

4.6.7 Legislative System Establishment for Effective Implementation of the Water Law

The water Law 10-95 and its application texts define legal system of the authorization and the concession for the utilization in the DPH, water right reconnaissance, the rules of the water conservation and the norms of the water quality, the royalty payment obligation for water use in the DPH and its collection, and also the revelation of the law violator by the water police and the penal regulations.

However, this water legislation is not sufficiently recognized and applied by the users. According to the questionnaire to the AUEA and the farmers carried out in this study framework, only 16% of farmers know the Water Law 10-95.

And moreover, the Water Law defines the water police that have to control the unauthorized digging wells and intake water and also the illicit water use and water pollution little function.

The reconnaissance of the water right is fixed by the Water Law in the five (5) years of the time limit after the promulgation of this law. Every authorizations and concessions of the new installations of water intake in the DPH have to be provided by the ABHT. However the activities carried out by the ABHT such as the campaign organization for promotion of the water right reconnaissance, the control of the illicit wells digging and water intaking did not satisfactorily succeed. The recognized water rights are limited yet by certain owners and users. The number of the authorized wells is limited to 12,603 on the other hand total number of the wells in the Haouz plain is estimated about 20.000. The number of the water intake installation that is unauthorized and unregulated could be numerous but they are not known certain.

To respect and accomplish the legal system concerned the water management, the reconnaissance to the users on the water legal system must be promoted to the users by the large diffusion of the information related the Water Law and its application texts. And also the necessary application texts have to be elaborated and approved for the effectiveness of the Water Law.

4.7 Strategy for Participatory Water Resources Management

4.7.1 Reinforcement of the Actions of Enlightenment for Water Saving and Water Resources Conservation

The saving water and the water management campaign have been implemented by the concerned structures especially in the agriculture and tourism sectors, but each executes individually as a function of their competence particularly finance capacity. Thus, results of the campaigns haven't been satisfied because impacts to water users have been little significant. The activities of the enlightenment for the saving water and the water resources conservation must be preceded strategically to the multiple concerned stakeholders based on the elaborated communication plan.

The target stakeholders to the enlightenment actions are multiple such as local authorities, local collectivities, traditional organs, private companies, tourism sector, irrigation associations, farmers and citizens, and their participation to the water management and use are different. Also, the opportunity and the access mean to information are multiple by the stakeholders and the enlightenment themes have to be considered this diversity.

It is possible to pass message on the importance of the saving water and the water resources conservation through the enlightenment activities for the resources management considering the diversity of the stakeholders by the multiple mean of the communication and media.

4.7.2 Activation and Reinforcement of Capacities of Water User's Associations, Competence Transfer for Water Management

The Agricultural Water Users Associations (AUEA) plays an important part of the irrigation water distribution and the hydro-agricultural equipments management. In fact, the irrigation for agriculture dominate 92% of the total water demand in the Haouz plain, the AUEA have to play an important role to the water resources management such as the federator of the farmers.

However, numerous AUEA has organizational and institutional problems as shown below and their activities stagnating:

- The organizational management capacity is insufficient, particularly the financial management is not enough transparent;
- The financial capacity of the ABHT for insure management and maintenance of the hydro-agricultural facilities is weak, because the assessed rate payment level by members is low and sometime not paid;
- The AUEA has only one financial mean by their assessed rates. Thus the land status Guich that is the more representative in the Haouz plain doesn't permit for the farmers to benefit to the credit access of the bank establishment like the CNCA. This is one of the cause of the affection of the drip irrigation technique development;
- The technical capacity of the AUEA for insure the auto-management of the hydro-agricultural facilities is insufficient;
- The lack of communication between the members is one of the major cause of the motivation falling and the weak technique level of certain members for the dynamic participation of activities of the AUEA;
- The existence of conflicts between members can be one constraint for activities of the AUEA,
- Certain AUEA don't organize anymore their general assembly and as a consequence their organization become weak;
- The role of the AUEA to the water resources management focus especially on the surface water management (canals and segues) and the role for the ground water management is not clear. Therefore the participation of the AUEA on the ground water intake management is very limited.

To promote the saving irrigation water, the AUEA as the principal actors of the water use must participate actively to the management and the saving of the irrigation water by the drip irrigation practice. The progressive competence transfer to the AUEA on the water management such as the management of the hydro-agricultural facilities (canal and seguia), the management of irrigation water distribution (surface and underground), the royalty collection and the control of the illicit water use (participation to the water police's activities) have to be examined. That's why the organizational, institutional and technical capacity of the AUEA must be reinforced.

4.7.3 Contract for Groundwater Management and Use

A participation of all stakeholders is indispensable for the sustainable management and use of the water resources in the Haouz plain. Thus all stakeholders must understand the importance of the resources conservation and make an effort of the equitable management to reach the goal to aim the regional socio-economic development and sustainable water use in the Haouz plain.

The contract for the ground water management that the ABHT aims to realize is a participatory and contractual framework for the water resources management. It defines the utilization conditions and the action for the ground water management engaged by the ensemble of intervenient in the water domain including the users. The contract of the ground water management clarifies the actions of implementation, the partners and their responsibilities of each action, the cost, the financial plan and its participation part and the monitoring-evaluation program. The elaboration of the dossiers of the contract will be examined at the consultation framework, and finally approved and signed at the Basin Committee level: The contract of the ground water management will insure the concrete actions implementation by the responsibility and the engagement of the stakeholders.

4.8 Scenarios for Integrated Water Resources Development and Management

4.8.1 Scenarios for Improvement and Maintenance of Water Balance

(1) Sustainable Water Balance

The sustainable use of water resources of the Haouz plain requires the improvement of the balance of the groundwater. To realize that, it is necessary to take in consideration the global water balance, including surface and groundwater. The development and efficient use of surface water will relieve the dependence on groundwater, so that the demand in groundwater will be decreased and the loads of the aquifer will be reduced.

In the Haouz Plain, where drawdown of the groundwater level is already elicited, the equality in annual balance of input and output is a minimum requirement for sustainable use of groundwater resources. Moreover, the target level of water balance shall be examined based on factors such as further drawdown expected during the period before reaching annual balance, required recovery of groundwater level to enable stable utilization of groundwater, and management during drouts. These factors will be further examined based on the results of groundwater simulation with management.

(2) Scenarios for Development and Management of Water Resources

The available water resource in the Study Area is estimated to be 501 Mm^3 in 2007 and 522 Mm^3 in 2010 as for surface water. The available groundwater in consideration of the sustainable water balance is not valued until now, but it is not possible that it exceed the present level of the water use. On the contrary, the forecasted demand of water will not at all be acceptable from the aspect of the sustainable water use. Therefore, the objectives of the integrated water resources management is determined to achieve and to maintain a situation of the offer and the demand to satisfy the sustainable water balance as far as possible through the efforts both of the development of water resources and the reduction of the water demand.

In the development and management of water resources, it is required to develop water resources exploitable in consideration of the socioeconomic aspect as well as to use existing water resources efficiently. To this effect, the monitoring system both of surface and groundwater resources will be reinforced and the water use will be managed in an adequate manner with the monitoring of the

situation of water resources. On the basis of it, the water allocation for each sector will be set, and each sector should take efforts for the reduction of their demand while considering the allocation plan to reach.

4.8.2 Scenarios for Water Resources Development

(1) Scenarios for Maintenance of Existing Dam Sources

The Lalla Takerkoust Dam, that is one of the major dams of the Haouz plain, has problems of the sedimentation. After the completion of the Wirgane Dam, which is located in the upstream of the Lalla Takerkoust Dam, the sedimentation runoff will be reduced extensively in the Lalla Takerkoust Dam, but it is still necessary to supervise the sedimentation runoff for the two dams and to take necessary measures, as the scheduling of preservation of the basins in long-term, etc. The Lalla Takerkoust Dam is assumed to maintain the regulating capacity of 82 Mm^3 (excluding amount of the industrial water) in future.

(2) Scenarios for Development of New Dams

The Wirgane Dam under the construction will have an important role in the source of Marrakech water supply, which is continuing enlarging. Besides, the Taskourt Dam will act as source of irrigation in the area of the DPA Chichaoua. The Taskourt Dam will contribute to the efficient use of the surface waters through improving water intake from river which is unsteady at present. These dams are expected to construct and set in service as scheduled and to contribute to the improvement of the water balance of the Haouz plain. To the present stage, the DPA Chichaoua accelerates the formulation of the irrigation development plan under the Taskourt Dam. This irrigation development should be set in motion since the completion of the construction of the Taskourt Dam.

Scenarios for development of new dams

Dam	Projected regulating capacity	Year of setting in service
Wirgane Dam	17 Mm^3/year	In 2008
Taskourt Dam	24 Mm^3/year	In 2010

(3) Scenario for Development of Treated Sewage Reclamation

With regard to the RADEEMA's plan for utilization of treated sewage, the consultant company is now carrying out the study and design of the secondary treatment, tertiary treatment and disinfection facilities including the study of required water utilization volume for re-use and the study will be concluded finally in 2008. The most promising alternative as of today is to implement the secondary treatment system at the same capacity of the primary treatment facilities at 90,720 m^3/day and the tertiary treatment facilities is designed at 52,600 m^3/day to supply reclaimed water to meet with the provisional water demand of the Tensift riverside palm garden and the golf course & resort areas in the south-east suburbs of Marrakech. The plan is scheduled to start utilization of reclaimed water in the middle of 2010. Under the Master Plan Study, the RADEEMA's plan is respected basically in the contents and the time frame. However, the scenario of the tertiary treatment processes will be modified to design the chemical sedimentation basins and the rapid sand filters to produce better quality of reclaimed water and distribute after disinfection.

For the development of treated sewage reclamation after 2015, it will be advisable to decide carefully by watching the status of the first facilities scheduled to start in 2010 and the trends of speculative-like golf course & resort development projects. It will be preferable to study the future development of water reclamation at the same time with the review of the Master Plan after 5 years, and the study for future development of treated sewage reclamation will not be counted in this Study.

(4) Scenarios for Artificial Recharge of Groundwater

It is necessary to place the artificial recharge of the groundwater in the important activities for the improvement of the balance of the aquifer with effective use of surface waters, to begin a pilot project and to execute plans of action of ABHT. A total of 14.3 m^3/year is estimated in this study with 4 artificial groundwater recharge facilities in the rivers of Rerhaya, Ourika, Zat and R'dat.

Estimated Recharge Capacity of Artificial Groundwater Recharge Facilities

River	Estimated Recharge Capacity
R'Dat river	2.1 Mm^3/Year
Rerhaya river	2.9 Mm^3/Year
Ourika river	3.8 Mm^3/Year
Zat river	5.5 Mm^3/Year
Total	14.3 Mm^3/Year

(5) Regionalized allocation of surface water distribution

In areas with significant drawdown in groundwater level due to high dependency on groundwater, use of surface water resources will be promoted as much as possible to control area specific drawdown. Particularly in the N'fis left bank area, where drawdown (dry up) is most significant, distribution of surface water will be reallocated to alleviate the situation. The 6Mm^3 taken from the Lalla Takerkoust dam for water supply for Marrakech shall be taken from the Rocade canal, and the excess water from the dam shall be allocated to the ZR irrigation sector of the N'fis left bank. This will contribute in alleviating the pressure on groundwater in this area. The water from the Rocade canal shall be devised by decreasing the amount of irrigation water to other GH areas along the canal. (the 6 Mm^3 taken for water supply is an emergency measure, of which the water right is originally to be allocated for agricultural purposes)

4.8.3 Scenarios for Reduction of Water Demand

(1) Scenarios for Reduction of Irrigation Water Demand

1) Scenario by mainstreaming the level of the present irrigation

The water demand of the irrigation sector, which is the biggest water user, to the present level is of 883 Mm^3/year while the potential demand is of 1,298 Mm^3/year. In addition, the maximum water demand in 2020 will be of 1,657 Mm^3/year on the assumption that the trend of increase of groundwater abstraction in the PMH sectors will continue. This demand of 1,657 Mm^3 need of quantity of groundwater abstraction of more than 1,000 Mm^3/year in the annual water balance. It means that this quantity will never be acceptable in the groundwater, even though of various measures for water saving were taken. To this effect, to have the demand in realistic water, has place to consider agriculture by the present irrigation, to know the cultivated surface and the water stress for crops, as present level. On the basis of it, of various measures for water saving will be taken, the efforts will be expanded to the maximum and the water demand i will be reduced to reach to the sustainable water balance.

2) Scenario of reduction of water demand by introducing drip irrigation

In principle, the equipment of drip irrigation is to be introduced by users themselves, but to reach to the objective, it will be necessary to arrange the environment that can incite users to the drip irrigation, as the system of subsidy, the extension and enlightening, the development of the infrastructures if necessary, etc. In particular, the system of subsidy is indispensable so that the users install the equipment of drip irrigation and it is therefore important to maintain the system of subsidy in progress and to improve the services as regards to use. On the basis of it, the spread of drip irrigation will be prioritized in the agricultural lands which have advantage to introduce drip irrigation such as the field of the GH equipped pressurized system and the field using groundwater. To this effect, drip irrigation will be promoted by arranging the secondary pipeline extension or the new installation of outlet to the field t, in case of necessity, , as well as making obligation to users to introduce drip irrigation at the time of the authorization for the construction of a well or for the withdrawal of water, on the other hand.

Target of the introduction of drip irrigation

GH sectors with pressurized system	PMH sectors using groundwater	Other GH sectors with open channel
To introduce drip irrigation in 100% of the irrigated area equipped pressurized system	To make obligation to introduce drip irrigation at the time of the construction of a new well or replacement	To determine the priority crops and 50% of the objective to reach
To introduce drip irrigation in the areas of 19,000 ha on 21,100 ha, total surface, (Necessary pipeline extension of the 16,000 ha)	Newly introduce to 62 000 ha by the year 2020 with the average of 4 000 ha/year (estimating increase in groundwater usage in PMH sectors: Basic Action). Newly introduce to 47 000 ha by the year 2020 with the average of 3 000 ha/year (estimating that increase in groundwater usage in PMH sectors is controlled: Major Action). (Including introduction of drip irrigation to 100% of PMH sector in N'fis left bank)	Introduction in 10,000 ha on 25,700 ha of the total surface

The drip irrigation makes the effect for the reduction of the irrigation water, which is able to reduce 20~30% of irrigation water in the field by changing irrigation method from the traditional one. However, it is necessary to consider that water in excess infiltrated in soil contributes to the recharge of the groundwater.

At the assessment of the global water balance, it is to note that the drip irrigation will contribute to the improvement of global water balance only in reducing evaporation loss and the reduction of infiltration in the field will not contribute to the global water balance. In this Study, it is assumed that drip irrigation will have for result to improve the water balance with the reduction of 10% of the quantity of irrigation water.

3) Scenario of the control of the construction of new wells in PMH sector

In the Study, it is estimated that the construction of well in the PMH is 4% per year of which half, either 2%, is destined for the new demand in water. If the tendency of this continuous increase, about 90 000 ha of groundwater irrigation (present evaluation on the basis of 82 700 ha in 2002/03) will have reach to 118,000 ha in 2020.

Actually, before the enlarging of irrigated area is achieved, the decrease of the groundwater level or the dry-out of the aquifer will prevent this enlarging. But taking into account the present situation of the critical water balance, it is necessary to prepare a scenario that controls the new construction of well other than replacement. The only legal control cannot prevent the construction of new wells, therefore for the realization of the realistic control, the supports for farmers who need water will be combined with other measures, such as the extension of surface water use by rehabilitation and maintenance of existing seguia system, and the redistribution efficient of water resources created by the reduction of irrigation water by drip irrigation.

(2) Scenario for Reduction of Water Demand in Water Supply

Effective use of water supply facilities, namely water leakage control and water saving through the water user's positive activities, will be the themes in water supply system in the reduction of water demand. The following paragraphs describe the scenarios to carry out the respective scheme.

Water leakage measures will be carried out with the immediate urgent measures and the regular water leakage survey & control works to be formulated in the water leakage control plan and the annual financial arrangement. These projects will be the priority projects in the water leakage control measures for contribution to the reduction of water demand. Another scheme for water demand reduction in the effective use of water supply facilities will be made by reducing the distributing water

pressure. The method is practiced by controlling the main valve(s) on the water distribution pipeline and/or the block valve(s). This method will bring decrease of water leakage amount and the water distribution amount control simultaneously. Increased effect is expected in decrease of water leakage amount by the implementation of above schemes together. Water leakage control shall be implemented to reduce the current nearly 40% water loss ratio to 15% in the final target level through the stepwise targets of 20 % in 2020 for the purpose of reduction of water demand in water supply systems.

Saving water measures is carried out by raising the awareness of water users to save water for decreasing water consumption. For the purpose to fulfill the scheme, the drastic change throughout the society is a key issue. Moreover, the awakening of awareness of individual person in the surrounding environment will restrict by oneself against the excessive water consumption behavior and be directed to the water saving activities finally. It also expects that the water users awareness will be raised through the programs of water saving campaigns, seminars, etc. and take a positive action for water saving. The main target water user group for saving water program will be the domestic & institutions water users in urban area who are consuming about 90 % of the total water consumption. Other water users including the tourism industries such as hotels, golf course & resorts, factories, the rural residents are also requested to participate in the program and the water saving measures shall be tackled with under the framework of the movement in the entire society.

(3) Scenario for reduction of water demand of golf courses

In the Study Area the golf courses are numerous, either 3 existing golf courses, 3 others of which the water use is already authorized, 5 others whose demand is already made and 8 others in progress of development projects. It counts 19 golf courses to the total (in the forecasting of the water demand, only the four golf courses among the 8 of which the projects of development are in progress are registered.) Taking into account the necessity in the economic activities of the Haouz plain and Marrakech, it is difficult to control the water use for these projects of development.

The pressure of the development of the golf courses on the water demand of the other sectors will be relieved by the means of the framing the golf courses projects to make maximum efforts of water saving in order to reduce the demand, such as using treated waste water for golf course irrigation in maximum. It is necessary to take in consideration, finally, that the source of irrigation water of all golf courses is replaced by the treated wasted water.

4.8.4 Scenarios for Integrated Water Resources Management

(1) Water Allocation Plan

For the adequate allocation of limited water resources, considering the priorities of each sector, the water allocation plan will be set and the measures for the reduction of water demand will be taken in each sector having this setting for value of objective.

Since the drinking water is indispensable as basic human needs, the source of drinking water should be assured above all. The demand in drinking water in 2020 is estimated in 100.3 Mm^3, of which 77.3 Mm^3 for the Marrakech city will depend on 8 Mm^3 of the groundwater and 69 Mm^3 of the surface waters supplied by the Rocade Canal and the Lalla Takerkoust-Wirgane Dam. To the commune level in rural area, the demand in drinking water is estimated in 23 Mm^3 whose whole quantity will be taken in the groundwater.

The water demand of golf courses will have increase from 2.5 Mm^3 at present to 19.4 Mm^3 in 2020. The water demand for golf courses irrigation will depend on the treated wastewater after the beginning of the supply by the project of development of RADEEMA.

The water demand of irrigation is estimated currently in 883 Mm^3 and is increased to 1,046 Mm^3 in 2020. In the case of the maximum demand, the forecasting will be in 1,528 Mm^3. These values of forecasting have been estimated before introducing measures for the reduction of the water demand. The water demand will be reduced according to the strategy of reduction of the irrigation demand. The quantity of surface waters to distribute for the irrigation in 2020 is estimated in 233 Mm^3 of the river water and seguias, 210 Mm^3 of the dam water and transferred of the outside of the basin, either in 443

Mm^3 to the total. The rest of the irrigation demand will depend on the groundwater. The amount of available water from the point of sustainable groundwater management is set at 564 Mm^3 in the case where Major Actions are taken, based on the results of the groundwater simulation. The provisional allocation of water resources at the year of 2020 based in this figure is indicated below. Maximum efforts shall be made to reduce water demand in order to realize water use based on this level which enables sustainable groundwater management.

Forecasting of the water sharing (2020)

(Mm^3/year)

		Water Demand	Water Source			
			Surface Waters		Treated Waste Water	Groundwater
			River water and Seguia	Dams and Waters Transferred		
Available Water			233	289	19	564
Use	Water Supply	100	-	69	-	31
	Irrigation	979	233	210	-	526
	Golf Courses and of Other Urban Uses	26	-	-	19	7

(2) Scenarios for the Integrated Water Resources Management

In addition to the 2 scenarios examined in 4.2.1 (continuation and maximum demand), integrated water management scenarios were examined taking into regard the scenarios for improvement and maintaining of water balance, the scenarios for water source development, and the scenarios for water demand reduction. 2 additional scenarios with different levels were examined and simulations were done for both of them. The 2 scenarios are outlined as follows.

1) Basic Action Scenario: maintaining the water sufficiency for crop production at the current level, introduction and dissemination of drip irrigation, development and utilization of treated wastewater, artificial groundwater recharge, and regionalized allocation of surface water resources are included in the basic actions.

2) Major Action Scenario: in addition to the measure included in the basic actions, the control of increased groundwater usage by PMH sectors is included.

4.8.5 Groundwater Simulations Based on Scenarios

(1) Four groundwater development conditions tested

The expected groundwater table levels and balance beneath the Haouz plain were obtained from groundwater flow simulations (see Supporting Report G: "Groundwater Simulation" for details). The scenarios of groundwater abstraction conditions were simulated, based on the possible actions on the water balance as described in § 3.10.1.

A "**Basic Actions**" scenario was constructed to simulate the impact of a first step of positives measures on the water demand as well as the water resource. All the conditions of the "**Continuation**" scenario were kept, except:

- Reduction of the level of evaporation from 15% to 5% over 85.000 ha as the result of the introduction of drip irrigation system;
- Use of 19.4 MCM/year of treated wastewater from 2010 for the existing and planned golf courses.
- The source of the 6 Mm^3 taken for water supply in Marrakesh shall be shifted from the Lalla Takerkoust dam to the Rocade canal, and the excess from the dam shall be allocated to the N'fis left bank irrigation sectors. The water taken from the Rocade canal shall be devised by decreasing the amount of irrigation water to other GH areas along the canal.
- Artificial groundwater recharge facilities shall be installed in the 4 rivers of Rerhaya, Ourika, Zat and R'dat. This is expected to result in the additional recharge of 14.36 Mm^3.

Then, a "**Major Actions**" scenario was simulated for the evaluation of the introduction of a second stage of positives actions. All the conditions of the "**Basic Actions**" scenario were kept, except:

- The groundwater abstraction in the PMH sector was kept as the 2007/2008 level. No new borehole in the PMH sector is authorized and an efficient control is introduced (the only authorized boreholes are those drilled to replace dry or clogged boreholes).
- The target for the introduction of drip irrigation will be 70 000 ha in total due to the change in the introduction to PMH sectors, which will be reduced from 62 000 ha to 47 000 ha due to the control of expansion.

The conditions set for each scenario is summarized as follows.

Detailed hypothesis for the main parameters of the four scenarios

	Scenarios			
	Continuation	**Maximum Demand**	**Basic Actions**	**Major Actions**
Irrigated areas GH PMH	40.514 ha 135.190 ha in 2006/07 162.863 ha in 2020/21	46.883 ha 135.190 ha in 2006/07 162.863 ha in 2020/21	40.514 ha 135.190 ha in 2006/07 162.863 ha in 2020/21	40.514 ha 135.190 ha Up to 2020/21
Drip irrigated surfaces GH				
N'Fis right bank	-	-	17.500 ha in 2011	17.500 ha in 2011
Other sectors	-	-	11.500 ha in 2017	11.500 ha in 2017
PMH	0 ha	0 ha	62.000 ha in 2020	47.000 ha in 2020
Water stress conditions	18%	0%	18%	18%
Growth rate of PMH irrigated by groundwater	2%	2%	2%	0%
Surface water availability (MCM/year)	501 up to 2007/08 518 up to 2009/10 522 up to 2020/21	501 up to 2007/08 518 up to 2009/10 522 up to 2020/21	501 up to 2007/08 518 up to 2009/10 522 up to 2020/21	501 up to 2007/08 518 up to 2009/10 522 up to 2020/21
Golf courses water demand	Up to 15 golf courses from 2015 (19.7 MCM/year)		Covered by 19.4 MCM treated wastewater from 2014	
Rainfall	282 mm/year			
Flood infiltration rate	about 25%, based on flood regime			
Regionalized allocation of surface water resources	-	-	Shift 6Mm^3 from Lalla Takerkoust dam to Rocade canal for Marrakech Water Supply	
Artificial groundwater recharge	-	-	14.3 m^3 as total of 4 rivers	

(2) Outline of the scenario results

The evaluation of the results of each scenario based on the criteria examined in 3.9.1 is summarized as follows:

Summary of the scenario results (simulated period from 2006/07 to 2020/21)

			Continuation	Maximum Demand	Basic Actions	Major Actions
Indicates related to Groundwater	Surface "Change50"(ha)		29,000	97,000	3,690	-6,214
	Groundwater Balance (Mm^3)	Whole period	-1,310	-3,440	-696	-289
		2006/07	-39	-126	-35	-35
		2020/21	-121	-263	-70	-21
Economic Indicators	Average depth of the groundwater table (m): 41.4m at present		41.4	48.4	38.7	37.3
	(Economic Impact: Million dh)		(3,757)	(7,605)	(1,918)	(1,606)
	Dried out aquifer surface (ha)		9,100	44,000	3,714	3,589
	(Economic Impact: Million dh)		(448)	(2,166)	(183)	(177)
	Number of dried out boreholes		1,805	6,883	414	283
	(Economic Impact: Million dh)		(253)	(964)	(58)	(40)
	Number of people losing jobs		4,306	20,821	1,758	1,699

According to the results of the simulation, implementation of the basic actions will reduce the annual deficit of groundwater balance from the current 121 Mm^3 to 70 Mm^3 in the year 2020. Furthermore, the implementation of the major actions, which include the control on expanding irrigation by

groundwater in PMH sectors will reduce the deficit of water balance to 21 Mm^3 in the same year. In regard that the deficit of water balance is limited to some 3% of the volume of groundwater used in this year (564 Mm^3), it may be said that the groundwater balance has nearly reached equilibrium. Moreover, the in regard of the decrease of accumulated deficit in groundwater balance and the drawdown of groundwater table, it may be evaluated that the implementation of the Major Action scenario will realize a sustainable state in groundwater use. Thus, the Master Plan for Integrated Groundwater Management discussed in Chapter 6 of this report will determine activities to realize the major action scenario.

Table 4.6.1 Principal stakeholders on the water resources management and use in the Haouz plain and their roles

Category / Organisms		Roles for the water resources management	Action zone
Local Collectivity	Regional Council (CRMTH)	Decision-making on the water resources management at the regional level, Political and institutional support; Coordination between the organizations concerned in the water sector at the regional level.	Marrakech-Tensift-Al Haouz Region
Local Collectivity	Province (Water Services)	Coordination between the organizations concerned in the water sector at the province level; Planning and implementation of programs and projects on the water resources management and use.	Provinces
Consultative Commissions	Prefectural and Provincial Commissions of the Water (CPPE)	Participation for elaboration and implementation of the PDAIRE; Support activities for the saving water and the safeguarding of the water quality at the commune level; Implementation of the publicity campaigns on the protection and the conservation of the water resources	Provinces
Local Collectivity	Communes and Commune Councils	Realization and maintenance of the infrastructures AEP, sanitary, hydraulics at the communal level; Riverside protection, Safeguarding of the water quality in particular drinking water, Sewage water treatment; Participation for elaboration and implementation of the PDAIRE	Communes
Public Establishment	Agency of the Tensift Hydraulic Basin (ABHT)	Diffusion of information on the water resources to the stakeholders; Enlightenment for rational use and water saving; Monitoring and control of the illicit water use; Examinations and issues of the authorization of the DPH use.	Tensift Basin
Public Establishment	National Office of Drinking Water (ONEP)	Planning of drinking water supply; Production, treatment adduction and distribution of drinking water in urban and rural area; Maintenance of AEP system; Treatment and recycle of sewage water and its redistribution	Marrakech-Tensift-Al Haouz Region
Public Establishment	Marrakech Regional Water and Electricity Distribution Company (RADEEMA)	Water and electricity supply, infrastructures management in Marrakech City; Treatment of sewage water and water quality protection in Marrakech City	Marrakech City
Public Establishment	National Office of Electricity (ONE)	Production, transport and distribution of the hydraulic electric power; Maintenance of the electricity station	Marrakech-Tensift-Al Haouz Region
Public Establishment	Regional Office of Agricultural Development of Haouz (ORMVAH)	Maintenance of the hydraulic infrastructures and irrigation in GH and PMH; Irrigation water distribution, Royalty collection, Organization and leading of the Association of Irrigation (WUA); Dissemination of agricultural techniques for the irrigation water saving	Haouz plain (Action Zone of the ORMVAH)
Administrative Structure	Provincial Department of Agriculture of Marrakech and Chichaoua (DPA)	Maintenance of the hydraulic infrastructures and irrigation in PMH; Organization and leading of the Agricultural Water Users Association (WUA); Dissemination of agricultural techniques for the irrigation water saving	Provinces (out of the action zone of the ORMVAH)
Public Establishment	Urban Agency of Marrakech	Examinations and issues of the authorization for the construction of the residences, the tourist establishments, the factories for the water quality conservation and the prevention of flood damage; Planning of the urban development plan in Marrakech City	Marrakech City
Administrative Structure	National Institute of the Agricultural Research (INRA)	Development and diffusion of the irrigation techniques for the water saving, and the varieties less consuming water and additional economical values	Marrakech-Tensift-Al Haouz Region
Administrative Structure	Regional Delegation of Water and Forests (DREF)	Planning, study and implementation of the actions for the water resources protection and hydraulic basin management	Marrakech-Tensift-Al Haouz Region
Administrative Structure	Regional Inspection of Land Management, Water and	Study on the environmental impacts of the hydraulic infrastructures construction, Water quality protection	Marrakech-Tensift-Al Haouz Region

	Environment (IRATEE)		
Administrative Structure	Regional Delegation of Tourism(DRT) / Regional Center of Tourism(CRT)	Water saving efforts promotion to the sector tourism (hotels, golf etc.)	Marrakech-Tensift-Al Haouz Region
Administrative Structure	Provincial Direction of the Equipment (DPE)	Maintenance of hydraulic infrastructures (Dams); Realization of drinking water supply in the rural areas	Provinces
Professional Organization	Chamber of Agriculture	Interlocutor and intermediary with the administrative structures on the water resources management for the interest of farmers; Diffusion of useful information to farmers; Support to diffuse the irrigation techniques	Provinces
Professional Organization	Chamber of Commerce and Industry	Promotion of respect on the standards of the flow and the quality of water by the factories and the companies; Support for realization of the sewage water treatment installation	Provinces
Water Users Association	Agricultural Water Users Association (WUA)	Equitable water distribution for the agricultural use; Maintenance of the hydraulic installation for irrigation; Drip irrigation technique development	Marrakech-Tensift-Al Haouz Region (WUA Action zone)
Water Users Association	Drinking Water Supply Association	Drinking water supply installation management ; Pumping water saving and water quality protection	Marrakech-Tensift-Al Haouz Region

Table 4.6.2 Missions, Constraints and the countermeasures necessary of the ABHT for the sustainable water management in the Haouz plain

Missions and attributions	Constraints and problems	Countermeasures necessary and actions of reinforcement of the capacities to solve the constraints
On the institutional level		
Authorization of the water resources use in the DPH	Procedure of the authorization is complicated and time necessary to have the authorization is very long.	• Simplification of procedure to the authorization of exploitation in the DPH • Single form elaboration for the proclamation of the digging and pumping authorization • Increase of the personnel in charge of the authorization procedure
	Illicit water use and intake of the wells not-authorized.	• Promotion of the registration and the regularization of the exploitation situations through the declarations period prolongation the existing wells and drillings
Surveillance and control of the illicit water use, royalty collection	Royalty is not collected except the ORMVAH and ONEP and it does not permit to manage the income for activities of the ABHT.	• Consultation organization with the actors to fix the adequate tarification of water • Creation of the service in charge of the regulation of the water use and the collection of the ground water royalty, reinforcement of the personnel
	The system of the royalty collection from the ground water pumping is not established.	• Augmentation of the personnel in charge of the royalty collection and the finance • The ground water royalty fixing according to the volume pumped and used • Determination of the royalty collection modality • Financial management training
	Activities of surveillance and control to the illicit use of water by the water police are not sufficiently realized.	• Reinforcement of the personnel in charge of the water police (recruit, training, material means, budget) • Reinforcement of the water use control network through the competence transfer to the local collectivities
Consultation and coordination of the water resources management with the concerned organisms	Periodic consultation framework with the concerned actors does not exist.	• Establishment of the consultation framework of the water resources • Deliberation of the countermeasures with the concerned actors through the thematic commissions establishment
Pool and diffusion of the information of the water resources	Information related the water resources is not ordered and diffused effectively though a lot of the studies were realized.	• Common and unified documentation and data management • Creation of The water resources information system
	Information on the water resources is not sufficiently diffused to the stakeholders.	• Information diffusion through the enlightenment and communication activities • Diffusion of Information on the water through the Web site establishment and its updating
On the technical level		
Monitoring and evaluation of the water resources	Number of the hydrological stations installed in the sub basin level is not sufficient for the monitoring	• Increase of number of the hydrological stations • Analyze and diffusion of the hydrographical information
	Volume of water intaken by the seguia irrigation networks in the PMH is not sufficiently known.	• Increase of the seguia water observation networks and periodical observation under close collaboration with the ORMVAH and the DPA
	Situation of the wells undeclared is not known.	• Wells inventory implementation • Creation and update of the database of wells
Ground water resources simulation and analyze	Personnel in charge of the ground water simulation and results analyze is absent (hydrogeology expert)	• Recruit of a specialist in the hydrogeology field • Technical training (simulation software operation)
Support to the water resources management	The concrete projects for the water resources management by the ABHT are not executed.	• Effective implementation of the projects for the

and conservation activities	The implementation system of the concrete actions under close collaboration with the concerned structures is not established.	water resources management and conservation under close collaboration with the concerned structures • Budget mobilization of the ABHT for implementation of the concrete projects
Water quality protection	Water quality measurement, analysis and diffusion of the results are not periodically executed.	• Periodic water quality measurement and information diffusion to the public (scheduled 4 times / year)
	The water analysis laboratory is exist but is not functioned. Materials are insufficient and are not maintained.	• Reinforcement of the personnel in charge of the water analyze (recruit and training) • Equipment of the necessary materials for the water analyze
Planning and management of the action related the water resources management	The knowledge and experience of the participatory water resources management and the projects management are insufficient.	• Workshop organization in the field of the project planning and management

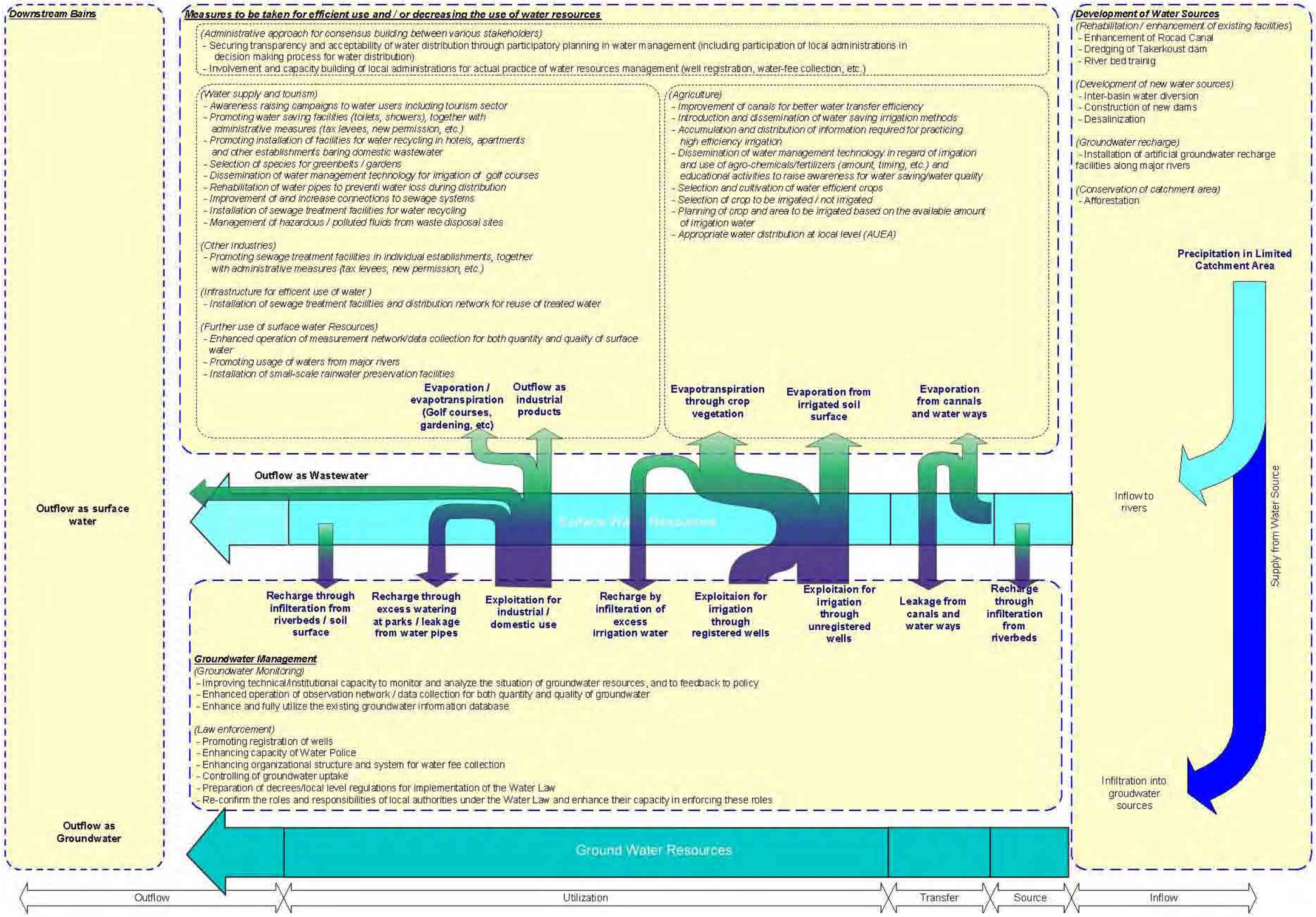


Figure 4.1.1 Factors Related to Water Balance and Strategies for Integrated Water Resources Management

CHAPTER 5 MASTER PLAN ON INTEGRATED GROUNDWATER MANAGEMENT

5.1 Object of the Master Plan

The Master Plan for the Integrated Groundwater Management aims at the realization of the appropriate management of the groundwater which is necessary to guarantee the utilization of the water resources continuously and stably on the inhabitant's life and the agricultural production, in consideration of supply and demand of the groundwater in the Haouz plain.

5.2 Targets of the Master Plan

5.2.1 Target Year

The target year of the Master Plan is established in 2020, taking into consideration of the Integrated Water Resources Management Strategies and the target year of the National Water Resources Plan which is being prepared by the Morocco Government. The implementation period will be 13 years, while an interim review shall be conducted after 5 years of implementation (2012).

5.2.2 Achievement Target

To realize the improvement and maintenance of the water balance in the Haouz plain, the scenario (Major Action Scenario) examined in the former chapter is realized. In other words, the equilibrium of water balance of the groundwater will be roughly attained by the target year, 2020.

5.2.3 Objective Area

The objective area of the Master Plan is the Haouz plain located in the upper basin of the Tensift River, and total area is about 6,000 km2.

5.2.4 Target Group

The beneficial target by the execution of the Master Plan is about 1,610 thousand people that lives in the Haouz plain. The urban population of Marrakech City is about 820 thousand. Further, the tourists are also contained as an influence effect in the tourist sector.

5.3 Strategies to Attain the Master Plan Object

5.3.1 Basic Concepts

Based on the Integrated Water Resources Management Strategies shown in the preceding chapter, the Master Plan is elaborated mainly the groundwater management which aims at improvement and sustainability of the water balance in the Haouz plain, and the basic concepts are composed of the followings:

1) New water resources development and surface water management plan,
2) Groundwater management plan, including the regulation of extraction in consideration of the balance of demand and supply in the Haouz plain,
3) Water quality management plan,
4) Plan for appropriate groundwater distribution and use, which could obtain consensus among various stakeholders,
5) Plan for organizational and institutional strengthening for the management of water resources, and
6) Participatory water resources management plan through the participation of the stakeholders

5.3.2 Components of the Master Plan

The main pillars of the Master Plan are the "Surface Water Sources Development and Surface Water Resources Management Plan" and "Water Demand Reduction Plan", which directly approach the improvement of the water balance in the Haouz Plain. These Plans are regarded as the main projects, because they not only contribute to realizing the objectives of the Master Plan, but also stand as a model for water balance improvement, which can be applied technically to the water resource management plans in other regions. On the other hand, the agency shouldering the central role in the management of water resources is ABHT, standing in a position to manage and supervise the implementation of the aster Plan in coordination with the agencies in charge of the implementation of the individual projects and programs formulating the Master Plan. The components which compose the Master Plan are as the followings.

Components of the Master Plan

Plan Field	Program / Project
Surface Water Sources Development and Surface Water Resources Management Plan	Artificial Groundwater Recharge Project
	Reclaimed Water Supply Project
	Hydrological Observation Network Reinforcement Project
Groundwater Management Plan	Program for Groundwater Facility Registration Management
	Program for Scientific Estimation of Available Groundwater
Water Quality Management Plan	Program for Water Quality Monitoring
Water Demand Reduction Plan	Program for Drip Irrigation Introduction and Dissemination
	Program for Seguia and Water Management Improvement
	Program for Accumulation and Distribution of Technical Information for Water Saving Farming and Irrigation
	Water Supply Leakage Control Project
	Program for Water Saving Dissemination
Organizational and Institutional Improvement Plan	Program for Water Resources Management Capacity Development of ABHT
	Program for Legal and Institutional Frameworks Improvement for Water Law Implementation
	Program for Water Police System Enhancement
	Program for Appropriate Pricing and Effective Collecting of Water Royalty
Participatory Groundwater Management Plan	Program for Formulation of Collaboration and Decision – Making Framework for Water Resources Management
	Program for Activation and Capacity Development of Water Users Association
	Program for Public Awareness on Water Saving and Conservation

5.4 Contents of the Master Plan

The programs and projects which compose the Master Plan are as follows:

5.4.1 Surface Water Sources Development and Surface Water Resources Management Plan

The amount of present water use (the average of 1994 to 2004) is estimated to 942 Mm^3 and the present potential water demand is estimated in 1,384 Mm^3 while the water demand in 2020 is forecasted 1,153 ~ 1,657 Mm^3. To solve this large gap between available water and demand, it is necessary to develop various water sources and to lead activities foe water saving.

In addition to the Rocade Canal, the project of transfer of water of the outside of the basin is being examined. However, the plan is not necessarily determined at this point, and therefore, will not be considered in the master plan because it won't be ready for the target year of the master plan that is 2020. The Wirgane Dam and Taskourt Dam under the construction or whose construction has just begun are incorporated already in the future plan. Therefore, the master plan will take into account only about the functional improvement of the existing hydraulic facilities, the artificial recharge of groundwater and the reuse of the treated wastewater.

In order to implement effective groundwater use and aquifer management effectively, both of surface water resources and groundwater resources shall be managed appropriately. The major objectives of surface water management in the integrated water resources management are:

1) Collecting information on surface water resources for assessing the natural recharge to aquifer, and
2) Grasping the precise situation of water usage foe assessing water demand and usage by sector and by resource.

Assessment of natural recharge from the High Atlas, which occupies major part of recharge source of the Haouz aquifer, and the infiltration from the seguia canals is expected to be improved in its accuracy due to solving objective "1)". By objective "2)", it is expected that the information on water withdrawal and usage of seguia system will be collected precisely and those will be held in common among concerning organizations so that the information will be fully used in water management activities timely and effectively.

(1) Artificial Groundwater Recharge Project

1) Implementing agency: ABHT

2) Objectives of the project:

   Recharge groundwater by infiltrating stocked water in the river bed.

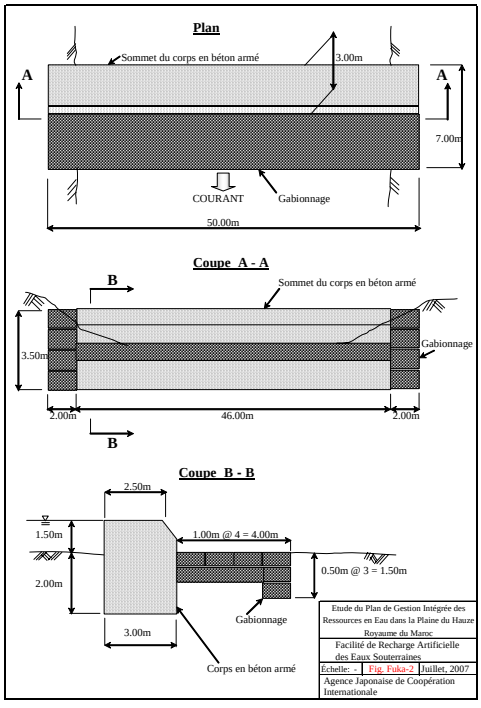
3) Implementation Target:

   Initial target: Start artificial groundwater recharge at R'dat river by the year 2008. Examine the outcomes of the project in R'dat, and start the projects in the rivers of Rerhaya, Ourika and Zat.

   Final target: Manage the artificial groundwater recharge facilities in the 4 rivers and maintain and annual average recharge of 14.3 Mm^3 in total.

4) Outline of the project

   Implementation of artificial groundwater recharge has various aims such as long term retention of water, maintaining and upraising groundwater level, and decreasing groundwater pumping costs. Infiltration of water from the soil surfaces may be named as a standard method for groundwater recharge, which can be further divided into recharge by in-river facilities or by facilities along side the rivers. The « Programme de recharge artificielles des nappes (PRN) » prepared in 2003 proposes an in-river structure based on factors such as the advantage in efficient utilization of surface water and natural conditions in the area. This will retain the invalid discharge flow which has conventionally been discharged from the basin during floods and will promote its percolation into the riverbed.



   Prior to the implementation of the artificial groundwater recharge project, a pilot project in R'dat river should be completed by 2010 in order to confirm the effect of such facilities. Based on its results, recharge facilities in the three rivers of Rerhaya, Ourika and Zat shall be implemented by the year 2020.

   As result, artificial recharge facilities will be installed in the four rivers of Rerhaya, Ourika, Zat and R'Dat. The actual locations of the facilities shall be selected among examination of 1) its validity as a pilot project (availability of basic data, possible construction methods), 2) capacity

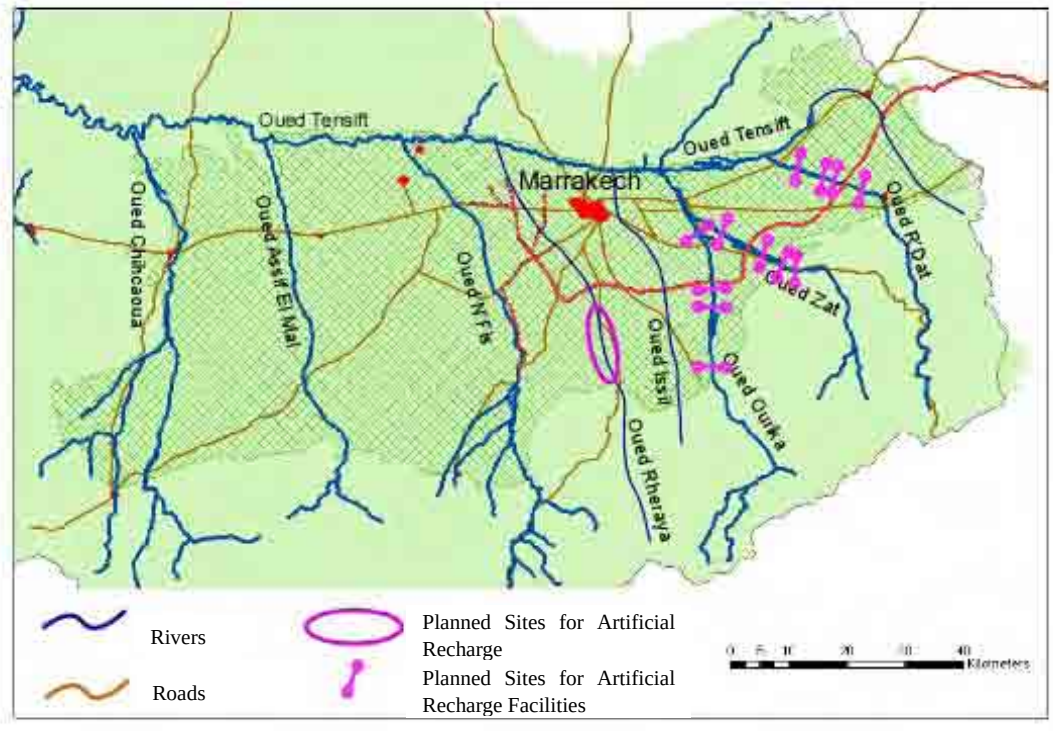
of recharge (storage) and amount of available water (river flow, frequency of floods, riverbed conditions), 3) water quality (the amount of suspended sediments will particularly affect the project life), 4) existence of adjustment functions by dams (downstream of dams in the Study Area are unsuitable since there is almost no discharge), 5) direct contribution to the aquifers of areas to be strictly protected or special risk zones.

The structures for artificial recharge are planed to be sills with the height of 2 m and with the average length of 50 m. Such sills are planned to be installed in a 10 km distance with the interval of 2.5 km. The actual scale of these structures will be further determined through the pilot project in R'Dat river.

The expected capacity of the artificial recharge facilities are estimated as in the following table. The actual effect of the facilities to the groundwater table of the surrounding area shall be examined in the pilot project in R'Dat river and further reflected to the groundwater management plan.

The Expected Contribution of Artificial Recharge Facilities and their Priority

River	Evaluation of Priority		Expected Contribution
Rerhaya River	Major contribution to Marrakech water supply cature area	2	2.9 Mm^3/year
Ourika River	Contribution to Z7 pump sector and risk area along Ourika river	3	3.8 Mm^3/year
Zat River	Contribution to Z7 pump sector and risk area along Ourika river	4	5.5 Mm^3/year
R'Dat River	Rich river flow. Contribute to whole aquifer due to its location in the upstream.	1	2.1 Mm^3/year
Chichaoua River	Low priority due to its location in the downstream area, and that drawdown of groundwater table is not a major issue in the surrounding area.	—	—
Assif El Mal River	Not suitable due to scarce river flow after completion of Taskourt Dam	—	—
N'Fis River	Not suitable due to scarce river flow after completion of Wirgane Dam	—	—



Planned Sites for Artificial Groundwater Recharge

5) Implementation schedule: as described in Table 5.5.1.

6) Effects of the Project:

a. Contribution to maintaining the quantity of groundwater in the Haouz aquifer
b. The artificial recharge facility in Rheraya river will contribute to maintaining the groundwater level in the Marrakech water supply capture area operated by ONEP

7) Monitoring of Progress of the Project

The following indicators will be set to monitor the progress of the project.

a. Operation of artificial recharge facility in R'Dat river, which is a pilot project for the remaining projects
b. Measurement of recharge capacity of artificial recharge facility in R'Dat, and groundwater levels in the surrounding areas
c. Preparation of a report analyzing the recharge capacity of the pilot project in R'Dat, based on the measured data
d. Implementation of recharge projects in the rivers of Rerhaya, Ourika and Zat.
e. Continued monitoring of recharge in each artificial recharge facility and ensured budget for monitoring.

8) Cost Estimation:

The project cost estimated based on previous studies on artificial groundwater recharge by ABHT (Programme de recharge artificielle des nappes, 2003) are as follows.

Item	Project Cost				Remarks
	Qtt.	Unit	Unit Price	Cost	
・Artificial Recharge Project in R'Dat river (pilot project)					
Preparation	1	set	0.5 MDH	0.5 MDH	
General Planning of the Project	1	set	1.0 MDH	1.0 MDH	
Detail Design	1	set	1.0 MDH	1.0 MDH	
Construction Activities	1	set	8.0 MDH	8.0 MDH	Installation of sills in 4 locations (average height: 2.0 m, average width: 50 m)
Evaluation of artificial recharge capacity	1	set	3.5 MDH	3.5 MDH	
Operation and maintenance (overhaul) of the facility	10	year	2.0 MDH	20.0 MDH	20% of construction cost / year
・Artificial Recharge Project in Rheraya river					
Preparation	1	set	0.5 MDH	0.5 MDH	
General Planning of the Project	1	set	1.0 MDH	1.0 MDH	
Detail Design	1	set	1.0 MDH	1.0 MDH	
Construction Activities	1	set	8.0 MDH	8.0 MDH	Installation of sills in 4 locations (average height: 2.0 m, average width: 50 m)
Evaluation of artificial recharge capacity	1	set	3.5 MDH	3.5 MDH	
Operation and maintenance (overhaul) of the facility	7	year	2.0 MDH	14.0 MDH	20% of construction cost / year
・Artificial Recharge Project in Ourika river					
Preparation	1	set	0.5 MDH	0.5 MDH	
General Planning of the Project	1	set	1.0 MDH	1.0 MDH	
Detail Design	1	set	1.0 MDH	1.0 MDH	
Construction Activities	1	set	8.0 MDH	8.0 MDH	Installation of sills in 4 locations (average height: 2.0 m, average width: 50 m)
Evaluation of artificial recharge capacity	1	set	3.5 MDH	3.5 MDH	

Item	Project Cost				Remarks
	Qtt.	Unit	Unit Price	Cost	
Operation and maintenance (overhaul) of the facility	5	year	2.0 MDH	10.0 MDH	20% of construction cost / year
・Artificial Recharge Project in Zat river					
Preparation	1	set	0.5 MDH	0.5 MDH	
General Planning of the Project	1	set	1.0 MDH	1.0 MDH	
Detail Design	1	set	1.0 MDH	1.0 MDH	
Construction Activities	1	set	8.0 MDH	8.0 MDH	Installation of sills in 4 locations (average height: 2.0 m, average width: 50 m)
Evaluation of artificial recharge capacity	1	set	3.5 MDH	3.5 MDH	
Operation and maintenance (overhaul) of the facility	3	year	2.0 MDH	6.0 MDH	20% of construction cost / year
Total	106.0 MDH				

(2) Reclaimed Water Supply Project

RADEEMA has been working on the construction of a sewage treatment plant in Marrakech since 2006. The amount of sewage in 2020 is estimated to reach 45.2 Mm^3 / year (124,999 m^3/day). This is regarded as a potential for an alternative source of water if it can be treated and reused. Although treated wastewater is not suitable for drinking even after tertiary treatment, there is a good possibility of it being used for irrigation in golf courses, which is one of the major water consumers.

1) Implementing Agency: RADEEMA

2) Implementing Objectives:

Supply reclaimed water of treated sewage of Marrakech to the Tensift riverside palm garden and golf course & resort areas for irrigation water for the alternative water sources of groundwater and surface water.

3) Implementation Target:

Initial target: Development and utilization of 52,600 m^3/day in the Phase-1 Project (start operation in 2010)

Final target: Development of 38,120 m^3/day and utilization of 90,720 m^3/day in total in the Phase-2 Project

4) Outline of the Implementation Program

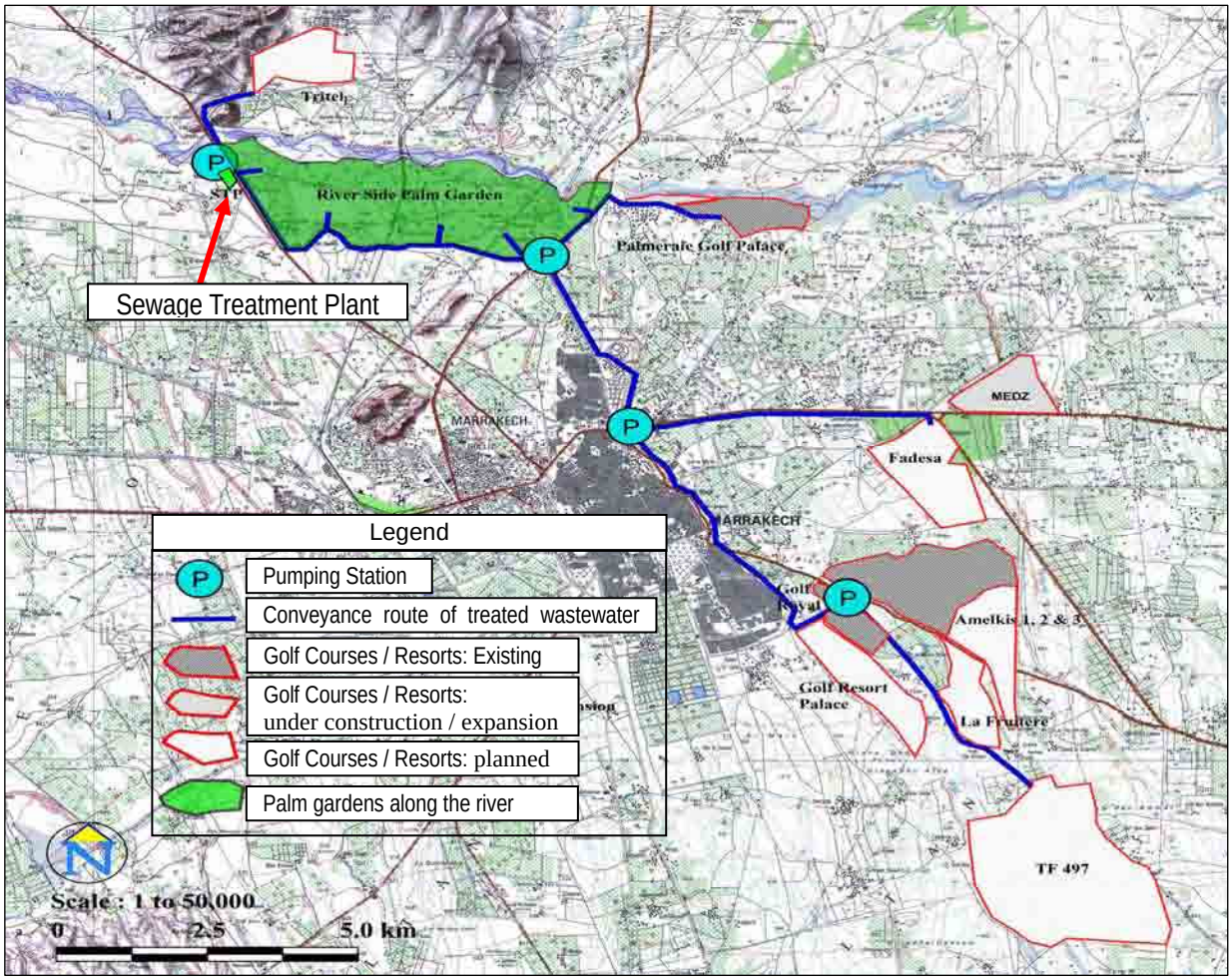
a. Phase-1 Reclaimed Water Utilization Facilities Construction Project

The reclaimed water utilization plan is now under preparation by the consultant company hired by RADEEMA together with the design of secondary treatment facilities and the amount of utilization of reclaimed water. The contents of the plan will be concluded in 2008. Supplying reclaimed water, 52,600 m^3/day, to the places listed below including the Tensift riverside palm garden and eight (8) gold & resort areas is a preferable reclaimed water utilization plan to lighten the financial burden to RADEEMA.

Phase-1 Reclaimed Water Supply Target Sites: Tensift riverside palm garden, Palmeraie Golf Palace, Tritel, Fadesa, Golf Royal, Golf Resort Palace, Amelkis 1, 2 & 3, La Fruitere, TF 497

The plan uses the secondary treatment sewage to produce reclaimed water by the tertiary treatment processes. In order to produce the better quality reclaimed water, the tertiary treatment processes shall be comprised of chemical sedimentation, rapid sand filtration and disinfection. At present, there are several alternatives for the conveyance route of treated wastewater. However, in regard of energy efficiency, it is expected that the route connecting the tertiary treatment plant and the water users in the shortest path will be most efficient, and

will bare minimum pumping cost. This route is indicated in the following map. The final layout of the pumping facilities and conveyance route will be further determined based on further studies such as detailed topographical surveys, etc. The construction work will be carried out by a lump sum contract as well as the construction work of the primary treatment facilities and scheduled to complete in 18 months.



Source: Prepared by the Study Team

An Alternative for Conveyance Route of Treated Wastewater

b. Future Reclaimed Water Utilization Plan

Except for the prescribed eight (8) golf course & resort projects, there are 11 development projects are listed up in the south-west suburbs of Marrakech and the peripheral areas. In case all the 19 golf course & resort projects are supplied with reclaimed water, it will be required to develop new reclaimed water production facilities with the capacity of 38,120 m^3/day or 13.9 Million m^3/year, which is obtained from the capacity of Marrakech sewage treatment Plant at 90,720 m^3/day subtracted by the capacity of Phase-1 water reclamation at 52,600 m^3/day. Since there are many unknown development status of golf course & resort projects listed, the Phase-2 project will be planned to supply reclaimed water to the following six (6) projects of which construction sites are known. It is preferable to forward the Phase-2 reclaimed water utilization plan as occasion demands by watching the development status of the golf course & resort projects.

Phase-2 Reclaimed Water Supply Target Sites: Latsis Group, Assoufid, Club Thamesloht Partners, Golf Finance House, Golf Royal Palm de Marrakech, Atlas Golf Resort

5) Implementation schedule: as described in Table 5.5.1.

6) Effects of the Program:

- Effects of water quality conservation to the Tensift River since the effluent of sewage treatment plant is reclaimed and utilized
- Water sources are preserved since the reclaimed water of treated sewage is used for irrigation water of golf & resort areas for the alternative water sources of Rocade canal and groundwater.

7) Monitoring of Progress of the Project

Implementation status of the project, operation status, utilization status of reclaimed water will be monitored for evaluation of the progress of works

8) Cost Estimation:

At present, the sewage disposal equipment divides it into two terms, and it is built, and the pipeline construction of the drainage water supply is contained in the sewage disposal equipment at Tensift riverbank, the improvement of the existent drain and intercepts collection facilities in Marrakech city.

The sewage treatment equipment under present construction work consists of first processing and second processing facilities. The costs of 190 MDH (refer to Interim report dated on March 2007) for 1st term construction, and the second term construction of the cost is 500 MDH, and a total cost is estimated 690 MDH with daily average treated water is a 90,720 m^3/day. Therefore the construction work expense per the capacity of 1.0 m^3/day serves as 7,606 DH. On the other hand, in regard that the operation cost for 5 years being 20 MDH (4 MDH/year), the annual cost for the capacity of 1m3/day is 44 DH. The amount of sewage treatment in 2020 is summarized in three classifications according to an area as follows.

・Marrakech city	45.2 Mm^3/year	(123,836 m^3/day)
・17 communal control by	2.7 Mm^3/year	(7,397 m^3/day)
・Other areas control by ONEP	12.6 Mm^3/year	(34,521 m^3/day)
Total	60.5 Mm^3/year	(165,754 m^3/day)

The enforcement cost required in order to reclaim sewage water is estimated as follows.

Item	Project Cost				Remarks
	Qtt.	Unit	Unit Price	Cost	
・Reclaimed water supply planning, design, tender & contract	1	Set	3.5 MDH	3.5 MDH	
・construction of tertiary treatment plant	1	Set	60.0 MDH	60.0 MDH	Rapid filtration pond
・construction of tertiary treatment plant	1	Set	60.0 MDH	60.0 MDH	Chemical sedimentation pond
・construction of water distribution facilities	1	Set	160.0 MDH	160.0 MDH	
・Operation of reclaimed water supply facilities	10	Year	35.3 MDH	353.0 MDH	
Total	636.5 MDH				

(3) Hydrological Observation Network Reinforcement Project

1) Implementation Agency: ABHT

2) Objective of Project:

Improving the accuracy of assessment of natural recharge of the Haouz aquifer from the High Atlas

3) Implementation Target:

Initial target: Establishing 2 new water gauges
Final target: Improving measurement accuracy by introducing automatic water gauges

4) Description of Project

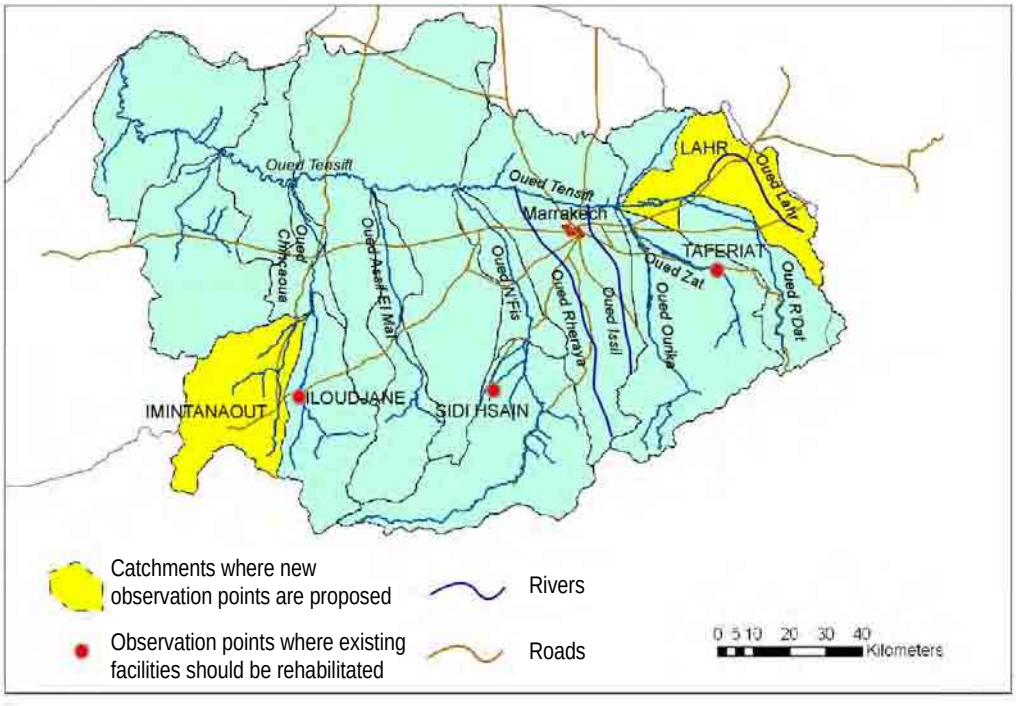
The existing hydrological observation network oh ABHT is equipped necessary function to grasp the active runoff of major tributaries of the Tensift river, and had accumulated information effectively. However, during establishing and calibrating the new groundwater simulation model of the Haouz aquifer in the Study, it was found that taking account discharge of some of small sub-basins which had not been observed would contribute to improve the model accuracy. Thus, 2 sites, which do not have water gauge, proposed to equip the water gauge in order to reinforce the observation network.

- Target catchment: Imintanout and Lahr
- Observation Facility: Visual observation of water mark by observation personnel (Simplifiee)
- The location of observation points shall be selected considering the following conditions:
  - Points near to areas where inflow to the aquifer is assumed o be occurring
  - Points where water flow is rectified
  - Points with relatively stable riverbeds and channels
  - Points where observation can be conducted safely
  - Easy access and availability of observation personnel in the area
  - Points where observation can be made during droughts

The major activities to be carried out in this project are as follows.

a. Selection of the site
b. Installation of watermarks
c. River surveying and preparation of HQ-curve
d. Preparation of ledger, obtaining observers

In regard of improving the accuracy of measurement, automated devices for measurement shall be introduced to the measurement points in the future. Such devices shall be installed in a total of five points: three existing points and two newly proposed points.



Target Observation Points for Hydrological Observation Network Reinforcement

List of Hydrological Observation Network of ABHT (Haouz Plain and High Atlas)

Station	Type	Code	Coordinates			Estab-lished	Remarks	Sub-Basin
			X	Y	Z			
TAFERIAT	Simplifiée	1562/53	291.25	107.5	760	1982	**Proposed to be improved**	Zat
AGHBALOU	Principale	2089/53	276.15	83.05	1070	1969	Automatic water guage equiped	Ourika
TIOURDIOU	Simplifiée	3570/53	277.2	69.3	1850	1996	Automatic water guage equiped	OUrika
AMENZAL	Simplifiée	3571/53	278.22	67.2	2230	1997	Automatic water guage equiped	Ourika
TOURCHT	Simplifiée	3572/53	286.85	74.15	1650	1997		Ourika
TAZITOUNT	Simplifiée	3603/53	281.95	77.8	1240	1999	Automatic water guage equiped	Ourika
AREMD	Simplifiée	3604/53	259.3	62.1	1950	1999		Rheraya
TAHANAOUT	Principal	1565/53	255.9	80.4	925	1970	Automatic water guage equiped	Rheraya
IGUIR NKOURIS	Principale	510/62	238.35	55	1100	1974	Automatic water guage equiped	N'Fis
IMIN EL HAMAM	Principale	1566/53	241.4	72.4	770	1968	Automatic water guage equiped	N'Fis
SIDI HSAIN	Simplifiée	2431/53	229.1	70.17	1030	1998	**Proposed to be improved**	N'Fis
ABADLA	Principale	1675/44	200	129.5	250	1969	Automatic water guage equiped	Tensift
S.BOUATHMANE	Principale	1676/53	209.4	74.3	820	1989	Automatic water guage equiped	Assif El Mal
ILOUDJANE	Simplifiée	628/52	176.245	70.525	757	1989	**Proposed to be improved**	Seksawa
SIDI RAHAL	Principale	44/54	303.1	117.8	690	1970	Automatic water guage equiped	R'Dat
IMINTANAOUT							**Proposed to be establised**	Imintnout
LAHR							**Proposed to be establised**	Lahr

5) Implementation Schedule: as described in Table 5.5.1.

6) Benefits and Impacts of Project

Reinforcing of hydrological observation network will improve the measurement accuracy for assessing the natural recharge to the Haouz Plain, which will contribute to improve groundwater monitoring.

7) Monitoring Program: Accumulation of observation data

8) Cost Estimation:

The items below are considered for the cost estimation of the project. On the other hand, the following items are not regarded in the cost estimate because it will be included in the later mentioned "Program for Scientific Estimation of Available Groundwater": selection of observation points, preparation of inventory, employment of observation personnel, profile leveling and preparation of HQ-curve.

a. Installation of water marks
b. Installation of automated measurement devices

The cost estimation of the project based on general unit prices of ABHT is as follows.

Item	Project Cost				Remarks
	Qtt.	Unit	Unit Price	Cost	
・Installation of water marks	5	Set	0.1 MDH	0.5 MDH	Cost for equipment procurement and installation works
・Installation of automated measurement devices	5	Set	0.5 MDH	2.5 MDH	Cost for equipment procurement and installation works
Total	3.0 MDH				

5.4.2 Groundwater Management Plan

(1) Program for Groundwater Facility Registration Management

Though registration of 10,700 boreholes is confirmed through the borehole survey in 2001, sampling surveys indicate that some 31% of the total boreholes are still unregistered. Moreover, in regard of the increase of boreholes after the survey, it is estimated that there are some 17,000 to 18,000 boreholes in the Study Area. ABHT already has a system functioning for well registration, but issues such as the time required for registration procedures and insufficient understandings of the well owner is hindering its smooth implementation. The current system should be strengthened / improved in order to facilitate immediate registration of all groundwater facilities, and to understand the situation of groundwater usage.

1) Implementing Agency: ABHT

2) Implementing Objectives:

Utilizing the registration data for grasping the status of groundwater utilization and for the basic data of groundwater analysis.

3) Implementation Target:

Initial Target (1) :	Executing the application, approval and registration of new and renovation wells
Initial Target (2) :	Preparation of data base of existing registered and unregistered wells
Mid-term Target (1):	Monitoring of utilization conditions of wells
Mid-term Target (2):	Renewal of registration of wells in the period of 5-10 years
Final Target:	Executing the processes of application, registration, renewal of registration and monitoring of all (100%) groundwater intake facilities (well, spring, river-bed water, *ketthara*) and the possessors.

4) Outline of the Implementation Program

a. Execution of application, approval and registration for construction and renovation of wells

By means of public information, the owners and the drilling companies of wells shall be informed widely and thoroughly the necessity of application and approval for construction and/or renovation of well and be fined in case of violation of the rules. It is worth to consider the services for provision of a window for application and preliminary examination by the local administration body in addition to provide a window at the Head Office of ABHT. Even though the application is submitted to the local administration body, the final approval of construction or renovation shall be remained to ABHT. The items mentioned, attachment document, evaluation criteria, etc. shall be standardized so as to establish the system to minimize the period from application to approval within 30 days. After report of completion of construction / renovation of the well, pumping permission shall be issued upon pumping test carried out in the presence of owner and/or the licensed constructor of the well. It will be a considerable matter to install a flow meter for the wells newly constructed and renovated. ABHT prepare the database of the progress of application, evaluation, and the contents of registration.

b. Updating and preparation of database of existing registered/unregistered wells

The Contents of present registration and approval shall be reviewed whether it will meet with the purpose to grasp the utilization status of groundwater and with the basic conditions for groundwater analysis. The contents of registered wells shall be updated in comparison with the contents of registration of newly constructed wells through inventory survey. Simultaneously, a permit stating the effective period (5-10 years) shall be re-issued and the permit shall be renewed upon expiry of the term of validity. Unregistered wells shall take the procedures for registration. All the items of registration shall be prepared with database. The inventory survey will be carried out through outsourcing.

c. Monitoring of utilization status of wells

Water police and/or the representatives shall conduct regular monitoring activities. They shall take a strict legal control to give notice, warning and penalizing the well owners who act against the contents of the permission. ABHT shall consider the system to structure the monitoring system in cooperation with the local administration bodies.

d. Preparation of database of groundwater intake facilities other than wells

Other than wells, there are such groundwater intake facilities as springs, river-bed water and ketthara. If there is a possessor of the facility, he shall take the same application procedures with that of well registration and a permit will be issued. In case of no possessor of the facility, field survey shall be conducted for observation of flow rate including the seasonal changes and record in database. The survey will be conducted by outsourcing.

5) Implementation Schedule: as described in Table 5.5.1.

6) Effects of the Program:

- Utilization status of groundwater will be grasped by the registration database,
- A precious and basic data for carrying out accurate groundwater analysis,
- Basic information as pumping control and suspension will be enforced,
- Basic information as the groundwater management fee will be collected

7) Monitoring of Progress of the Program

Progress of the program will be monitored by the number of registration increase.

8) Cost Estimation:

The items below are considered for the cost estimation of the Program. On the other hand, the monitoring of utilization status of wells is not considered as a cost because it will be included in the "Program for Water Police System Enhancement"

a. Employment of 2 staffs for ABHT for office works regarding application, approval and registration for construction and renovation of wells
b. Subcontracting of works for updating and preparation of database of existing registered/unregistered wells
c. Subcontracting of works for preparation of database of groundwater intake facilities other than wells
d. Procurement computer for groundwater intake facilities database

The cost estimation of the project based on general unit prices of ABHT is as follows.

Item	Project Cost				Remarks
	Qtt.	Unit	Unit Price	Cost	
・Execution of application, approval and registration for construction and renovation of wells	13	Year	0.12 MDH	1.56 MDH	Employment of 2 additional staffs
・Updating and preparation of database of existing registered/unregistered wells	3	Year	1.0 MDH	3.00 MDH	Subcontract
・Monitoring of utilization status of wells	1	Set	-	-	Included in the Program for Water Police System Enhancement
・Preparation of database of groundwater intake facilities other than wells	1	Set	1.0 MDH	1.00 MDH	Subcontract
・computer for groundwater intake facilities database	1	Set	0.1 MDH	0.10 MDH	Including peripherals
Total	5.66 MDH				

(2) Program for Scientific Estimation of Available Groundwater

In order to realize sustainable use of the limited groundwater resources in the Haouz Plain, indiscreet exploitation of groundwater must be controlled. On the other hand, in order to set a limit for groundwater extraction with consensus of the water users, it is essential that the limit is set based on concrete scientific background. It is required to prepare a groundwater simulation model base on more detailed information, such as the amount of groundwater use obtained from registration of groundwater extraction facilities, hydro-geological information, piezometric information of observation wells and information obtained from satellite images. Based on such simulation model, analysis of current situation of the aquifer, along with various case-studies shall be conducted in order to define a limit for groundwater exploitation. Furthermore, a groundwater management manual stating necessary measures for sustainable management of groundwater by situation and by zone shall be prepared in the future.

1) Implementing Agency: ABHT

2) Implementing Objectives:

Determination of available groundwater amount, pumping control water level and volume based on the groundwater analysis

3) Implementation Target:

Performing the accurate groundwater analysis by scientific means supported with adequate information

4) Outline of the Implementation Program

a. Accumulation of new Hydrogeological Data in the Upper Part of the Aquifer

Obtain the water table elevations beneath at the most upstream (mountain side), of the aquifer. In these sectors (mainly where the Tensift tributaries enter the Haouz Plain), the annual as well as inter-annual water table elevation should not significantly vary: it is controlled by the geometry of the alluvial materials which extend here in the narrow valleys of the Atlas mountains in the south (or Jbilets in the north). The groundwater flow which enters the plain beneath these sites is regulated by the groundwater level. Though there are records of wells in these areas, no detailed location or groundwater level is being recorded. Monitoring of groundwater tables in these wells along with measurement of precise locations should be done.

b. Accumulation of Cultivation Land Information

Clarify the location of the agricultural sectors irrigated by groundwater. In the Study, the cultivated areas used for the groundwater simulation model were estimated from a combination of the remote sensing data studied by the SudMed Project and the ABHT database of the application for well drilling. Irrigated sectors in a radius of 700 m around a well drilling application site were considered as irrigated by groundwater. This technique gives an acceptable estimation of the areas irrigated by groundwater, but could largely be improved. A detailed mapping shall be conducted by the DPAs and ORMVAH in their respective sectors.

c. Accumulation of new Deep Hydrogeological Data

Clarify the relationship between the Haouz plain aquifer and the underlying systems. A potential ascending leakage from the Eo-cretaceous aquifers underlying the Plio-quaternary series of the Haouz plain aquifer is suspected: in 1972 , the aquifer recharge from the Lias reservoir (including the oriental Haouz sector) was estimated to 50.5 Mm^3/year and an estimate of the inflow from Cenomanian-turonian aquifer gives some 9.5 Mm^3/year in 1987 . But these estimates are based on very rare measures. Up to date, there is neither accurate quantitative estimate regarding the potential transfers from the underlying systems nor any localization of these transfers. A specific investigation program should now be conducted: a) in order to define the extension of the direct contact of an aquifer terrain and the Haouz sedimentary materials; b) in order to evaluate the hydraulic gradients between these layers.

d. Accumulation of Data on Water Level

The monitoring of the groundwater table is the first step in the groundwater behavior understanding. An important effort should be done for the groundwater table monitoring, necessary to clearly identify the changes in the availability of the groundwater resource. An optimization should be found in the present groundwater table monitoring to prevent to double measures, and the regularity of the campaigns (especially the provincial service of Wilaya) should be improved.

The monitoring carried out by the ABHT is still limited to a very small number of wells compared to the aquifer extension: 15 piezometers equipped with automatic data loggers (including 10 new ones equipped for the present project) and 16 manually measured points. Additional piezometers to the current network shall be equipped: downstream, beneath the north-western part of the aquifer; upstream, beneath the southern part of the aquifer; and in the extreme East limit of the occidental Haouz plain.

Regular detailed piezometric campaigns remain the basic stage of the groundwater control. Such campaign, based on a minimum of 200 points (perfectly leveled) should be conducted

each year or every two years to follow the groundwater table regional changes.

To date, the topographic information is mostly given by the topographic maps scale 1:50,000. Very few piezometers have been leveled (23 up to date). All the piezometers included in the measurement campaign, including private wells and boreholes, should be precisely leveled in order to draw precise piezometric maps.

e. Accumulation of Data of Groundwater Users

Except for the ONEP wells, the details of the groundwater abstraction are still not directly measured. As many of the wells of the groundwater users are not registered and the abstracted quantities never measured, the groundwater abstraction over the plain could only be estimated. In order to reduce the uncertainty in the groundwater balance as part of the definition of the integrated groundwater management plan, all of the groundwater abstraction point should perfectly be located and the abstracted volume known, starting from the major groundwater users: golf courses & resort areas, hotels and water-related complexes, large farms, etc.

f. Staff Reinforcement and Capacity Building for Groundwater Analysis

The ABHT staff shall be reinforced with two hydrogeologists familiar with GIS and groundwater modeling softwares. The hydrogeologists shall participate in the training programs of groundwater analysis and GIS at the least for the period of three (3) months respectively so the groundwater analysis could be carried out without troubles.

A set of computer(s), peripheral equipment, and software for groundwater analysis shall be procured.

g. Performing Scientific Mean Groundwater Analysis

Groundwater analysis shall be made along with the updating of input data (and possibly calibration) to construct the accurate groundwater flow modeling tool. Various cases of simulation will be made for future prediction. The simulation cases assuming to change the water demand may be decided upon consultation and consent with the agencies concerned. When the better alternative is worked out, the groundwater simulation shall be carried out with the conditions and judge the risky area and sorting out the conditions as well. Annual groundwater utilization plan shall be prepared based on the result of optimum case groundwater analysis in coordination with the agencies concerned.

h. Determination of Available Groundwater Amount, Pumping Control Water Level and Amount

The result of groundwater analysis indicate the conditions of groundwater and pumping and the risky area if exists. The pumping control conditions shall be drafted to consult with the relevant agencies. During the implementation period, after agreed the pumping control conditions, the groundwater status shall be grasped regularly by the analysis of the groundwater level monitoring wells. If the status shows a sign of groundwater level drop from the predetermined control water level, the causes shall be studied and take appropriate measures. If the cause is due to the breach of control conditions, ABHT will request the relevant agencies strongly to keep the rules. If the causes are supposedly something else, the groundwater analysis shall be carried out after reviewing all the input conditions, reviewing and/or reinforcing the control conditions to revise the control conditions finally.

i. Preparation of Groundwater Management Manual

ABHT will prepare the groundwater management manual based on the framework proposed in the Master Plan Study. The groundwater manual shall prescribe the managerial procedures for the normal year and the drought year, especially paying attention to the special measures in the drought year. The special measures in the draught year are taken on the cooperation of the agencies concerned. Therefore, the groundwater management manual will be completed only after prior consultation, coordination and agreement by

signing the memorandum with the relevant agencies.

Zone Wise Issues and Directionality of Necessary Measures

Capture area for Marrakech water supply

The capture area for Marrakech water supply consists of the ONEP well fields and their influence area. The water supply is considered as the most high priority sector of water use, and the necessary amount shall be secured stably. Marrakech water supply rely its water resource on dam water in the basin, inter-basin water transfer and groundwater. The major part of the water is withdrawn by the surface water usually, but the groundwater is not only considered as a part of water source but also as a buffer of water source during the severe drought situations. The protection of groundwater for water supply is one of the most important objectives of the water management.

The condition of the aquifer of the capture area of the Marrakech water supply well fields shall be monitored carefully. In order to secure the necessary amount of groundwater abstraction and maintain the adequate water level, it is necessary to control pumping amount for other purpose than water supply in the capture area, if necessary. Especially during the severe drought conditions, a pumping control or a restriction of groundwater abstraction shall be introduced beneath a wide area including the capture area of the well fields.

Marrakech urban and peri-urban area

Marrakech urban area is the centre core of the economic activity of the Haouz plain, and the water demand for gardening of hotels and gardens and irrigation for the golf courses will be increase, according to the growth of the tourism sector. Above all, without any control the demand for irrigation for the golf courses will possibly become as large as affecting to other water users (the aquifer may dried out in the southern part of Marrakech City, including beneath the Issil well field of ONEP). In the south-east and the south-west of Marrakech City, where many new golf courses are proposed to be developed, it is necessary to be careful to explore groundwater because the area is close to the capture area of Marrakech water supply. In order to cope with this increasing water demand, the reclaimed waste water shall be developed and used in those golf courses irrigation and other gardening, so as to prevent to increase groundwater abstraction in this area. Due to the intensive use of chemicals for the golf courses and in order to preserve the groundwater quality for drinking water supply, no golf courses can be authorized beneath or nearby the capture area of the Marrakech water supply well fields.

Special risk area in the Lower N'Fis Left Bank PMH sector

The Lower N'Fis Left Bank PMH sector is the agricultural area developed mainly by private sector using the groundwater, which presently suffers significant groundwater depletion. According to the scenario simulation analysis, this area is expected to face serous groundwater depletion or dry out of aquifer in near future.

It is necessary to monitor the condition of aquifer very carefully as a special risk area, and to reduce groundwater abstraction in this area and upstream though reducing irrigation water demand by rapid introduction and expansion of drip irrigation and water saving farming. To save this area, it is also necessary to introduce actions together with neighboring area, which is considered as a "sub-basin" including upstream area. The demand control and reduction of groundwater abstraction in the N'Fis Left Bank GH sector, which is also categorized to a risk area or partly special risk area, is required, certainly by increasing the available surface water for irrigation. Furthermore, the artificial recharge project in the N'Fis river, of which pilot project is proposed in the master plan, is also expected to realized if the positive water balance of the artificial recharge is confirmed through the pilot project.

Irrigation sectors in risk area

In the GH irrigation sectors in the risk area where serious groundwater deletion is expected, the surface water sources from GH irrigation system shall be fully and effectively used so as to reduce the amount of groundwater abstraction for irrigation immediately. Decreasing conveyance loss in the canal system after the GH main canal is necessary to reduce loss before water reaching to the field, as well as reducing irrigation water demand through expansion of the drip irrigation and water saving farming in the field.

The expansion of drip irrigation shall be promoted in the N'Fis Right Bank GH sector including N4 sector, where pressurized distribution system is quipped which makes drip irrigation easy to introduce. Secondary pipeline system to the dispersed parcels shall be developed to accelerate the expansion of the

drip irrigation there. In other GH irrigation sectors, drip irrigation is expected to be expanded in a selection of priority crops too.

According to the results of the proposed experimental study, the complementary groundwater abstraction may also be controlled when modifying the crop selection and thereby the corresponding water demand.

The water use in the ZR (Zone Réhabilitée) sector of the N'Fis Left Bank GH affects to the aquifer condition of the Lower N'Fis Left Bank PMH sector mentioned above. It is necessary to protect and maintain the aquifer of both areas together. It is required to control the groundwater use in the upstream (ZR sector) by improving water use efficiency and strengthening surface water irrigation system.

In the PMH irrigation sectors in the risk area where serious groundwater deletion is expected, expansion drip irrigation and water saving farming in the field shall be promoted to reduce groundwater abstraction immediately through reducing irrigation water demand in the field. According to the results of the proposed experimental study, the groundwater abstraction may also be controlled when modifying the crop selection and thereby the corresponding water demand. In parallel, the expansion of groundwater irrigation by construction of new well is necessary to be controlled as well as pumping control in the existing wells.

Other irrigation sectors

In the GH and PMH irrigation sectors in the limited drawdown area, reducing irrigation water demand through expanding drip irrigation and water saving farming shall be considered in order to improve/maintain the global water balance in the whole of aquifer, even if groundwater depletion is not significant or serious in this area. Effective use of surface water source and maintaining and improving the seguia system are required to reduce the dependence on groundwater. In this area, the groundwater abstraction may also be controlled when modifying the crop selection and thereby the corresponding water demand, according to the results of the proposed experimental study.

5) Implementation Schedule: as described in Table 5.5.1.

6) Effects of the Program :

- Sustainable utilization of aquifer will be made by avoiding the worst situation through determining the optimum available groundwater amount,
- Sustainable development in social life and economic activities, especially the great effects will be made in the agricultural production,

7) Monitoring of Progress of the Program

- Status of accumulation of input data (number of monitored piezometers, number of large piezometric campaign...), participation to the training programs and the capacity building by the groundwater analysis operators will be used for the indicators for monitoring the progress of the program,
- Status of progress and completion of groundwater analysis model is used for the indicators,
- Meetings, conferences with the relevant agencies for presentation, consultation, agreement for the issues concerned and issuance of annual groundwater utilization plan are used for the indicators for evaluating the progress of the program.

8) Cost Estimation

The items below are considered for the cost estimation of the project. On the other hand, the costs for "Accumulation of new Hydrogeological Data in the Upper Part of the Aquifer", "Accumulation of Database of Groundwater Users" and "Determination of Available Groundwater Amount, Pumping Control Water Level and Amount" is not regarded in the cost estimate for the following reasons: costs for "Accumulation of new Hydrogeological Data in the Upper Part of the Aquifer" will be included in the "Accumulation of Data on Water Level", "Accumulation of Data of Groundwater Users" and "Determination of Available Groundwater Amount, Pumping Control Water Level and Amount" will be conducted through normal works of ABHT.

a. Satellite images for Accumulation of Cultivation Land Information (2 sets per year)
b. Subcontracting for Accumulation of new Deep Hydrogeological Data
c. Installation of automated piezometers, regular observation and subcontracting for leveling survey for Accumulation of Data on Water Level
d. Recruitment of staff and procurement of necessary tools for analysis of aquifer for Staff Reinforcement and Capacity Building for Groundwater Analysis
e Consumables for Performing Scientific Mean Groundwater Analysis
f. Printing costs for Preparation of Groundwater Management Manual

The cost estimation of the project based on general unit prices of ABHT is as follows.

Item	Project Cost				Remarks
	Qtt.	Unit	Unit Price	Cost	
・Accumulation of new Hydrogeological Data in the Upper Part of the Aquifer	1	Set	-	-	Included in Accumulation of Data on Water Level
・Accumulation of Cultivation Land Information	13	Set	0.10 MDH	1.30 MDH	Satellite images, 2 sets per year
・Accumulation of new Deep Hydrogeological Data	1	Set	3.50 MDH	3.50 MDH	Sobcontract, 3 years, including boring
・Accumulation of Data on Water Level					
Leveling Survey	1	Set	1.00 MDH	1.00 MDH	Subcontract, 200 sites
Installation of Automated Piezometers	15	Set	0.05 MDH	0.75 MDH	Procurement and installation
Monthly observation	12	Year	0.21 MDH	2.52 MDH	30 sites / month
Annual observation	12	Year	0.15 MDH	1.80 MDH	170 sites / year
・Accumulation of Data of Groundwater Users	13	Year	-	-	Normal works of ABHT
・Staff Reinforcement and Capacity Building for Groundwater Analysis					
Procurement of Tools for Analysis of Aquifer	1	Set	1.00 MDH	1.00 MDH	Including peripherals
Reinforcement of ABHT Staff	13	Year	0.24 MDH	3.12 MDH	2 new staff
・Performing Scientific Mean Groundwater Analysis	12	Year	0.10 MDH	1.20 MDH	Consumables, activities carried out through normal works of ABHT
・Determination of Available Groundwater Amount, Pumping Control Water Level and Amount	12	Year	-	-	Normal works of ABHT
・Preparation of Groundwater Management Manual	4	Set	0.50 MDH	2.00 MDH	Printing costs
Total	18.19 MDH				

5.4.3 Water Quality Management Plan

Considering the present status and the prescribed object and strategies of water quality management, the following projects and programs is proposed to be implemented for water quality management in the Tensift River Basin.

- Implementation of Water Quality Monitoring Program (ABHT、ORMVA、ONEP、RADEEMA、and Private Enterprise)
- Development Project for Sewerage Facilities (ONEP, RADEEMA)
- Development Project of Wastewater Treatment Facilities for Factory and Business Establishments (Private Enterprise)
- Measures for the Facilities and Activities Potentially Cause of Water Pollution in Public Waters (Municipality, Private Enterprise, Residents, Farmers, etc.)
- Implementation of Educational Activities to Structure the Environment-friendly Society (Government Agencies, Municipality, NGOs, Private Enterprise, Residents and Farmer)
- Enactment and Enforcement of Water Pollution Control Law and the Relevant Rules and Regulations (Morocco Government and Relevant Ministries and Agencies).

Among the projects and programs listed above, the water quality monitoring will be the program for ABHT to take the main role for implementation. The program in the following section is proposed for an action plan to be implemented by ABHT.

(1) Program for Water Quality Monitoring

There are several indications that the groundwater quality in some areas satisfy the standards for irrigation water, but do not satisfy the standards for raw water for potable water supply. In order to realize sustainable use of water resources, it is necessary to also consider the quality of water. Monitoring of water quality as well as the sharing of information with stakeholders will be carried out through this program, and will contribute to efficient use of groundwater resources.

1) Implementing Agency: ABHT

2) Objective:

   Monitoring for maintaining the water quality meeting with the various types of water use

3) Implementation Target:

   Implementation of water quality test by 4 times per year for the respective water quality monitoring site

4) Description of Program

   a. Review and Set Up of Water Quality Monitoring Sites

      Present set up of water quality monitoring sites are; rivers-26 sites, reservoirs and canals-6 sites, groundwater in Haouz and other 3 provinces-76 sites. Review and new set up of water quality monitoring sites will be conducted mainly for groundwater sampling sites. Due to the possibilities of water pollution in the water source areas of the dams and the areas along the Rocade canal, the water quality monitoring sites of reservoirs and canals shall also be reviewed. Direct water intake from the rivers in the Haouz Plain is limited only in the up stream sections and the present monitoring sites would be acceptable though all the water quality monitoring sites of the rivers shall be confirmed the appropriateness through the status of surrounding areas obtained from the field reconnaissance.

      Contour line of groundwater table and the direction of groundwater flow will be obtained from the result of groundwater simulation. Present site set up of groundwater monitoring shall be reconsidered so as to grasp the probable groundwater contamination accurately by reviewing the results of groundwater simulation. Regarding the auto logger stations for measuring water level in the wells, there exist five (5) stations installed by ABHT and ten (10) stations installed by JICA in the Haouz Plain. Observation of water level and water quality of the neighboring well taken simultaneously will be effective for the analysis of status of groundwater contamination. Groundwater quality monitoring sites shall be reviewed and set up in consideration of the descriptions above.

   b. Preparation of Improvement Plan of Water Quality Monitoring

      Improvement plan for water quality monitoring shall be formulated based on the selected sites and the numbers of water quality monitoring sites. The improvement plan shall take the following items in consideration.

      - Setting up water quality monitoring sites including new sites,
      - Frequency of sampling for regular monitoring (taking samples four times per year for the respective sampling site),
      - Implementation method for temporary water quality test
      - Parameters of water quality monitoring (add salinity for the parameter of groundwater quality),
      - Preparation of database and analysis of the test results,
      - Consultation with the authorities concerned and measures for the test results and publicizing

- Preparation of annual water quality monitoring report,
- Securing the staff for sampling and water quality test or out sourcing,
- Annual budget estimates,

c. Implementation of Water Quality Test based on the Present System

Two programs mentioned above will take two years for completing the plan. Accordingly, the water quality test operation for 2008 and 2009 shall be carried out following to the system currently practiced.

d. Implementation of Water Quality Test based on New System

Improvement plan of water quality monitoring is scheduled to implement from 2010. Several points for implementation are indicated in the following section. These points are the key issues to include in the water quality monitoring improvement plan.

i) Regular Water Quality Test
Under the water quality monitoring improvement plan, the regular water quality test will be conducted four (4) times per year for all the water quality monitoring sites. Approximately 100 sites including new sites will be the objective water quality monitoring sites. The result of water quality test will be arranged for a database.

ii) Extra Water Quality Test
Extra water test will be conducted at the sites appearing a sign of water contamination other than the regular water quality monitoring sites and/or the water contamination is reported and/or requested. As it require the water quality parameters other than that of the regular water quality test, the extra water quality test will be conducted for the specific water quality parameters.

iii) Liaison Conference of Water Quality Monitoring
A Liaison Conference will be established among the administration agencies concerned. ABHT will call for a meeting of Liaison Conference in every four (4) months and present the result of analysis of the water quality monitoring to the relevant administration agencies. The respective administration agency concerned also present the water quality test to have common understanding to the status of water contamination and consult each other the required measures.

iv) Preparation and Publicizing Annual Water Quality Monitoring Report
ABHT prepares the result of water quality monitoring operation in an annual report and distribute to the relevant organizations concerned in addition to open the data to the public in the ABHT Website.

5) Implementation Schedule: as described in Table 5.5.1.

The program will start in 2008 with the study for reviewing the present water quality monitoring sites and all the programs will be completed in 2020.

6) Effects of Program

- Conservation of water resources through the analysis of the cause of water contamination at the sites where water contamination is in progress and request the polluters to take measures,
- Conservation of water resources through grasping the sign of water pollution earlier from the result of routine water quality test, analyzing the cause of water contamination, consultation and request for taking measures,
- Conservation of the nature and ecological system in the river basin through the activities proposed in the water quality monitoring program.

7) Monitoring of Progress of Program

Actual result of the activities such as holding the Water Quality Monitoring Liaison Conference with four (4) times per year, preparation of Water Quality Monitoring Annual Report and updating of data in ABHT Website will be proposed for the indicators to monitor the activities

of the water quality monitoring program.

8) Cost Estimation:

The items below are considered for the cost estimation of the Program. On the other hand, costs for "Review and Set Up of Water Quality Monitoring Sites" and "Preparation of Improvement Plan of Water Quality Monitoring" is not considered because it will be carried out through normal works of ABHT

a. Implementation of Water Quality Test based on the Present System
b. Implementation of Water Quality Test based on New System

The cost estimation of the project based on general unit prices of ABHT is as follows.

Item	Project Cost				Remarks
	Qtt.	Unit	Unit Price	Cost	
・Review and Set Up of Water Quality Monitoring Sites	1	Set	-	-	Normal works of ABHT
・Preparation of Improvement Plan of Water Quality Monitoring	1	Set	-	-	Normal works of ABHT
・Implementation of Water Quality Test based on the Present System	2	Year	0.576 MDH	1.15 MDH	2 times per year for 80 sites
・Implementation of Water Quality Test based on New System					
Regular Water Quality Test	11	Year	2.88 MDH	31.68 MDH	4 times per year for 100 sites
Extra Water Quality Test	1	Set	6.34 MDH	6.34 MDH	20% of regular tests
Liaison Conference of Water Quality Monitoring	11	Year	0.04 MDH	0.44 MDH	Costs for meeting (4 times / year)
Preparation and Publicizing Annual Water Quality Monitoring Report	11	Year	0.04 MDH	0.44 MDH	Preparation of report (once per year)
Reinforcement of ABHT Staff	11	Year	0.18 MDH	1.98 MDH	Recruitment of 3 staff
・Vehicles and Running Const for Water Quality Sampling					
Vehicle	2	Car	0.36 MDH	0.72 MDH	4WD pickup
Maintenance Cost	11	Year	0.022 MDH	0.238 MDH	3% of vehicle price per year
Fuel	11	Year	0.127 MDH	1.505 MDH	2 cars times 30 L per day times 20 days per month
Total	44.49 MDH				

(2) Additional Activities for Water Quality Management

1) Improvement of sewage collection network

Contents of this activity is described under section 3.2, under the "Reclaimed Water Supply Project"

2) Installation of waste water treatment facilities in factories / industrial establishments

Activities will be implemented under the initiative of the private sector. Measures to disseminate and realize such activities, including government subsidies shall be examined as a part of participatory integrated water resources management, later described in this report.

3) Measures to prevent possible pollution of public water surfaces

Activities will be implemented under the initiative of the private sector. Measures to disseminate and realize such activities, including government subsidies shall be examined as a part of participatory integrated water resources management, later described in this report.

4) Educational activities / measures to establish an environment friendly society

Activities will be implemented under the initiative of the private sector. Measures to disseminate and realize such activities, including government subsidies shall be examined as a part of participatory integrated water resources management, later described in this report.

5) Establishment / enactment of regulations related to water quality

Activities are indicated in organizational and institutional improvement, later described in this report.

5.4.4 Water Demand Reduction Plan

The problems of water demand in the Haouz plain will be relieved by the development and the reduction of water demand in both of water supply and irrigation. In formulating the project of reduction of water demand, the common objectives both of agriculture and non-agricultural sector is set as the improvement of the efficiency of hydraulic facilities and the reduction of water demand by water saving, and the projects and programs reflecting these common objectives in each sector will be proposed.

Agricultural Sector Water Demand Reduction Plan

(1) Program for Drip Irrigation Introduction and Dissemination

1) Implementing agencies: ORMVAH, DPA Marrakech, DPA Chichaoua, ABHT

2) Objectives of the program:

To Contribute to the improvement of the global water balance through the reduction of water demand for the irrigation as well as the reduction of the irrigation water use in the filed by t introducing and spreading drip irrigation.

3) Targets of the program:

Initial target 1:	Introduction of drip irrigation in 100% of the N'Fis Right Bank Sectors where pressurized system is equipped before 2012.
Initial target 2:	Introduction of drip irrigation in the area of 4,000 ha per year of the PMH groundwater area.
Initial target 3:	Introduction of drip irrigation before 2017 in 50% of the GH others than those of the initial target 1.
Final target:	Introduction of drip irrigation of about 85,000 ha of area before 2020.

4) Outline of the program

The agricultural sector is the largest user of water resources in the Haouz plain. Basin irrigation is a standard method for irrigation largely practiced in the Haouz plain. A portion of water used for basin irrigation evaporates into the air or percolates into the ground. Introduction of drip irrigation will raise the efficiency of water used for irrigation, and at the same time will reduce the invalid loss of water into the air. The major activities to be carried out in this program are as follows.

a. Defining Priority Area for and Introduction Plan for Drip Irrigation

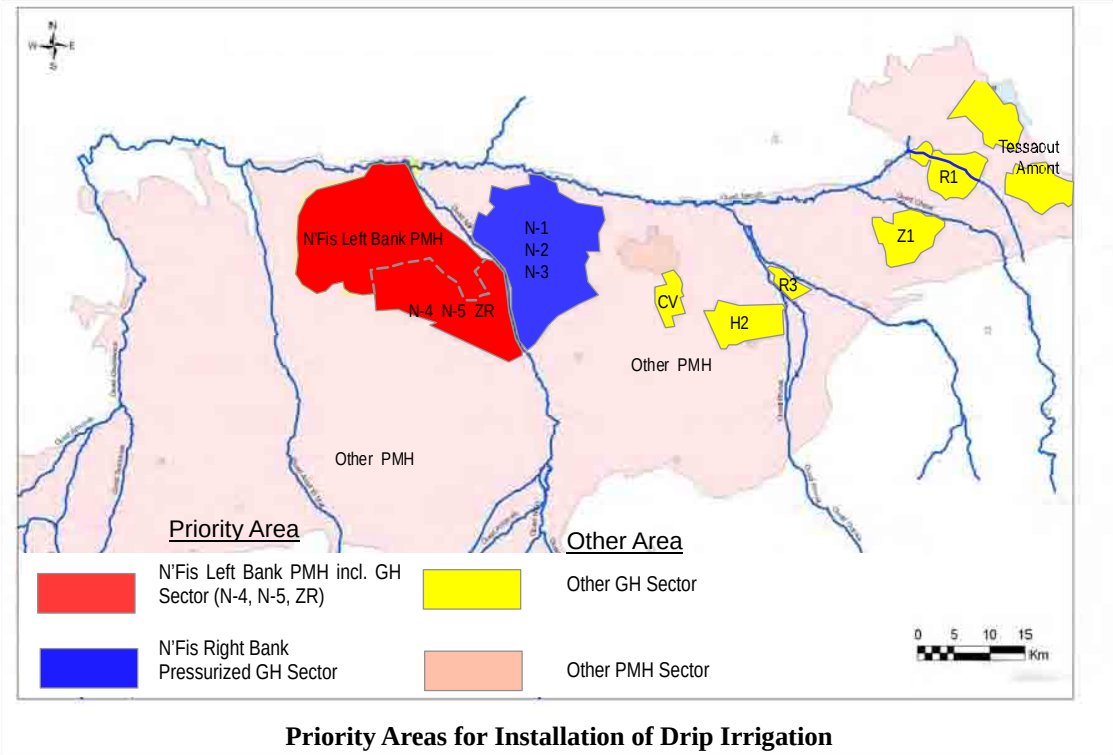
Installation of drip irrigation should basically be done to all irrigated areas. However, Priority shall be attached to pressurized GH sectors because it is easier to install the systems. Also, priority shall be attached to areas with significant draw down of groundwater requiring urgent action

GH Sector (irrigated by surface water)

- Priority Area: Installation of drip irrigation system in 100% of the pressurized GH sector in the right bank of N'Fis river by the year 2012
- Other Areas: Installation of drip irrigation system to 50% of the GH sectors besides the above by the year 2017.

PMH Sector (irrigated by groundwater)

- Priority Area: Installation of drip irrigation system in 100% of the PMH sector on the left bank of the N'Fis river (including pump irrigation area in N4 sector) by the year 2010
- Other areas: Installation of drip irrigation system in 3,000 ha/year of the PMH area using groundwater for irrigation and besides the above



Priority Areas for Installation of Drip Irrigation

b. Extension of Pipeline and Outlet

In the parcels of the N'Fis Right Bank GH Sectors where pressurized system is equipped, the drip irrigation will be introduced and will be spread, with the help of subsidies.

For the small and scattered parcels not equipped with own outlet, the necessary infrastructure for introducing drip irrigation will be developed by the process that first of all the users will be organized in group based on the location of parcels, then the secondary canals (pipeline) will be arranged and the parcels will be equipped with an outlet to the level of every grouped parcels, finally the users will introduce drip irrigation by themselves with the help of subsidy. The area that require the groupings and the extension of secondary canals are estimated to 16,000 ha. The ORMVAH will be in charge of this program.

c. Subsidies for Installing Drip Irrigation

In both of GH and PMH sector, the users will be in charge of the installation of the equipment of drip irrigation in principal. While relieving the loads of the users, the system of subsidy will be able to encourage the users to introduce drip irrigation. The subsidy for drip irrigation occupies 60% of the cost for equipment of drip irrigation including wells. So that the subsidy is more convenient for the users while keeping this system, it is desirable to make the improvement of the system, as the simplification of the procedures of the application, little the conditions of guarantee stern or the agreement of a public guarantee, the timing of the payment, etc. The subsidy is delivered by the National Case of Agricultural Credit (CNCA).

d. Supports for Procedures of Subsidy and Establishment of Consultation Desk

The consultation desk will be put in place to the level of the ORMVAH and the DPAs to bring the technical supports for the introduction of drip irrigation (information on the aquifer for the construction of a well, design of the facilities of drip irrigation) and the supports for the preparation of the documentation of the subsidy application. Currently, the two organizations, the ORMVAH and the DPAs, fill this function. However, to accelerate the spread of drip irrigation, it is necessary to hire the supplementary staff, to reinforce the structure, etc.

e. Administrative Guidance through Authorization of Well Construction

The users are obliged to get the authorization of the ABHT at the time of the boring of a well, either for the new construction or for the renewal. Therefore, to spread drip irrigation in the area using groundwater, it will be decided, in the setting of the administrative guidance, that the construction of a well will be allowed provided that the water saving irrigation is introduced and used. For the existing wells, at the time of the registration of well, it is necessary to consider that the introduction of the water saving irrigation will be set as a condition for groundwater use.

f. Extension and Guidance of Water Saving Irrigation

It will be sensitized and motivated of the users for the introduction of drip irrigation while spreading the water saving irrigation techniques, as a system of drip irrigation. In particular, the users know the present situation of the available water, as the present situation of water resources, the allocation of water distribution, and the necessity of the water saving in agriculture. Besides, to spread the water saving irrigation in the situation of the limited water use, it is necessary to show the advantages of the water saving techniques and farming practice. These activities will be led and expanded in the regular activities of extension through the CMV (ORMVAH) and the DPAs and the activities such as demonstration, study tour and seminar implemented by CTE will enhance those effects.

5) Implementation schedule: as described in Table 5.5.1.

6) Impacts of the program

Drip irrigation will be able to reduce 20~ 30% of the irrigation water in the field level in gross amount, while the spread of drip irrigation will decrease the quantity of recharge of the groundwater in the irrigated land. In regard of the evaporation loss from the agricultural fields, the net reduction of irrigation water should be judged applicable at 10% of the irrigation water. Consequently, as for the contribution to the total water balance, some 49~70 Mm^3 will be saved in 70,000 ha of the irrigation area with conditions that the irrigation water demand is 7,000~10,000 m^3/ha. In addition, the reduction of the gross amount of irrigation water will benefit in reduced pumping costs in areas irrigated by groundwater. The reduction of the gross amount of irrigation water is estimated as 98~140 Mm^3 for the target area of 70,000 ha. Furthermore, 11~16 Mm^3 of water can be saved in 16,000ha of the target area by the improvement of conveyance efficiency by the extension of pipelines, with condition that the increase of conveyance efficiency is 10% (assuming that the average length of earthen canals is 1km). Among the impact of the water saving mentioned above, the net contribution to the global water balance is expected to 60~86 Mm^3.

7) Monitoring program

- Progress of the development of the pipeline extension in the N'Fis Right Bank GH Sectors with pressurized system (ORVAH)
- Number of application of the subsidy for drip irrigation (ORMVAH/DPA)
- Monitoring of the farming practice and productions through the extension works (ORMVAH/DPA)
- Follow-up of the farming activity by the registered wells (Confirmation of the applied irrigation type) (ABHT)

8) Cost Estimation:

The cost for installation of drip irrigation in 70,000 ha by the year 2020 is estimated as 2,715 MDH as in the following table.

No.	Area	Installation of Pipeline / Diversion			Installation of Drip Irrigation System			Sub Total (MDH)	Remarks (Subsidy for Drip Irrigation)
		Area (ha)	Unit Price (DH/ha)	Cost (MDH)	Area (ha)	Unit Price (DH/ha)	Cost (MDH)		
1	GH Sectors in right bank if N'Fis River	16,102	27,000	435	19,000	28,000	532	967	(319)
2	PMH Sectors				41,000	28,000	1,148	1,148	(689)
3	Other GH Sectors				10,000	60,000*	600	600	(360)
	Total	16,102		435	70,000		2,280	2,715	(1,368)

*: Including farm pond / pumping facilities

Out of the total cost, the cost to be burdened by agency in charge is 435 MDH for the installation of pipeline and diversion works, and the 60% subsidy which accounts for 1,368 MDH.

(2) Program for Seguia and Water Management Improvement

1) Implementing agencies: Water User's Associations (WUA), ORMVAH, DPAs

2) Objectives of the program:

To use the surface water efficiently through maintaining and improving seguias, as well as to improve water management in irrigation through grasping the actual conditions of the water in seguia system

3) Implementation target:

Initial target: To understand the function and effect of seguias for groundwater recharge
Initial target 2: To reinforce the capacity of the WUSs for the management and the maintenance of the seguias
Initial target 3: To reinforce the capacity of the WUAs for the monitoring the water use in seguias system
Final target: To use the surface water effectively while maintaining the recharge of the aquifer by increasing efficiency of water use and improving water management

4) Outline of the program

Traditional seguias not only functions as the basis for irrigated agriculture in the Haouz Plain, but also as important sources for the recharge of groundwater.

While taking necessary precautions to avoid negative impact to the groundwater balance, these seguias should be efficiently used. Maintenance and improvement of both functions of seguias shall be realized through participatory operation, maintenance and monitoring activities. The major activities to be carried out in this program are as follows.

a. Survey for the clarification of the groundwater recharge function of seguias

To reduce a loss by infiltration in seguias and to increase the conveyance efficiency, the concreting of seguias is the most efficient. Indiscreet execution of repair works will not only cancel efficient improvement of seguias, but also may worsen the balance of groundwater. Therefore, the amount of intake, flow in canals and usage of water in the parcels shall be monitored, and the function and contribution of the seguias for groundwater recharge shall be examined. Results of such examinations shall be the basic information for the preparation of plans for seguia improvement from the view point of integrated water resources management.

b. Strengthening of Activities of WUAs for Operation and Maintenance of Seguias

The activities of operation and maintenance loaded by the WUAs, such as the cleaning and shaping of canal, the repair of facilities concerned, etc., will be activated to maintain and to improve the functions of the seguia. In principle, the members of the WUAs provide some

services and pay a contribution for the activities of operation and maintenance. To keep the activities of operation and maintenance to the adequate level, the increase of the rate of involvement of the members to the common work and the improvement of the rate of contribution recovery is necessary. To this effect, the necessity of the operation and maintenance of seguias will be recognized extensively through the regular organization of the general assemblies and the local meetings. On the other hand, the guidance of CMV or CV will be reinforced for the activities of operation and maintenance efficient.

c. Establishment of Monitoring System for Water Use in Seguias System by WUAs

The amount of water use of the seguias is measured by WUAs which are reported by ORMVAH, etc., however, the frequency and the precision of the measurement are to examine. It is necessary to conduct the measurement correctly and continuously of the quantity of water take and distribution to the field in order to figure the actual situation of irrigation water use correctly. It will contribute to the realization of adequate water allocation and to the improvement water management. At the same time, the continually measurement and accumulating data will be useful for clarify the actual conditions of infiltration in seguia canals and it will be used as a basic information of the groundwater management. The system of measurement and monitoring of water use will be established as daily activities of WUAs (disposition of the loaded people, planning of the facilities and necessary facilities).

5) Implementation schedule: as described in Table 5.5.1.

6) Impact of the program

- To use the surface water efficiently so that the dependence on groundwater will be decreased indirectly (to warn the change of water source for groundwater due to malfunctioning of seguias)
- To elaborate an adequate water distribution through clarifying the water use in seguias correctly
- To prepare a basic information for the groundwater management and to contribute to the improvement of the precision of the groundwater simulation

7) Monitoring program

- Situation of the execution of the operation and management activities of the seguias by WUAs
- Collected data of water use in seguia system measured by WUAs

8) Cost Estimation:

The intake of water from natural rivers to seguias is an important source for irrigated agriculture in the Study Area. The traditional seguias (earthen canals) intake water from the river without regulating facilities, and the amount of intake largely vary by the year. Out of the total length of irrigation canals in Chichaoua (42 km), traditional seguias hold 35.7km (85%). In regard of the conveyance loss before reaching the parcels, it cannot be said that such seguias have high efficiency. Improvement of such seguias with modern concrete lining can maintain the amount of water supplied to the parcels. However, the improvement of seguias has a double edged effect of decreasing the amount of groundwater recharge from agricultural lands. Therefore, improvement of seguias shall be kept at the level of maintaining the earthen canals. By this reason, only the cost to examine the function and contribution of seguias for groundwater recharge is considered for the cost of the program, while that for improving traditional seguias is not regarded.

(3) Program for Accumulation and Distribution of Technical Information for Water Saving Farming and Irrigation

1) Implementing agencies:

ORMVAH, DPA Marrakech, DPA Chichaoua, INRA, Of other institutes of research,

2) Objectives of the program:

To valorize (economic value adding) water through the development of the techniques of the water saving farming and irrigation, the accumulation of the technical information and the extension and distribution to users.

3) Implementation Target

Initial target 1:	To develop the techniques of the water saving irrigation and to accumulate the technical information
Initial target 2:	To select the crops and varieties for the valorization of water and to develop the cultivation techniques
Initial target 3:	To establish the system of the extension and enlightening of water saving farming and irrigation
Final target:	To popularize and to spread water saving farming and irrigation in the farmers of the Haouz plain

4) Outline of the program

In order to introduce drip irrigation at the on-farm level, it is essential that the farmers practice cultivation methods matching the characteristics of the water saving measure. Introduction of water saving methods that will limit or reduce farm incomes will not be accepted by the farmers and this is not practical. In this regard, information on agricultural technology such as selection of varieties and cultivation methods, for improving profitability shall be accumulated and disseminated together with measures for water saving irrigation. The major activities to be carried out in this project are as follows.

a. Development of the techniques of the water saving irrigation and accumulation of the technical information

Development of the techniques of the water saving irrigation practicable and inexpensive for the area where it is difficult to introduce drip irrigation (area of traditional seguia, etc.), by ex. terminal irrigation canal by PVC, etc. Such techniques will contribute in decreasing percolation and evaporation loss and will also improve the operation / closure at the diversions. Besides, for the garden farming, the plastic malting is an efficient method to increase the effect of drip irrigation.

b. Development of the techniques of the water saving farming and selection of crop/variety

Selection of the crop/variety resistant to the drought and that don't require a lot of water, local adaptation and development of the techniques of the culture.

Distinction of the crop to be irrigated and non irrigated in the situation of limited water resources.

Selection of the alternative agricultural products and development of the techniques of the rain fed culture, when the cereals and fodders are excluded from the target of irrigation.

The results of studies conducted by ORMVAH indicate that out of the major crops produced in the Haouz Plain, vegetables and olives show high economic productivities of 1.53 to 2.40 DM/m^3. On the other hand, Alphalpha, which shows high economic productivity per unit area does not show high economic productivity per volume of water (0.90 DH/m^3) due to the high consumption of water. Vegetables and olives (exotic species) are promising crops that are expected to decrease the amount of water consumption and maintain / increase profit of the farmers at the same time. Species, together with cultivation technique which are suitable in terms of productivity and profitability should be examined and selected.

Economic Productivity of Crops in Haouz Central Irrigation Sector

Crop	Irrigation water (m^3/ha)	Value added per unit area (DH/ha)	Value added per unit volume of irrigation water (DH/m^3)
Olive	6,800	13,427	1.53
Wheat	4,500	5,579	1.04
Alphalpha	12,750	12,409	0.90
Feed crop(bersim)	6,750	3,740	0.73
Vegetables (winter)	5,700	13,927	1.73
Vegetables (summer)	6,600	20,520	2.40

Source: Etude des Variantes d'Assolements dans les Périmètres Irrigués, ORMVAH

c. Extension and enlightening of water saving farming and irrigation

The technical information of water saving farming irrigation will be accumulated and will be distributed by ORMVAH and DPAs in their zones and this information will be shared in collaboration with the local university, the National institute of Agricultural Research (INRA), etc. The extension for the users will be charged by CMV in the zones of ORMVAH and by CV in the zones of DPAs.

5) Implementation schedule: as described in Table 5.5.1.

6) Impact of the program

- To accumulate the necessary technical information for the spread of the water saving irrigation
- To develop the farming and cultivating techniques of valorization and water saving
- To establish the necessary system for extension and enlightening of introducing drip irrigation

7) Monitoring program

- Information of the techniques of the water saving irrigation
- Crops/varieties selected for water saving agriculture
- Activities of extension work at the level of CMV and CV as well as involvement of farmers to the visits and participation to training, etc., organized by CTE

8) Cost Estimation:

Item	Program Cost				Remarks
	Qtt.	Unit	Unit Price	Cost	
・Development of the techniques of the water saving irrigation and accumulation of the technical information	1	Set	6.50 MDH	6.50 MDH	
・Development of the techniques of the water saving farming and selection of crop/variety	1	Set	6.50 MDH	6.50 MDH	
・Extension and enlightening of water saving farming and irrigation	1	Set	6.50 MDH	6.50 MDH	
Total				19.50 MDH	

Water Supply Sector Water Demand Reduction Plan

With the water low, as for the water supply sector which forms the mainstay of BHN priority is high set at the time of water distributing. However, actually the purification water has big losses coming out is remarkable with water leakage and stealing water on the transport section, and even a little many water saving is required in the water balance which becomes tight.

(1) Water Supply Leakage Control Project

The amount of unknown water loss from the potable water supply system during 2003 and 2005 account for more that one third of the total water (17.8 to 22.7 Mm^3 per year). Most of this loss is

assumed to be leakage from distribution networks, water supply pipes, water meters and faucets. Such leakage should be reduced in order to reduce the extraction of groundwater.

1) Implementing Agency: RADEEMA & ONEP

2) Implementing Objectives:

   To reduce water intake amount through decreasing the water leakage ratio and the amount in the water supply systems

3) Implementation Target

   Initial Target: To realize the unaccounted water (water leakage) ratio to 30%, urgent measures / Implementation of urgent water leakage control
   Mid-term Target: To realize water leakage ratio at 25% by 2015 and 20% by 2010
   Final Target: To realize water leakage ratio at 15% by 2025

4) Outline of the Implementation Program

   a. Urgent water leakage control measures

      Due to the facts that the water leakage ratio has not decreased in years, the water leakage repair works practiced currently is likely not effective. The measures for the water leakage repair works shall be reviewed to launch for the urgent water leakage control measures. One of the measures is to organize an urgent water leakage control task team and carry out the intensive inspection by sight in the entire water service area and requesting the residents in public information to report water leakage points to the authority. Detected and/or the reported water leakage points shall be repaired immediately by the special Water leakages shall be repaired immediately.

   b. Water leakage control measures by decreasing water distribution pressure

      Water leakage amount decreases as to the water distribution pressure decrease. To survey the residual water pressure at the far end of the distribution pipes and specify the water distribution blocks where the water distribution pressure is excessively high. Decrease the water distribution pressure tentatively for the specified water distribution blocks. Water distribution pressures decrease shall be made by controlling the valves of water distribution mains and of block valves. As the water distribution pressure drops, the residents will claim for the water service conditions and the valve control shall be adjusted according to the situation. Actual water distribution by the required minimum water distribution pressure shall be practiced after completion of the improvement works to increase the efficiency of water distribution network.

   c. Formulation of water leakage control plan

      Systematic approaches are required to realize the effective water leakage control. For the purpose, the water leakage control plan shall be prepared with the implementation plan including the block-wise water leakage survey for the entire water service area, the standard method for repair works, and the annual budget plan. In addition, efficient water leakage repair works shall be systemized by the support of water distribution pipe information system to be prepared under the project.

   d. Formulation of improvement plan to structure efficient water distribution network

      Improvement plan to increase the efficiency of water distribution network shall be formulated to perform the water distribution with the required minimum water pressure and the uniform water distribution pressure in the entire service area. The plan shall be formulated taking into consideration of the future water distribution network, water pressure in the respective water distribution block, monitoring and analysis of water pressure & flow rate, and the confirmation for optimizing the plan by the simulation of water distribution network. Secondly, the improvement plan shall be comprised of replacement of aged pipes, installation of additional pipelines, water distribution block valves, water pressure meters &

flow meters for monitoring the water distribution conditions, which are the necessary components to improve the water distribution efficiency. In addition, the linkage shall be made with the water leakage control plan through preparation and utilization of the water distribution pipe information system

e. Regular water leakage survey and repair works

Water leakage survey shall be conducted by the field survey using the water leakage detectors and the result of observation of water distribution pressure and flow rate. Water leakage survey shall be made by outsourcing to the special water leakage survey company(s) and it may be practical to repair the detected water leakage points by the own water leakage repair team. Water leakage survey and repair work shall be implemented block by block through the annual regular services. Water leakage survey and repair works shall be implemented repeatedly even after completion of all the water distribution blocks since the water leakage occurs again by the time elapsed and continue until the fulfillment of the water leakage ratio at the target year.

f. Water distribution network improvement work

The work consist of improvement of water distribution network including replacement of aged pipelines, additional pipelines, water distribution block valves, water pressure meters and flow meters for monitoring. The work shall be carried out by the annual plan in 3 years. The works shall be carried out separately from the expansion of water distribution network and preferably the works shall be carried out block-wise improvement work and for the entire water distribution network.

5) Implementation schedule: as described in Table 5.5.1.

6) Effects of the Project

a. The cut down on the rate of leakage will reduce the amount of water to be treated and contribute to preserve the water source by 11.6 Mm^3.
b. The cost for pumping 11.6 Mm^3 will be reduced.

7) Monitoring of Progress of the Project

Monitor the decrease of water leakage ratio analyzed in the annual water distribution record and check the status of attainment with the water leakage ration of the target year

8) Cost Estimation:

The items below are considered for the cost estimation of the project. On the other hand, the cost for “Urgent water leakage control measures” and “Water leakage control measures by decreasing water distribution pressure” is not regarded in the cost because it will be carried out through normal works of RADEEMA and ONEP.

a. Sub contracting for formulation of water leakage control plan
b. Sub contracting for formulation of improvement plan to structure efficient water distribution network
c. Sub contracting for regular water leakage survey and repair works
d. Sub contracting for water distribution network improvement work

The cost estimation of the project based on general unit prices of RADEEMA and ONEP is as follows.

Item	Project Cost				Remarks
	Qtt.	Unit	Unit Price	Cost	
・Urgent water leakage control measures	1	Set	-	-	Activities carried out through normal works of RADEEMA/ONEP
・Water leakage control measures by decreasing water distribution pressure	1	Set	-	-	Activities carried out through normal works of RADEEMA/ONEP
・Formulation of water leakage control plan					
Formulation of water leakage control plan (RADEEMA)	1	Set	5.0 MDH	5.0 MDH	Subcontract (consultant)
Formulation of water leakage control plan (ONEP)	11	Set	1.0 MDH	11.0 MDH	Subcontract (consultant), 11 systems
・Formulation of improvement plan to structure efficient water distribution network					
Formulation of improvement plan to structure efficient water distribution network (RADEEMA)	1	Set	5.0 MDH	5.0 MDH	Subcontract (consultant)
Formulation of improvement plan to structure efficient water distribution network (ONEP)	11	Set	1.0 MDH	11.0 MDH	Subcontract (consultant), 11 systems
・Regular water leakage survey and repair works					
Regular water leakage survey and repair works (RADEEMA)	11	Year	20.0 MDH	220.0 MDH	Subcontract of leakage survey and repair works
Regular water leakage survey and repair works (ONEP)	11	Year	5.5 MDH	60.5 MDH	Subcontract of leakage survey and repair works, 11 systems
・Water distribution network improvement work					
Water distribution network improvement work (RADEEMA)	1	Set	30.0 MDH	30.0 MDH	Improvement during 3 years
Water distribution network improvement work (ONEP)	11	Set	60.5 MDH	60.5 MDH	Improvement during 3 years, 11 systems
Total	403.0 MDH				

(2) Program for Water Saving Dissemination

Through the amount of water consumed through potable water supply is only 7% of the total water use, it is estimated that the water demand of the water supply sector (hotels, urban greenbelts, etc.) will reach some 107 Mm^3 in 2007. In regard of this large quantity, there will be a considerably large effect if a part of this demand can be reduced. Furthermore, in regard of the expected growth in he urban population and in the tourism sector, it is important that the minds of the individual water users are oriented towards water saving. Educational programs will be mainly carried out by water saving campaigns through mass-media and water saving seminars for the water users.

1) Implementing Agency: RADEEMA, ONEP and Wilaya

2) Implementing Objectives:

   Reduction of total water consumption by decreasing the unit water consumption rate (water consumption per capita per day) through water saving activities

3) Implementation Target:

   Initial Target: Per capita water consumption rate shall not be increased in the water supply systems in urban areas,
   Final Target: Establishment of water saving society

4) Outline of the Program

   The activities in the program will be mainly carried out by RADEEMA, ONEP and the Wilaya.

However, in regard of the similarity with the later mentioned “Program for Public Awareness on Water Saving and Conservation”, close coordination shall be made between the executing agencies and ABHT.

a. Development of water saving campaign through mass-medias

Spreading water saving activities of water users at the water consumption places (residential house, factory, business offices, tourism facilities, institution buildings, etc.) through mass-media such as television, radio, newspaper, pamphlet, internet, and public places. The programs shall be prepared for adult and children respectively with the contents including the following items but not limited.

- Presenting the strained status for providing water, the authorities are striving for the water resource development projects but the water resources are quite limited,
- Presenting the situation that the time is now pressing for the individual water user to take an action for saving water and reducing the water consumption amount,
- Presenting the method and activities which are practiced by the individual water user,
- Saving water campaigns for the tourists.

b. Holding water saving seminars for water users in urban area

RADEEMA and ONEP shall organize the water saving task team(s) and the team members shall be trained for building the capacity to spread water saving movement in the society. The task team(s) open from time to time the water saving seminars and conduct the assigned services to spread the water saving activities. The water saving seminars will be held at the public places and the door-to door guidance by the member of the water saving task team(s) at the residential houses and the work places. The contents of the seminar will consist of the same with that of above water saving campaigns and carry out by means of visual presentation such as video and/or power points and hand-outs of pamphlets, etc. prepared respectively for adult and children. For example, the places and the expected participants for the seminars are listed as follows.

- Primary school and high school students,
- Residents come to the Mosque
- Representatives and/or the responsible person of the factory and the work place,
- Representatives and/or the responsible person of tourist facilities and restaurants,
- Representative and/or the responsible person of institutions including schools, government & municipality offices,

c. Holding water saving seminars for water users in rural area

Member of the water saving task team of ONEP shall implement the seminars and activities for spreading the water saving activities in collaboration with the Commune Councils which are the lowest end of the government administration system. The places and the contents of the seminars shall be the same with that of the seminars in urban areas. But the minor adjustment shall be made for the contents of presentation to meet with the living conditions in the rural area. The seminars in the rural areas shall be also opened through the functions of traditional organization of MOUQUADAM represented by MERZAGUE.

5) Implementation schedule: as described in Table 5.5.1.

6) Effects of the Program:

- Water sources will be preserved from the reduction of water amount in water intake, water purification, water distribution owing to the decrease of water consumption through the water saving activities,
- Decrease of water charge amount of individual water user.

7) Monitoring of Progress of the Program

The indicators shall be obtained from the per capita water consumption for domestic water users

and per connection water consumption for other water users estimated from the analysis of annual water distribution record.

8) Cost Estimation:

The items below are considered for the cost estimation of the program.

a. Water saving campaigns through mass-media
b. Water saving seminars, handout material

The cost estimation of the program based on the scale of the campaign is as follows.

Item	Project Cost				Remarks
	Qtt.	Unit	Unit Price	Cost	
・Water saving campaigns through mass-media	13	Year	1.0	13.0 MDH	
・Water saving seminars					
Seminars by RADEEMA	13	Year	1.0	13.0 MDH	Costs for seminar, text books and handouts
Seminars by ONEP	10	Year	0.5	5.0 MDH	Costs for seminar, text books and handouts
Total	31.0 MDH				

5.4.5 Organizational and Institutional Improvement Plan

Considering the current organizational and institutional state related to the water resources management, the objectives aiming to the improvement of the institutional and legislative system in the integrated management strategy of the water resources, the program components are as follows:

- Establishment of the effective system of the water resources management by the implementation capacity reinforcement of the ABHT;
- Development of the legal system for the effective implementation of the Water Law;
- Reinforcement of actions of the water police and the competence transfer at the local level;
- Adequate pricing and effective collecting of the water royalty

(1) Program for Water Resources Management Capacity Development of ABHT

1) Implementing agency: ABHT

2) Program Objective:

Function of the ABHT as a federator of the water resources management is reinforced

3) Program Goal:

Improvement and reinforcement of the institutional and technical capacities of the ABHT

4) Outline of the Program

The ABHT must play a role of federator of the water resources management (WRM) in the Haouz plain. However, by taking account of the importance of its missions and the number of its tasks, certain institutional weaknesses and insufficiencies of the technical capacities must be improved and reinforced.

For the sustainable management and rational use of the water resources in the Haouz plain, the establishment of the water resource management system under the close collaboration with the various stakeholders is indispensable. The improvement and the reinforcement of the administrative system of the water resources management, through the actions of the capacity reinforcement of the ABHT which are technical level and also institutional level must be carried out. The major activities to be carried out in this program are as follows.

a. Capitalization and diffusion of the information on the water resources

The information related to water resource of the Haouz Plain shall be put under uniform management and efficiently shared within ABHT. At the same time, a framework to transmit necessary information to the stakeholders should be formulated. Currently, GTZ is providing

support for the preparation of a common platform for information. The following items shall be carried out utilizing such resources.

- Share and Uniform management of the documents and the data in the ABHT, Installation of the documentation center
- Development of the common information diffusion system in the ABHT
- Development of the common information diffusion system between the concerned structures
- Web site creation and information diffusion to the stakeholders

b. Reinforcement of the consultation and the cooperation with the concerned stakeholders on the water resources management

In order to realize sustainable management of water resources, it is essential to formulate a framework for coordination / consensus building with various stakeholders. Through such framework, the stakeholders can share issues on water resources and build consensus on necessary countermeasures. The “Tensift Basin Water Committee”, to be formulated in “Participatory Water Resources Management Program” stated later in this report shall function as a common platform for coordination with stakeholders.

c. Rationalization of the authorization procedure of the DPH

Appropriate issuing of permits for use of public waters is an essential measure to understand the actual situation of groundwater resources and to realize appropriate management. In ABHT, there is already a system functioning for the issuing of permits, but registrations of wells are not necessarily completed. Rationalization of permits for use of public waters including well permits will promote registration of water use facilities. The following items shall be carried out in order to understand the actual situation of water use facilities and use of water resources.

- Simplification and promptitude of the authorization procedure (to be partly implemented in the Program for Legal and Institutional Frameworks Improvement for Water Law Implementation)
- Quick checking of the declaration and the control of the observation of the authorization granting (to be partly implemented in the Program for Water Police System Enhancement)
- Capacity reinforcement of the service in charge of the authorization deliberation

d. Reinforcement of the control of the illicit water use, Royalty collection

In addition to the registration of wells, it is necessary to monitor and control water use from unregistered wells or use of groundwater exceeding the permission. Furthermore, in regard of the sustainability of activities for groundwater management, it is necessary to set and collect royalties for groundwater use depending on the amount of groundwater in the future. For preparation of groundwater royalties, the following items shall be carried out.

- Implementation of the actions for control by the water police (to be implemented in the Program for Water Police System Enhancement)
- Development of the royalty collection system

e. Reinforcement of the monitoring and the evaluation of the water resources

In order to understand not only the current situation of groundwater resources, but also to estimate possible states in the future, it is required to monitor and analyze the situation of groundwater based on registration of water use facilities and monitoring of illicit water use. Monitoring shall also be strengthened and data should be accumulated. Based on such data, the following items shall be carried out to improve the accuracy of the groundwater simulation model.

- Reinforcement and development of the hydraulic network (to be implemented in the Hydrological Observation Network Reinforcement Project)

- Establishment of the water intakes water monitoring in the PMH (to be implemented in the Program for Seguia and Water Management Improvement)
- Acknowledgment of the number, the distribution of the wells and the intake volume of the ground water (to be implemented in the Program for Groundwater Facility Registration Management)
- Capacity reinforcement of the ABHT for the water resources prevention by the ground water simulation technique (to be implemented in the Program for Scientific Estimation of Available Groundwater)

f. Reinforcement of the water quality control

In order to realize sustainable management of groundwater resources, it is necessary not only to monitor the quantity, but also the quality of groundwater resources. The following items shall be carried out for this purpose.

- Reinforcement of the activities and the personnel in charge of the water quality analysis (to be implemented in the Program for Water Quality Monitoring)
- Function of the water analysis laboratory (to be implemented in the Program for Water Quality Monitoring)

5) Implementation schedule: as described in Table 5.5.1.

6) Effects of the Program

- Information and the data relating to the water resources are ordered, diffused and shared with the concerned actors;
- The partnership of the ABHT with the other concerned structures of the water resources management is reinforced;
- The administrative and technical capacities of the ABHT for the implementation of the activities of the water resources management are reinforced and improved;
- The administrative procedure for the authorization of the water use is improved.

7) Follow up-Monitoring of the program

The indicators of the implementation of the program are as follows:

- The data base of the water resources of the ABHT: Contents and used condition;
- The information system of the water resources (internal ABHT, Extranet with the partners structures of the water resources management, Web site): The contents of the system, condition of the system use, frequency of the information updating, number of access
- The consultation framework of the water resources management in the Haouz: plain: Numbers of the held meetings, the participants, the contents of the discussion (Official reports) and the public diffusion of the information
- The function of the authorization procedure for the water use: The number of treatment of the authorization files, contents of the authorization procedure
- The water resources monitoring evaluation: conditions of the hydraulic observation networks at the sub-basins and the seguias, the frequency of the data processing and analysis, the inventory and the data base of the wells, the status of the ground water simulation execution and its exploitation, information diffusion on the water resources status
- The water quality control: the implementation status of the water quality analysis, the analysis reports elaboration and the results diffusion to the public
- The capacities of planning, monitoring and evaluation: the situation of the PDAIRE elaboration, the status of the planning, implementation and the follow-up-evaluation of the projects relating to the water resources management

8) Cost Estimation:

The items below are considered for the cost estimation of the project. On the other hand, the “Reinforcement of the consultation and the cooperation with the concerned stakeholders on the water resources management”, “Reinforcement of the control of the illicit water use, Royalty

collection", "Reinforcement of the monitoring and the evaluation of the water resources" and "Reinforcement of the water quality control" will be carried out through "Program for Formulation of Collaboration and Decision - Making Framework for Water Resources Management", "Program for Water Police System Enhancement" and "Program for Water Quality Monitoring", thus the costs are not included in this estimation.

a. Capitalization and diffusion of the information on the water resources
b. Rationalization of the authorization procedure of the DPH
c. Improvement of capacity for water resources management planning, monitoring and evaluation

The cost estimation of the program based on the scale of the activities is as follows.

Item	Project Cost				Remarks
	Qtt.	Unit	Unit Price	Cost	
・Capitalization and diffusion of the information on the water resources					
Share and Uniform management of the documents and the data in the ABHT, Installation of the documentation center	6	Times	0.005 MDH	0.03 MDH	Training for information management, once every two years
Development of the common information diffusion system in the ABHT	1	Set	-	-	Intranet already installed
Development of the common information diffusion system between the concerned structures	13	Year	0.036 MDH	0.47 MDH	Maintenance, security, update (by outsourcing)
Web site creation and information diffusion to the stakeholders	13	Year	0.036 MDH	0.47 MDH	Maintenance of website, updating (by outsourcing)
・Reinforcement of the consultation and the cooperation with the concerned stakeholders on the water resources management	1	Set	-	-	Normal works of ABHT
・Rationalization of the authorization procedure of the DPH					
Study on simplification and promptitude of the authorization procedure	1	Set	-	-	Considered in the Program for Legal and Institutional Frameworks Improvement for Water Law Implementation
Simplification and promptitude of the authorization procedure	11	Year	0.24 MDH	2.64 MDH	Recruitment of 2 new staff
Quick checking of the declaration and the control of the observation of the authorization granting	11	Year	-	-	Cost for vehicles, etc. Considered in the Program for Water Police System Enhancement
Capacity reinforcement of the service in charge of the authorization deliberation	4	Times	0.005 MDH	0.02 MDH	Training for procedures for permitting use of public waters, once every three years
・Reinforcement of the control of the illicit water use, Royalty collection					
Implementation of the actions for control by the water police	1	Set	-	-	Considered in the Program for Water Police System Enhancement
Development of the royalty collection system	4	Times	0.005 MDH	0.02 MDH	Training for financial affaires, once every three years
・Reinforcement of the monitoring and the evaluation of the water resources					
Reinforcement and development of the hydraulic network	1	Set	-	-	Considered in the Hydrological Observation Network Reinforcement Project

	Project Cost				
Establishment of the water intakes water monitoring in the PMH	1	Set	-	-	Considered in the Program for Seguia and Water Management Improvement
Acknowledgment of the number, the distribution of the wells and the intake volume of the ground water	1	Set	-	-	Considered in the Program for Groundwater Facility Registration Management
Capacity reinforcement of the ABHT for the water resources prevention by the ground water simulation technique	1	Set	-	-	Considered in the Program for Scientific Estimation of Available Groundwater
・Reinforcement of the water quality control					
Reinforcement of the activities and the personnel in charge of the water quality analysis	11	Year	-	-	Considered in the Program for Water Quality Monitoring
Function of the water analysis laboratory	11	Year	-	-	Considered in the Program for Water Quality Monitoring
・Improvement of capacity for water resources management planning, monitoring and evaluation					
Preparation of improvement plan for Institutional Capacity of ABHT	1	Set	1.33 MDH	1.33 MDH	Subcontract to consultants (6months)
Preparation and implementation of water resources management plan, monitoring / evaluation workshops	6	Times	0.01 MDH	0.06 MDH	Targeting senior staff of ABHT, workshops to be held every two years
Total	5.0 MDH				

(2) Program for Legal and Institutional Frameworks Improvement for Water Law Implementation

1) Implementing agency:

ABHT is a principal organization for this program implementation in collaboration with the local communities and the structures concerned on the water resources management

2) Program objective:

The function of the Water Law is improved and reinforced by the legal countermeasures

3) Program goal:

Elaboration of the texts of application and improvement of the authorization procedure relating to the water use in the DPH

4) Outline of the program

The water Law 10-95 and its application texts define legal system of the authorization and the concession for the utilization in the DPH, water right reconnaissance, the rules of the water conservation and the norms of the water quality, the royalty payment obligation for water use in the DPH and its collection, and also the revelation of the law violator by the water police and the penal regulations.

However, this water legislation is not sufficiently recognized and applied by the users. And moreover, the Water Law defines the water police that have to control the unauthorized digging wells and intake water and also the illicit water use and water pollution little function.

To respect and accomplish the legal system concerned the water management, the reconnaissance to the users on the water legal system must be promoted to the users by the large diffusion of the information related the Water Law and its application texts. And also the necessary application texts have to be elaborated and approved for the effectiveness of the Water Law. The major activities to be carried out in this program are as follows.

a. Elaboration and application of the necessary texts of application for the effective implementation of the Water Law

The texts of application quoted below will be elaborated for the implementation of the activities envisaged in the Water Law. These texts of application will be examined by the ABHT and the concerned organizations. Then, these texts will be proposed by the ABHT to the central government (MATEE), in order to be examined and approved.

- The attributions and the modalities of the implementation of the water police;
- The prolongation of the declarations period to the existing wells;
- The threshold and the prohibited area of the digging wells and the ground water intaking inside the action zone of the ABHT;
- The modalities of fixing and collecting of the royalty for the water use, in particular ground water of the Public Hydraulic Domain;
- The obligation of the installation of the water meters and of the control of the water intake volume on the authorized wells;
- The obligation of the implementation of the drip irrigation systems for the granting authorization of the digging and the water intakes of the wells for agriculture;
- The framing of the digging works of the wells by the digging licenses, the confiscation application of the drilling machine or the digging equipment of wells without preliminary authorization;
- The standards of the water flows quality of the industrial plants;
- The creation and the modality of the implementation of the ground water resources management funds.

b. Improvement of the authorization procedure for the digging and the water intake of the wells, and the authorization observance

The long and complicated procedure is one of the causes of the obstacle for the declaration of the existing wells and the authorization demand for the wells digging and the water intaking. Thus a series of activities to the improvement of the procedure and the exhaustive observation of the authorization will have to be carried out.

- Study implementation on the improvement of the authorization procedure
- Prolongation of the declaration period of the existing wells;
- Improvement of the authorization procedures of the wells digging and the water intakes (to be implemented in the Program for Water Resources Management Capacity Development of ABHT);
- Standardization and the simplification of the authorization request forms;
- Clarification and observance of the number of days required for the authorization procedure;
- Quick verification on site of the authorization demand (localization, user, demand objective etc);
- Quick verification on site of the demand observance after the authorization delivery. In the event of the infringement, the observation, the recommendation and finally the application of the sanctions such as the withdrawal of the authorization will be applied (activities by the water police);
- Diffusion of the information on the authorization procedures and the implementation of the enlightenment activities aiming to promote the declaration of the existing wells;
- The well contractor shall get the legal authorization for well digging works. In the event of the illicit work and without authorization, the revocation of the license or the confiscation of the drilling machine or the well digging equipment will be enforced.

c. Information on the Water Law 10-95 and the legal texts relating to the water

The activities of the information will be largely undertaken for the recognition to the users on the Water Law and its texts of application. These activities will be undertaken in the program of the enlightenment and the communication to the water saving and the water resources conservation.

5) Implementation schedule: as described in Table 5.5.1.

6) Effects of the Program

- The texts of application relating to the implementation and the application of the Water Law will be elaborated, published, the water resources management respecting the legal system will be realized;
- The authorization procedures of the well digging and the water intakes will be improved and the illicit water use will be reduced.

7) Follow up - monitoring of the program

- The elaborated and published texts of application relating to the water management;
- Number of the declared and officially authorized wells;
- Contents of the authorization procedure and the improved points

8) Cost Estimation

The items below are considered for the cost estimation of the project.

a. Elaboration and application of the necessary texts of application for the effective implementation of the Water Law
b. Improvement of the authorization procedure for the digging and the water intake of the wells, and the authorization observance
c. Information on the Water Law 10-95 and the legal texts relating to the water

The cost estimation of the program based on the scale of the activities is as follows.

Item	Project Cost				Remarks
	Qtt.	Unit	Unit Price	Cost	
・Elaboration and application of the necessary texts of application for the effective implementation of the Water Law					
Survey and examination / elaboration of drafts for legal texts	1	Set	1.33 MDH	1.33 MDH	Subcontract to consultants (6months)
Application of the necessary texts of application for the effective implementation of the Water Law	1	Set	-	-	Normal works of ABHT, MATEE/SEE
・Improvement of the authorization procedure for the digging and the water intake of the wells, and the authorization observance					
Study on simplification and promptitude of the authorization procedure	1	Set	1.33 MDH	1.33 MDH	Subcontract to consultants (6months)
Simplification and promptitude of the authorization procedure	11	Year	-	-	Considered in Program for Water Resources Management Capacity Development of ABHT
・Information on the Water Law 10-95 and the legal texts relating to the water					
Explanatory meetings on the water law and legal framework concerning water	6	Times	0.22 MDH	1.32 MDH	Per CMV/CT, once every two years
Preparation and distribution of pamphlets on the water law and legal framework concerning water	50,000	Copies	50 DH	2.50 MDH	
Total	6.5 MDH				

(3) Program for Water Police System Enhancement

1) Implementing body:

ABHT is a principal organization for this program implementation. This program aims to establish a ground water management system and an illicit water use surveillance system by the user's participation at the local communities level through the competence transfer to the local communities in particular to the provinces and the communes.

2) Program Objective:

Establishment of the monitoring system of the illicit water use and the coordination system between the users aiming at the equitable water use

3) Program Goal:

Prevention of the illicit water use through the control by the police force of water

4) Outline of the program

The water police carry out the monitoring and control the illicit and inadequate water use for realize the equitable water use by the users as well as the protection of the water quality. However the water police can not carry out the actions envisaged in the Water Law.

To realize the control of illicit water use by the water police, the ABHT should firstly take the initiative for the implementation of the water police. Taking account of the human and the financial capacity of the ABHT and also its wide action zone, it is not realistic that the ABHT carries out alone the actions of the water use control. To achieve the goal of the actions of the water police, such as the prevention of the illicit water use and the water resource protection, a close cooperation with the local communities (Region, Province and Commune) and the gradual competences transfer of the water police to the local communities are indispensable. It is dictated in Clause 104 of the Law 10-95 on Water, that "Concerning violations of the Water Law, officers / authorities consigned by the Hydraulic Basin Agencies of which has sworn among the Law of officers for sworn statements have the responsibilities to identify these issues, beside from regular police bodies,"

On the other hand, the authority of the water police, which has the jurisdiction to control violations of the Water Law, is not stated in the jurisdiction transferred to the local authorities. Therefore, in order to prevent illegal water use through strengthening of water police, a contract for implementing water police activities should be agreed among ABHT, local authorities and the officers consigned with the works. Necessary budget arrangements for transportation and remuneration should also be made.

It is prospective that the illicit water use will be reduced by the establishment of control networks through the actions of the water police at the communal level. The major activities to be carried out in this program are as follows.

a. Information on the activities of the water police to the stakeholders in particular to the local authorities

The large activities of information to the inhabitants, the concerned administrative structures and the Agricultural Water Users Associations (AUEA) will be carried out for the realization of the actions of the water police. Particularly, it is necessary to demand a close cooperation with the AUEA for the success of the activities to the illicit water use control. Finally, the meetings and the seminars will be organized in order to obtain the approvals and the cooperation of the local authorities (the governors of the provinces, caïds…) concerning the implementation of the water police.

b. Implementation of the water police by the ABHT

The activities of the water police by the ABHT will be implemented as follows:

- Elaboration of the term of references and the text of application to fix the modality of the

water police implementation;
- Recruitment of the ABHT agents in charge of the water police (at least 4 agents);
- Training of the agents on the necessary legal procedures to exercise the function of the water police;
- Delivery of the licenses of the water police to the trained agents;
- The availability of the material and financial means for the implementation: vehicles, fuels, displacement fee (ABHT budget, contribution of the CRMTH);
- Elaboration of the program of the water police activities which will make it possible to cover and control effectively considering the extent of the action zone and the significant number of the ground waters users;
- The implementation of the activities of the water police. In the event of the infringement, the observation, the recommendation, the application of the sanctions and the confiscation of the equipment will be gradually carried out.

c. Competences transfer of the water police activities to the local communities, and Establishment of the water use control networks

In parallel with the activities of the water police by the ABHT, competences of the water will have to be gradually transferred to the local communities and the control system to the illicit water use will have to be constituted in collaboration with the irrigation Associations (AUEA).

- Examination of contents of water police activities by local authorities, means of implementation and Preparation of TOR.
- Agreement on the contract for implementing water police activities between ABHT, local authorities and officers consigned for water police activities
- The delivery of the water police licenses to the personnel in charge of the water management at the local community levels;
- The training on the water police activities to the personnel in charge of the water management at the local community levels,
- The progressive implementation of the water police activities by the local communities;
- The organization of the meeting with the AUEA on the control activities of the illicit water use control (attribution, activities field, measures taken in the event of the detection of the infringement etc);
- The necessary support to the AUEA for the activities of the illicit water use control (communication and displacement means, delivery of the proxy or the certificate etc);
- The implementation of the activities of the illicit water use control by the AUEA;
- When the activities of the water police at the communal level will be done, the role of the ABHT will be gradually shifted to the coordination.

5) Implementation schedule: as described in Table 5.5.1.

6) Effects of the Program

- The wells digging, the illicit water intake and the water pollution will be prevented by the water police implementation;
- The water use control networks by the local communities and the users' organization will be established.

7) Follow up-Monitoring of the program

- Number of the personnel in charge of the activities of the water police (number of the licenses delivered personnel of the ABHT, the provinces and the communes), the activities reports (number of the mission, zones);
- Number of the declaration and registration of the wells, the denunciation of the infringement of the illicit water use (illicit digging and water intake, water pollution);
- Opinions to the activities of the water police by the questionnaire and the interview of the water users, the inhabitants and the local communities.

6) Cost Estimation:

The items below are considered for the cost estimation of the project. On the other hand, "Publitization on water police activities" and "Promote understanding of local authorities on water police" will be carried out through normal activities of ABHT, and therefore, is not included in the estimation.

a. Implementation of the water police by the ABHT
b. Competences transfer of the water police activities to the local communities, and Establishment of the water use control networks

The cost estimation of the program based on the scale of the activities is as follows.

Item	Project Cost				Remarks
	Qtt.	Unit	Unit Price	Cost	
・Information on the activities of the water police to the stakeholders in particular to the local authorities					
Publitization on water police activities	1	Set	-	-	Normal works of ABHT through collaboration with relevant agencies
Promote understanding of local authorities on water police	1	Set	-	-	Normal works of ABHT
・Implementation of the water police by the ABHT					
Elaboration of the term of references and the text of application to fix the modality of the water police implementation;	1	Set	-	-	Normal works of ABHT
Recruitment and training of the ABHT agents in charge of the water police	12	Year	0.48 MDH	5.76 MDH	Recruitment of 4 staff
Patrol vehicles	4	Vehicle	0.36 MDH	1.44 MDH	4WD pickup
Maintenance cost for patrol vehicles	12	Year	0.0433 MDH	0.52 MDH	3% of vehicle cost per year
Fuel cost for patrol vehicles	12	Year	0.216 MDH	2.59 MDH	30L / day times 15 days / month times 4 cars
Control and monitoring of water use (transportation and other costs)	12	Year	0.048 MDH	0.58 MDH	1,000DH / month / person
・Competences transfer of the water police activities to the local communities, and Establishment of the water use control networks					
Training of personnel in charge of the water management at the local community levels	10	Times	0.010 MDH	0.10 MDH	2 per province / prefecture and 2 per commune. Training in 10 locations.
Gradual implementation of water police activities by local authorities	8	Year	1.953 MDH	15.62 MDH	Transportation, fuel, allowance and other expenses
Patrol vehicles (motor cycles)	124	Vehicle	0.02 MDH	2.48 MDH	2 persons times 62 communes
Training of water police activities for AUEA	6	Times	0.088 MDH	0.53 MDH	AUEA to be divided into CMV (18) / CT (4), 2 days per training, once every two years
Total	29.6 MDH				

(4) Program for Appropriate Pricing and Effective Collecting of Water Royalty

1) Implementing agency:

ABHT is a principal organization for this program implementation in collaboration with the local communities (region, provinces and communes), local authorities, MATEE/SEE, ORMVAH and DPAs.

2) Program Objective:

Realization of the rational water use and the saving water by collection of the ground water management royalty

3) Program Goal:

Determination of the pricing of the groundwater management royalty and collecting to the users

4) Outline of the program

Water is a public property and cannot be the subject of private appropriation described clearly in the Water Law. All users using the surface and underground water resources in the DPH have the obligation to pay a royalty for water use. However, the excessive and often uncontrolled pumping are the principal causes of the important lowering of the ground water. The efforts for the control and the intake volume saving of the groundwater by the royalty collecting must be made.

The adoption of the tariffication to the water resource, particularly the underground resource intake, will have to be considered in an equitable way and differentiated according to the criteria defined such as the volume of water intaking, the effort for the water saving introducing the adequate technique or the type of water use developed. Thus, the big aversion of the users to the royalty payment in particular of ground waters is foreseeable; it is necessary circumspect discussion and efforts to obtain the comprehension and the approval of the water users by the communication and publicity campaigns.

In this program, the adoption of the adequate and equitable tariffication and the promotion for comprehension obtain to the ground water management royalty payment will be aimed in order to realize the sustainable ground water management and the water saving.

In this program, the adoption of adequate and equitable tarification and the promotion of comprehension obtaining of the royalty payment for the ground water management will be aimed to carry out the sustainable ground water management and the water saving. The major activities to be carried out in this program are as follows.

a. Examination and consultation on the water pricing and the collecting modality

The pricing and the mode of payment of the ground water management royalty will be examined within the consultation framework of the water resources management in the Haouz plain by taking part the stakeholders. The pricing have to be differed and considered according the criteria quoted below:

- Type of water use: Drinking / domestic water, water for irrigation and water for the tourist sector (Golf in particular). Pricing will be fixed according to the type and volume of water use;
- Type of irrigation technique: Farmers introducing drip irrigation will be encouraged by a pricing less penalizing because of the efforts made for investment for drip irrigation;
- Irrigated area and farm scale: The economic burden for the small farmers by the ground water royalty will not have to be much charged. Thus the pricing will have to be applied by the irrigated area and the farm scale;
- Water intake volume: In order to reduce excess abstraction of ground water, pricing will have to be applied according to the intake volume. (eg: the consumption less 1,500 m^3/ha/year will be exonerated and the pricing will be applied gradually according to the water intake volume);
- Zone type: The pricing will differ between the plain and the mountains because the mountain zone could be regarded as the supplier or the conservator of the water resources.

The pricing of the ground water management royalty will be applicable initially to the large water users (grand farmers or agricultural investors, the tourist sector like the hotels, the golf, tourist complexes). The possibility of the pricing extending to the other uses in particular

small farmers will be gradually studied and examined by 2013.

b. Elaboration and proclamation of the texts of application related to the water pricing and the collection modality

The current water royalty is fixed by the decree No 2-97-414 of February 4, 1998 and the joint decree of the Minister of economy and finances, the Minister of equipment and the Minister of agriculture, rural development and maritime fishery No 548-98 of August 21, 1998. The ground water management royalty will have to be taken account of the reality of the Haouz plain and to be precisely fixed according to the defined criteria basing on the existing texts of application. The project of text of application relating to the fixing of the ground water pricing will be formulated as the proposals of the ABHT at the Tensift Basin Committee before its submission to the governmental authorities (MATEE/SEE). It will be examined thereafter at the central level, approved and published. (to be implemented in the Program for Legal and Institutional Frameworks Improvement for Water Law Implementation)

c. Explanations and information to the users and relevant organizations at the local level on the new water pricing

The large action of the information in order to recognize new royalty pricing to the farmers and the actors in the tourist and the urban development field will have to be carried out. These activities will be undertaken within the program framework of the enlightenment and the communication.

Thus, the important aversion of the users to the royalty payment in particular of ground waters is foreseeable. In order to obtain the comprehension and the approbation of the local authorities (CRMTH, Provincial Councils, and elected persons), the local communities and community traditional organizations, a series of the seminars relating to the water royalty pricing will be organized.

d. Development of the royalty collection system

The activities for the ground water royalty collection will be undertaken as follows:

- The knowledge of basic information such as the water intake volume and the utilization of each well by the recognition and the registration of the wells;
- The obligatory installation of the water meters to regularize the water intake situation,
- The activities of water use control and royalty collection by water police of the ABHT: The application of the pricing and the ground water royalty collection will be limited for the moment to the large consumers who can be considered very few; therefore it will be possible to cover by the ABHT. (to be implemented in the Program for Water Police System Enhancement)
- The competences transfer of the ground water royalty to the communes;
- Taking account of the significant number of the wells, the ABHT cannot cover the royalty to all water users. Thus the services of the ground water royalty collection will be gradually transferred to the communes (to be implemented in the Program for Water Police System Enhancement)
- The study for the monitoring of the implementation, the revise of the tariffication and the implementation program

e. Establishment of the ground water resources management fund by the water royalty

The ground water management fund will be consisted of the royalty recovered by the users, the implementation budget of the ABHT and of the local communities (Region and Provinces), the government subsidy, the financial contribution of the private companies. The ABHT will ensure the secretariat of this fund. The fund will be mobilized for the community projects implementation in order to economize the water and conserve the water resources.

The principles of the implementation of this fund are as follows: a) the request made by the water users, b) the free loan for the continuity of the fund, c) the contribution of part of the

total project cost by applicant (beneficiary). By taking account of a number of recipients, the cost of each project will not have to exceed a certain amount defined by the ABHT. Also, taking account of public nature of the projects and these impacts, the recipients will have to be mainly the inhabitants' organizations, the associations or the cooperatives, the individual can not be the object of the project.

It will be possible to reach to the financial sources for the farmers who do not have the credit guarantees in order to install the drip irrigation system, because this ground water management fund do not require the guarantees for the project adoption.

Though a study for the establishment of the water resources management fund will be necessary for defining detailed procedures, general procedures of the implementation of this fund is envisaged as follows:

- A request of the project elaborated by the water users will be submitted to the ABHT;
- The ABHT will undertake a study on the spot. The technical feasibility study, the interview and the exchange with the recipients of the project, the project cost estimation, the repayment plan, the discussion with the local community (Commune) will be carried out. The projects will have to be contributed to the water saving or to the water resources conservation;
- The projects will be evaluated on the basis of the on-site study results (the justification);
- The projects proposed by the ABHT will be examined and approved by the administrative board of the ABHT (once a year);
- The approved projects will be financed and carried out;
- The ABHT will ensure the follow-up and the monitoring of the projects implementation and of the credit repayment.

5) Implementation schedule: as described in Table 5.5.1.

6) Effects of the Program

The royalty of the ground water management and its pricing will be examined and the text of application fixing the ground water royalty waters will be elaborated and published;

- The assent and the cooperation of the local authorities and the local communities will be obtained;
- The comprehension relating to the ground water management royalty will be obtained by the water users; the royalty will be collected gradually;
- The water resources management fund will be created on the basis of collected royalty and the projects requested by the water users concerning the water saving and the water resources conservation will be financed and implemented.

7) Follow up - Monitoring of the program

The program indicators are as follows:

- The elaborated and published texts of application relating to the ground water royalty and the pricing;
- The number of users which will accept and pay the ground water royalty, the collected amount, the water volume taken by the users category;
- The situation of creation of the water resources management fund, the number of the financed projects and the projects contents.

8) Cost Estimation: Total cost estimated 10.3 million DH, details shown in Table 5.4.15.

The items below are considered for the cost estimation of the project. On the other hand, the "Examination and consultation on rate of water royalty and collection method" will be carried out through normal works of ABHT, MATEE / SEE and will not be considered in the estimation.

a. Examination and consultation on the water pricing and the collecting modality
b. Explanations and information to the users and relevant organizations at the local level on the new water pricing

c. Development of the royalty collection system
d. Establishment of the ground water resources management fund by the water royalty

The cost estimation of the program based on the scale of the activities is as follows.

Item	Project Cost				Remarks
	Qtt.	Unit	Unit Price	Cost	
・Examination and consultation on the water pricing and the collecting modality					
Study for appropriate pricing of water royalty and system implementation	1	Set	1.33 MDH	1.33 MDH	Subcontract to consultants (6months)
Examination and consultation on rate of water royalty and collection method	1	Set	-	-	Normal works of ABHT
・Elaboration and proclamation of the texts of application related to the water pricing and the collection modality					
Examination and drafting of legal texts by external consultants	1	Set	-	-	Implemented through Program for Legal and Institutional Frameworks Improvement for Water Law Implementation
Preparation of legal texts to improve effectiveness of the water law	1	Set	-	-	Implemented through Program for Legal and Institutional Frameworks Improvement for Water Law Implementation
・Explanations and information to the users and relevant organizations at the local level on the new water pricing					
Seminars for stakeholders related to tourism and urban development	3	Year	0.10 MDH	0.30 MDH	Marrakech, 2 times / year for 3 years
Seminars for AUEA and farmers	6	Times	0.22 MDH	1.32 MDH	By CMV/CT, once every 2 years
Explanatory meetings for local authorities, and government	3	Year	0.30 MDH	0.90 MDH	By province / prefecture, 2 times / year for 3 years
Preparation and distribution of pamphlets on water royalty	50,000	Copies	50 DH	2.50 MDH	
・Development of the royalty collection system					
Installation of water meters to individual wells	1	Set	-	-	Burdened by well owner
Implementation of water police activities by ABHT	12	Year	-	-	Implemented through Program for Water Police System Enhancement
Implementation of water police activities by local authorities	7	Year	-	-	Implemented through Program for Water Police System Enhancement
Monitoring, review, improvement of water royalty and implementation plan	2	Set	1.33 MDH	2.66 MDH	Subcontract to consultants (2 times every 5 years, 6 months)
・Establishment of the ground water resources management fund by the water royalty	1	Set	1.33 MDH	1.33 MDH	Subcontract to consultants (6months)
Total	10.3 MDH				

5.4.6 Participatory Groundwater Management Plan

Taking account of the objectives quoted in the strategy for the participatory water resources management, the program components are as follows. These programs must be implemented mainly under the initiative of ABHT.

- Establishment of the consultation and the decision making framework on the water resources management by the stakeholders
- Activation and reinforcement of the implementation capacities of the Agricultural Water Users Associations (AUEA);
- Enlightenment and communication for the water saving and the water resources conservation

(1) Program for Formulation of Collaboration and Decision - Making Framework for Water Resources Management

1) Implementing agency:

ABHT is a principal organization for this program implementation in collaboration with the local communities, the governmental services and the private sectors.

2) Program Objective:

The participatory water resources management system is established

3) Program Goal:

Establishment of the framework of the consultation and decision- with participation of the concerned stakeholders

4) Outline of the Program

The use of the water resources in the Haouz plain is multiple and complex. Actors concerned with the water use and management such as the governmental services, the local communities, the irrigation associations, the farmers, the agro-industrial companies, the tourist sector, the research institutes, projects and ONG, also their participation degrees on the water resources management are much diversified. Indeed, for the sustainable management and the rational use of the water resources in the Haouz plain, all stakeholders concerning water will have to take part in the water management with its various aspects, in particular the framework installation for follow-up and monitoring of the water resources, the enlightenment activities for awareness-raising to water saving, the introduction or the reinforcement of the water users organizations and the dissemination of the water saving techniques.

Thus, to carry out the sustainable management and the rational use of the water resources with participation of various stakeholders, stakeholders themselves at the beginning have to clarify and recognize their role and responsibility for these resources management. Then, a mechanism to concert, to make the decision and to implement concrete actions of the water resources management should be established on the basis of the role and the responsibility of each stakeholder. The major activities to be carried out in this program are as follows.

a. Establishment of the Tensift Basin Committee

The Tensift Basin Committee is a consultation framework to examine and determine a global orientation of the water resources management of the Tensift basin together with the concerned actors. Indeed, a project of the circular note for the creation of the committee of basin is on going to preparation.

As the consultation framework of the Tensift basin included the Haouz plain, under the Committee of Basin, the Prefectural and Provincial Commission of Water (CPPE) and the Thematic Commissions will be established. On the one hand the Prefectural and Provincial Commission of Water (CPPE) will examine measurements of the water resources management with the local actors at the provincial level. In the other hand the Thematic Commissions will examine the transverse and technical important issues for the water resources management with the actors directly concerned.

The members of the Tensift Basin Committee will be fixed by joint decision of the Minister of Land Management, Water and Environment (MATEE) and the Minister of Interior, after opinions of the Minister of Agriculture, Rural Development and Martine Fishery, and the Minister of Finance and Privatization, and the High commissioner of Water and Forest and to combat against Desertification. The members will be envisaged in the following table.

The members of the Tensift Basin Committee (Project)

Administrative structures	Local Communities	Water users and socio-professional Associations, Private sectors, NGO
ABHT, ORMVAH, DPA (Marrakech and Chichaoua）, ONEP, RADEEMA, ONE, DREF, Urban Agency of Marrakech, DPE, Regional Delegation of the Plan, DRT and DPT, INRA	CRMTH, Provinces (Water Service), CPPE, Local Authorities, Communal Council Representation	AUEA, AEP, Agricultural Chamber, Commerce and Industry Chamber, CNCA, Associations for the development, NGO

The principal roles and attributions of the Tensift Basin Committee are envisaged as follows:

- To establish a consultation framework of the water resources management in the Haouz plain with the participation of all stakeholders;
- To clarify the responsibility and the role of the stakeholders;
- To share and diffuse the information on the water resources situation;
- To examine and approve the proposals elaborated by the thematic commissions;
- To examine and approve the adequate necessary countermeasures for the management and the control of the water resources;
- To examine the pricing and the water royalty collection;
- To concert, examine, approve and sign the agreement of the ground water management (contract de nappe);
- To support the CPPE in order to promote the local water resources management;
- To formulate a report on the project of the Master Plan of the Integrated Water Resources Development (PDAIRE) before its tender to the governmental authorities concerned with the water management;
- To examine the texts of application taking account of the regional specificity for the management and the use of the water resources and to propose to the government (particularly the water police, the pricing and the royalty collection, the water quality standards and the determination of the prohibited zone of water intake).

The Tensift Basin Committee will be chaired by the Wali of the Marrakech-Tensift-Al Haouz Region; it will meet by the convocation of its president and at least once all two (2) years. The secretariat of the Committee will be ensured by the ABHT.

b. Establishment of the Thematic Commissions

The Thematic Commissions are established in order to examine the important issues on the water resources with the actors directly concerned.

The compositions and principal roles of Thematic Commissions proposed are as follows

Thematic commissions	Envisaged members of commissions	Roles and activities of commissions
Reinforcement of the local system of the water resources management	ABHT, CRMTH, Willaya/MHT, Provinces, Local authorities, Communal Councils, ORMVAH、DPA、ONEP	・To examine the consultation mechanism of the concerned actors ; ・To examine a system of the integrated water resources management at the local level (Provincial and Communal); ・To examine the role, the TOR and the composition of Prefectural and Provincial Commissions of Water; ・To examine the capitalization and the diffusion of information of the water resources (establishment of an information system of the water resources); ・To examine a periodic monitoring and follow-up/evaluation system of the water resources (hydraulic stations on the sub-basin level, measurement stations of the seguia in the PMH) ・To examine the establishment of a measurement system for groundwater extraction (piezometric data, Intake water volume by volumeters installation with the large consumers, in particular); ・To examine the implementation modality of the Water Police and the responsibility/role for each part concerned; ・Examination of measures for the registration of unregistered wells.
Valorization of water in the agricultural sector	ORMVAH, DPA, ABHT, AUEA, Agricultural Chamber , CNCA, INRA	・To examine the strategy for the generalization and conversion of the drip irrigation system (simplification of a system of the subsidy procedure, diffusion method etc); ・To examine the varieties and the farming techniques which are more draught-resistant and high economical values
Water saving in the tourist and urban sectors	Chamber of Commerce and Industry, Tourist board, ABHT, Marrakech City Corporation, CRMTH, Provinces, ONEP, RADEEMA	・To examine the strategy and the approaches for the water saving in the tourist sector (Golf, Hotel etc); ・To examine the strategy and the approaches for the water saving in the green spaces, the parks and the habitats
Water quality preservation	ABHT, ONEP, RADEEMA, Chamber of Commerce and Industry, Tourist board	・To examine follow-up-monitoring methodology for water quality; ・To follow-up periodic the study on the water quality, analyze the results, elaborate the report on the water quality and propose the measures to be taken; ・To examine and propose the specific standards of the water quality and the public health; ・To examine the program of the sewage water recycling
Education / communication for water resources management and water saving	ABHT, ONEP, CRMHT, Willaya / MHT, Provinces	・To elaborate a Plan of enlightenment and communication of the integrated water resources management; ・To elaborate the tools and the supports of communication for the water saving and the integrated water resources management (Presses, Articles in the newspapers and magazines, Posters, Booklets, Stickers, Spots, Web site, Radio, TV transmissions etc); ・To elaborate a program of the school establishments on the water resources management (schools, colleges etc); ・To examine the implementation approach for the information and the enlightenment campaign on the integrated water resources management to general public; ・To conceptualize and prepare the manuals on the water saving techniques (Irrigation, tourism, industry, domestic)

The thematic commissions will examine the ground water management in the Haouz plain, but they will also examine on the water resources management to the whole of the Tensift basin within the framework of the implementation of the Master Plan of Integrated Development of the Water Resources (PDAIRE).

c. Constitution of the water management system at the provincial level by the enhancement of the Prefectural and Provincial Commissions of Water (CPPE)

For the establishment and the enhancement of the CPPE, the composition of the Commission, the term of reference and the attribution of the CPPE, the organization method and the discussion topic will have to be examined by taking account of the reality of each province.

The CPPE composition envisaged by the Water Law and the Decree No 2-97-488 of Feb 4, 1998

Administrative structures (6 members)	Representations of the Local governments (7 members)
Provincial Direction of Equipment (DPE), DPA, ONEP, ONE, ABHT, ORMVAH	President of the prefectural and provincial assembly, Chamber of Agriculture, Chamber of Commerce and Industry, 3 Representations of the Commune Councils, Representation of the ethnic community

The total number of the CPPE member is limited by the Water Law to 14. The number of the representatives of the communal councils is limited and the representatives of water users like the AUEA and drinking water associations are not included. The role and the attribution of CPPE are not clearly given. Thus it is necessary to examine the composition and the precise term of references of the CPPE.

The ABHT will examine the composition and the function of the CPPE and will propose its organization to the governors of the province. The governors will convene the members and will organize the CPPE following the proposal of the ABHT.

The CPPE will be chaired by the governors of the provinces and will meet four (4) times per year (each quarter). The ABHT will ensure the secretariat of the CPPE and the follow-up of the execution. The minutes of meeting of the CPPE will be elaborated and distributed to the participants. The results of CPPE will be diffused to the public by the Web site of the ABHT.

d. Competences transfer of the water resources management at the communal level

The establishment of the water resources management system at the communal level which is a series of activities quoted below will have to be approached in the mid-and long-terms. The actions of the establishment of the water management system and the capacities reinforcement of the communal actors will be envisaged.

- To examine and prepare for the creation of the communal committees of the water management (analysis of competences of the communes, the composition, the role and attribution, the execution budget and the legislative text necessary for the establishment of committees)
- To create the communal committees of the water management;
- To organize the planning workshops to the committee members and the communal council, the water users organizations (AUEA, AEP), the associations of development;
- To elaborate the communal plan of the water resources management and development;
- To organize the formations of the water management to the actors (the organizational and financial management, the activities planning, the techniques of the management and the maintenance of the hydraulic equipment, the irrigation technique for saving water, the monitoring and the control of the illicit water use by the water police).

5) Implementation schedule: as described in Table 5.5.1.

6) Effects of the Program

- Information on the water resources situation is shared and the conscience to the sustainable water resources management are developed by all the stakeholders;
- The concrete activities of the water resources management on the basis of consultation of the stakeholders are planned and carried out;
- The activities of the water resources management are followed and evaluated by the stakeholders.

7) Follow up - Monitoring of the program

The organization of the Committee of Tensift Basin, the thematic commissions and the Prefectural and Provincial Commissions of Water, official reports of each committee and commission, the situation of the activities implementation of the programs and the information diffusion.

8) Cost Estimation:

The items below are considered for the cost estimation of the program.

a. Establishment of the Tensift Basin Committee
b. Establishment of the Thematic Commissions
c. Constitution of the water management system at the provincial level by the enhancement of the Prefectural and Provincial Commissions of Water (CPPE)
d. Competences transfer of the water resources management at the communal level

The cost estimation of the program based on the scale of the activities is as follows.

Item	Program Cost				Remarks
	Qtt.	Unit	Unit Price	Cost	
・Establishment of the Tensift Basin Committee	6	Times	50,000 DH	0.30 MDH	Once every 2 years, 6 times until 2020
・Establishment of the Thematic Commissions	13	Year	60,000 DH	0.78 MDH	5 commissions / 2 months, including preparation of reports
・Constitution of the water management system at the provincial level by the enhancement of the Prefectural and Provincial Commissions of Water (CPPE)	12	Year	120,000 DH	1.44 MDH	3 provinces, 4 times / year
・Competences transfer of the water resources management at the communal level					
Establishment of communal committees of the water management	9	Year	348,000 DH	3.13 MDH	87 communes, 4 times / year
Transfer of partial competences to communal committees of the water management	3	Times	450,000 DH	1.35 MDH	Workshops (held in 5 sub-basins, 3times until the year 2020)
Total	7.0 MDH				

(2) Program for Activation and Capacity Development of Water Users Association

1) Implementing agency: ORMVAH, DPA of Marrakech and Chichoua

2) Program Objective:

Realization of the management and the allocation of water resources by the water user's organization

3) Program Goal:

Capacities Reinforcement of the water management by the training of management and technique

4) Outline of the program

Major roles of Agricultural Water Users Associations (AUEAs) include the distribution of irrigation water and operation and maintenance of agricultural water use facilities. In regard that irrigation water counts up to 93% of the water consumption in the Haouz plain, the function of AUEAs have a significant potential in water resources management. On the other hand, many of the AUEAs are not actively functioning in water resources management due to institutional issues.

Activation of AUEAs, which are the main actors for irrigation agriculture will contribute in fair distribution of irrigation water, strengthen the capacity of water resources management at the end-user level, and will also contribute in formulating a recipient body for the introduction of water saving techniques and educational campaigns.

The actions of the reinforcement of the organizational and technical capacities of the AUEA which are the principal actors of agricultural irrigation are as follows:

a. Trainings to the executive committee members of the AUEA for the reinforcement of organizational and financial management capacities

   A series of trainings on organizational and financial management to the executive committee members of the AUEA will be organized.

   - Training for the organization: the function of the AUEA, the roles and attributions of the executive committee members, the method of the information diffusion to the members, the conflict control between the members, the relationship with the concerned organisms of the AUEA activities;
   - Training for the financial management: A theoretical and practical training for the treasurers and the president of the AUEA. elaboration of the account book, method of fund management, the collecting of the contribution, the regular financial report to the members;
   - Training for the management and maintenance techniques of the hydro-agricultural equipments: maintenance of the channels and the seguias, the allocation of the management tasks with the OMVAH and DPA, the method of the irrigation water distribution, water quality control, exhaustive observation of the regulation on the wells digging and with the intake water volume.

b. Financial capacities reinforcement of the AUEA by the contributions of members

   The result of the investigation to the AUEA and the farmers carried out within the framework of the study shows that more half of the AUEA does not pay the contribution. Even the majority of the AUEA which are paid have the unpaid constraints or the difficulties of the delay of contributions payment. The lack of unique and own financial source is one of the major causes of the weakness of the AUEA.

   To raise the motivation of contributions payment by the members of the AUEA, the improvement of the transparency of financial management by the periodic financial report and the elaboration of the investment plan for the activities of the AUEA to the profit of the members will be promoted. The development of the financial resource allowing the AUEA activities by the member’s financial participation through the regular contribution will have to be reinforced. These activities will be undertaken by the guidance of the ORMVAH and DPA.

c. Improvement of the information diffusion system by the organization of general assembly of the AUEA

   More than half of the AUEA do not organize their general assemblies periodically and by consequence their organizations become weak. Also the information given by the OMVAH and DPA to the AUEA through their presidents or the committee members seldom passes to the AUEA members. The improvement of information and the communication and also the enhancement of the AUEA activity will be reinforced by the support to the periodic

organization of the general assembly. Also the communication system of information on the agricultural technique and the water resources management to the AUEA and the farmers will be improved. For example, the installation of the display panels at the CNV or the Center of Technique (CT) could be considered. These activities will be undertaken by the ORMVAH and the DPA.

d. Relationship reinforcement with the ORMVAH and the DPAs

The ORMVAH organizes the periodic meetings with the AUEA since 2007; these meetings make it possible the AUEA to disseminate information and to exchange on the important topics of the water management. The relation between the AUEA and the leading organizations will have to be reinforced by the regular consultation of the two parts.

e. Training for the agricultural techniques in order to save the water (drip irrigation, varieties draught resistant)

The training workshops on the agricultural techniques aiming at the water saving of irrigation to the profit of the AUEA members will be organized. The envisaged topics are as follows:

- The current situation of the water resources and the necessary countermeasures;
- The promotion of the drip irrigation system development;
- The knowledge obtaining on the Water Law and its texts of application;
- The presentation of the drip irrigation technique (the advantage, the installation and the necessary cost, procedure of subsidy granting etc);
- The farming technique by the drip irrigation, economic and technical advantage;
- The presentation of the draught resistant species/varieties (fodder Sorghum, Atriplex, Cactus)

f. Exchange with the advanced AUEA on the saving water activities

The study trips in order to visit the practiced sites of drip irrigation and exchange with the advanced AUEA in the irrigation water saving will be organized in the area which is largely practiced the drip irrigation for the executive committee members of the AUEA. The Souss-Massa region could be planned to undertake these activities.

g. Financial support to the AUEA for the realization of the agricultural activities saving water

The actions of the financial capacities reinforcement of the AUEA will have to be carried out so that they can realize the saving agricultural water.

- The creation of the water resources management fund to guarantee the conversion of the drip irrigation system (within the framework of the program of adequate pricing and the effective water royalty collection);
- The support of credit obtaining to the AUEA in order to ensure the management and the maintenance of the hydro-agricultural equipments (special countermeasures for the farmers which do not have the guarantees, the implementation of projects financed by ABHT/ORMVAH/DPA etc);
- Information diffusion on the financial organizations such as the Agency of Social Development (ADS) and the associations of microfinance.

5) Implementation schedule: as described in Table 5.5.1.

6) Program impacts

- The capacity of management of the organization and the hydro-agricultural equipments of the AUEA will be reinforced by the trainings on organizational, financial and technical management;
- The number of the farmers introducing the drip irrigation system will be increased by the actions of popularization of technique for the water saving;
- The management and the maintenance of the hydro-agricultural equipments will be ensured by the financial resources reinforcement of the AUEA.

7) Follow up-Monitoring of the program

- The organization of the general assemblies and the executive committee meetings (Minutes of meeting, list of the participants), financial Reports of the AUEA;
- The situation of the management and the maintenance of the hydro-agricultural equipments, the situation of irrigation water distribution;
- The number of the farmers introducing the drip irrigation system.

8) Cost Estimation:

The items below are considered for the cost estimation of the program. On the other hand, "Financial capacities reinforcement of the AUEA by the contributions of members", "Improvement of the information diffusion system by the organization of general assembly of the AUEA", and "Financial support to the AUEA for the realization of the agricultural activities saving water", which are the expected function of AUEAs, and "Relationship reinforcement with the ORMVAH and the DPAs", which is to be done through regular works of ORMVAH and DPAs are not included in the cost estimation.

a. Trainings to the executive committee members of the AUEA for the reinforcement of organizational and financial management capacities
b. Training for the agricultural techniques in order to save the water (drip irrigation, varieties draught resistant)
c. Exchange with the advanced AUEA on the saving water activities

The cost estimation of the program based on the scale of the activities is as follows.

Item	Program Cost				Remarks
	Qtt.	Unit	Unit Price	Cost	
・Trainings to the executive committee members of the AUEA for the reinforcement of organizational and financial management capacities	6	Times	0.132 MDH	0.79 MDH	Hold trainings by CMV (18) / CT (4), 3 days / training course every 2 years
・Financial capacities reinforcement of the AUEA by the contributions of members	13	Year	-	-	Normal works of ORMVAH / DPA
・Improvement of the information diffusion system by the organization of general assembly of the AUEA	13	Year	-	-	Normal works of ORMVAH / DPA
・Relationship reinforcement with the ORMVAH and the DPAs	13	Year	-	-	Normal works of ORMVAH / DPA
・Training for the agricultural techniques in order to save the water (drip irrigation, varieties draught resistant)	6	Times	0.132 MDH	0.79 MDH	Hold trainings by CMV (18) / CT (4), 3 days / training course every 2 years
・Exchange with the advanced AUEA on the saving water activities	3	Times	0.148 MDH	0.44 MDH	16 AUEAs (10AUEAs from ORMVAH area and 6 AUEAs from the 2 DPAs), 3 persons / AUEA for 3 days, every 4 years
・Financial support to the AUEA for the realization of the agricultural activities saving water	12	Year	-	-	Normal works of ORMVAH / DPA
Total	2.0 MDH				

(3) Program for Public Awareness on Water Saving and Conservation

1) Implementing agency:

ABHT is a principal organization for this program implementation in collaboration with the concerned stakeholders of the water resources management in the Haouz plain such as the local communities (region and provinces), the governmental services and the private sectors.

2) Program Objective:

Development of the consciences of the water users for the sustainable management and use of the water resources

3) Program Goal:

Implementation of the publicity campaigns on the water saving and the water resources protection to the various stakeholders

4) Outline of the program

The saving water and the water management campaign have been implemented by the concerned structures especially in the agriculture and tourism sectors, but each executes individually as a function of their competence particularly finance capacity. Thus, results of the campaigns haven't been satisfied because impacts to water users have been little significant. The activities of the enlightenment for the saving water and the water resources conservation must be preceded strategically to the multiple concerned stakeholders.

The target stakeholders to the enlightenment actions are multiple such as local authorities, local collectivities, traditional organs, private companies, tourism sector, irrigation associations, farmers and citizens, and their participation to the water management and use are different. It is possible to pass message on the importance of the saving water and the water resources conservation through the enlightenment activities for the resources management considering the diversity of the stakeholders by the multiple mean of the communication and media. The major activities to be carried out in this program are as follows.

a. Elaboration of the plan for enlightenment and communication

The plan for enlightenment and communication on the water saving and the water resources conservation will be elaborated by the ABHT and the thematic commission. The following points will have to be considered for the development of the plan for enlightenment and communication.

- Identification of the necessary enlightenment activities according to target stakeholders;
- Identification of the implementation bodies according to the target activities and actors;
- Approach and modality of the implementation;
- The costs estimation for the implementation of the enlightenment and communication activities and the budgetary allocation by the concerned organizations;
- Methods of the follow-up and the evaluation and indicators of the follow-up.

The plan of enlightenment and communication will be revised at each three (3) years according to the evolution of the user's consciences on the water use and the advance of the enlightenment activities.

b. Implementation of the enlightenment and the communication activities on the water resources management

The activities of enlightenment and communication for the water saving and the water resources conservation are summarized as follows:

The activities of enlightenment and communication

Activities/Themes	Targets	Concerned organizations	Activity contents
Obtaining comprehension to local authorities, local governments and traditional organizations on water resources management	Local authorities Local governments (Provinces, Communes) Organizations traditional (Mouquadam, Chieikh)	Region, Provinces, Communes	・Explanations on the water resources situation and the envisaged scenarios; ・Explanation on the necessary countermeasures and the activities concerning the water resources management and discussions for obtaining the comprehension and the cooperation.
Promotion of the water saving agricultural	Irrigation associations (AUEA), Farmers	ORMVAH, DPA (Marrakech and Chichaoua), Provinces, Communes, Chamber of Agriculture, Bank establishments, CNCA	・Creation of the periodic consultation framework with the AUEA and the farmers; ・Elaboration of the booklets on the drip irrigation technique and the culture; ・Presentation of the water saving techniques at the Souk and the agricultural Forums; ・Examination of alternative countermeasures for the farmers who do not have access to the credit (Creation of the funds, Microfinance etc); ・Visit and exchanges with the advanced farmers concerning the water saving technique.
Prevention of the digging wells and the illicit water intaking of the wells			・Organization of the meetings with the AUEA and the farmers on the procedure of the well digging and water intaking authorization; ・Elaboration and distribution of the booklets on the authorization procedure.
Information on the law and the regulation related to water	Private companies, Farmers, Tourist sector, Local communities	Region, Provinces, Communes, ORMVAH, DPA (Marrakech and Chichaoua)	・Elaboration and distribution of the booklets related to the Water Law; ・Organization of the seminars of the Water Law recognition to the AUEA and the farmers
Explication and information to the water users related to the ground water royalty	Irrigation associations (AUEA), Farmers, Golf, Hotels, Tourist complexes, others big water consumers	Region, Provinces, Communes, ORMVAH, DPA (Marrakech and Chichaoua), DRT, CRT, Urban Agency	・Elaboration and distribution of the booklets related to the royalty and the pricing; ・Organization of the meetings with the local authorities and local communities on the water royalty and the pricing ・Organization of the meetings with the actors of the tourism and urban development domain; ・Organization of the meetings with the AUEA and the farmers; ・Publicities by the media means
Water consumption control in the hotel and the tourist complexes	Hotels, Golf, Tourist complexes, Tourists	Hotel Association, DRT, CRT	・Elaboration, distribution and notice of the stickers and the posters related to the water saving; ・Presentation of the water saving techniques and technologies (Sewage water recycling, watering technique for gardens etc)
Utilization of the recycled Sewage water for watering of golf courses	Hotels, Golf, Tourist complexes, Tourists	ORMVAH, RADEEMA, Provinces	・Organization of the meetings with the golf on the sewage water treatment by the RADEEMA
Water resources management and conservation to the school education	Primary and secondary schools, High schools, Region of MTH, Communes	Provincial Delegation of the Education, Schools	・Development of the education programs and the teaching equipments relating to the water management and the water saving; ・Training to the teachers on the knowledge of the water resources management; ・Organization of visit of the sewage water treatment stations and the refuse disposal facilities.

Activities/Themes	Targets	Concerned organizations	Activity contents
Elaboration and posting of the placards on the water resources management and the water saving	Citizen of the MTH region, Administrative structures, Public establishments	Regions, Provinces	・Distribution and post at the administrative structures, public establishments, public places, hotels, tourist complexes etc
Contest of the water management and the water saving	Citizen of the MTH region, Administrative structures, Public establishments, Private companies	Regions, Provinces, Chamber of Agriculture, Chamber of Commerce and Industry	・Granting of premium of the users, organizations and companies which carry out the activities of the water saving and the water conservation in the agricultural, tourism and urban development domains, Presentation their activities to the public
Saving water enlightenment at the mosques	Citizen of the MTH region	Regional Delegation of the Islamic and Habous	・Enlightenment on the importance of the water resources, drip irrigation, the Water Law after the prayer
Mass media promotion on the water resources management and the water saving	Citizen of the MTH region	Regions, Provinces	・Conception and diffusion of the radio transmission on the water resources management
		Regions, Provinces	・Elaboration and diffusion of the TV spots, Documentary film on the water resources management
		Regions, Provinces	・Articles Publication relating to the water resources management on the newspapers and magazines, Advertisements advertising
		ABHT	・Information diffusion by the Web site on the water resources management

5) Implementation schedule: as described in Table 5.5.1.

6) Program impacts

- The consciences of the water users on the water saving and the water resources conservation will be developed by the publicity campaigns;
- The activities of the water saving by the stakeholders will be undertaken actively by the enlightenment and communication activities.

7) Follow up-Monitoring of the program

The number of the organization of the campaign of the water saving and the water resources conservation, the implementation situation of the enlightenment activities, activity reports of each concerned structures, tools and medias prepared for the enlightenment activities, the results of the investigation and the interview after the enlightenment activities.

8) Cost Estimation:

The items below are considered for the cost estimation of the program.

a. Elaboration of the plan for enlightenment and communication
b. Implementation of the enlightenment and the communication activities on the water resources management

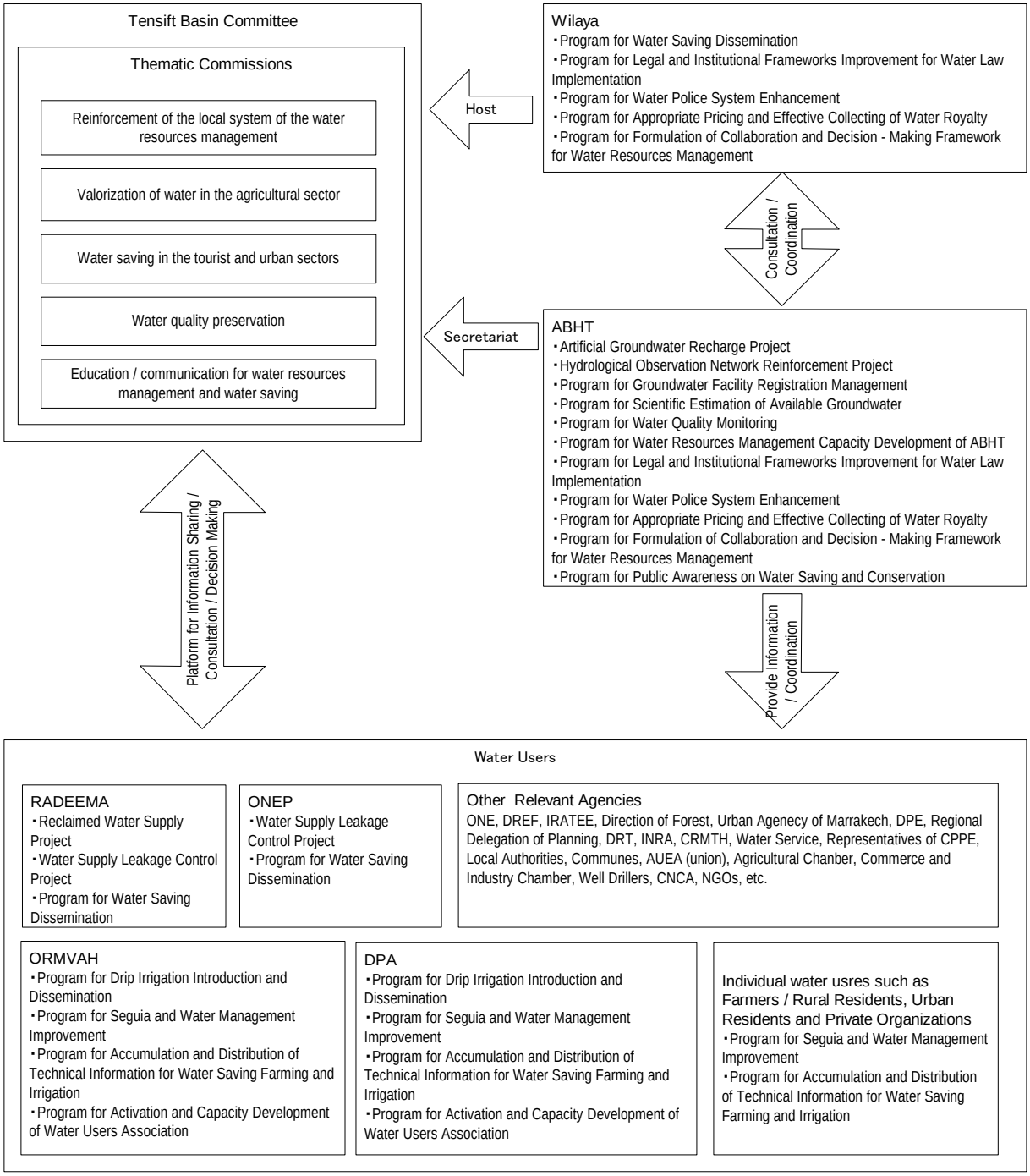
The cost estimation of the program based on the scale of the activities is as follows.

Item	Program Cost				Remarks
	Qtt.	Unit	Unit Price	Cost	
・Elaboration of the plan for enlightenment and communication	1	Set	1.00 MDH	1.00 MDH	Subcontract, with close coordination with relevant agencies
・Implementation of the enlightenment and the communication activities on the water resources management	1	Set			
Obtaining comprehension to local authorities, local governments and traditional organizations on water resources management	1	Set	2.10 MDH	2.10 MDH	Seminars (by province, 2 times /year for 2 years) and preparation / distribution of pamphlets
Promotion of the water saving agricultural	1	Set	7.07 MDH	7.07 MDH	Preparation of pamphlets for drip / water saving irrigation, seminars for farmers and AUEAs (every 2 years), exhibition of water saving technologies at trade fairs etc. (approx. 5 times / year)
Prevention of the digging wells and the illicit water extraction	1	Set	3.82 MDH	3.82 MDH	Explanatory meetings on procedures for well digging / groundwater extraction permits (every 2 years), preparation and distribution of pamphlets on well digging / groundwater extraction permits
Information on the law and the regulation related to water	1	Set	-	-	To be implemented in the Program for Legal and Institutional Frameworks Improvement for Water Law Implementation
Explication and information to the water users related to the ground water royalty	1	Set	-	-	To be implemented in the Program for Appropriate Pricing and Effective Collecting of Water Royalty
Water consumption control in the hotel and the tourist complexes	1	Set	3.55 MDH	3.55 MDH	Preparation and posting of posters / stickers for water saving, seminars for water saving targeting hotels and resort facilities (every 2 years)
Utilization of the recycled Sewage water for watering of golf courses	1	Set	0.15 MDH	0.15 MDH	Explanatory meetings for usage of treated waste water targeting golf courses (in coordination with RADEEMA, every 3 years)
Water resources management and conservation to the school education	1	Set	4.83 MDH	4.83 MDH	Preparation of curriculum and material for school education regarding water saving and management (outsourcing), seminar/ training for school teachers and administration (4 for each province, every 3 years)
Elaboration and posting of the placards on the water resources management and the water saving	1	Set	3.00 MDH	3.00 MDH	Preparation and posting of posters for water management and water saving in public space / organizations
Contest of the water management and the water saving	1	Set	6.00 MDH	6.00 MDH	Every 2 years
Saving water enlightenment at the mosques	1	Set	0.60 MDH	0.60 MDH	Seminar targeting staff under the Ministry of Habous and Islamic Affaires (once / year)
Mass media promotion on the water resources management and the water saving	1	Set	9.40 MDH	9.40 MDH	Programs on water management and saving on local radio stations (once / week), production and broadcasting of TV spots and documentary programs, advertisements on tourist pamphlets, magazines and newspapers.
Total	41.5 MDH				

5.5 Implementation of Integrated Groundwater Management Master Plan

5.5.1 Institutional Arrangement of the Master Plan Implementation

The strategies of the integrated groundwater management master plan aim to allocate the limited water resources fairly and effectively and to make water use sustainable keeping supply and demand in balance in the Haouz Plain. In order to implement securely the strategies as already described with the basic concept, it is indispensable that the implementation framework clarifies the responsibility of the organization as shown in the figure below. ABHT will naturally take a leading part and additionally the understanding and cooperation with the other related organizations should be essential to achieve the plan.



Implementation Structure of the Integrated Groundwater Management Master Plan

5.5.2 Schedule of the Master Plan Implementation

The detailed schedule of the projects / programs proposed in the Master Plan is shown in Table 5.5.1.

5.5.3 Costs of the Master Plan

(1) Basic policy for the cost estimations of the project

1) Unit cost

The unit costs used for cost estimation of the individual Projects / Programs of the Master Plan on Integrated Water resources Management are basically based on the information and documents collected from the relevant agencies. These unit prices are aforementioned in the description of individual Projects / Programs. Some basic unit prices in the Study Area are listed below.

Basic unit prices in the Study Area

Item	Unit	Price (DH)
Personnel		
Engineer	Day	800
Assistant Engineer	Day	250
Labor	Day	70
Construction Material		
Cement	50kg	70
Sand	m^3	160
Ballast	m^3	110
Gravel	m^3	60
Crushed Rocks	m^3	80
Iron frame	Ton	13,000
RC	m^3	1,200 - 1,500
Construction Cost		
Excavation (Machine)	m^3	30 - 50
Excavation (Man)	m^3	120
Embankment	m^3	30
Filling	m^3	25
Gabion	m^3	500
Others		
Gasoline	Liter	9.24
Diesel	Liter	7.33

Source: Based on interviews by the Study Team

2) Foreign currency exchange

The cost estimates in this study are based on the prices levels indicated below and expressed in Moroccan Dirham according to the following exchange rates:

US$1.00=DH8.059794=JPY124.24 1.00DH = 15.41yen

(2) Cost for the Master Plan

Each project cost of programs / projects of the Master Plan are summarized in the following. Breakdown of the cost is shown in Table 5.5.2.

Project Cost of Programs / Projects

Plan Field	Title of Programs / Projects	Execution Agency	Project Cost (MDH)
Surface water sources development and management	Artificial Groundwater Recharge Project	ABHT	106.0
	Reclaimed Water Supply Project	RADEEMA	636.5
	Hydrological Observation Network Reinforcement Project	ABHT	3.0
Groundwater management	Program for Groundwater Facility Registration Management	ABHT	5.7
	Program for Scientific Estimation of Available Groundwater	ABHT	18.2
Water quality management	Program for Water Quality Monitoring	ABHT,	44.5
Water demand reduction	Program for Drip Irrigation Introduction and Dissemination	ORMVAH, DPA, ABHT	2,715.0
	Program for Seguia and Water Management Improvement	Water Users Association, ORMVAH, DPA	2.0
	Program for Accumulation and Distribution of Technical Information for Water Saving Farming and Irrigation	ORMVAH, DPA, INRI	19.5
	Water Supply Leakage Control Project	RADEEMA, ONEP	403.0
	Program for Water Saving Dissemination	RADEEMA, ONEP, Willaya	31.0
Organizational and institutional improvement	Program for Water Resources Management Capacity Development of ABHT	ABHT	5.0
	Program for Legal and Institutional Frameworks Improvement for Water Law Implementation	ABHT	6.5
	Program for Water Police System Enhancement	ABHT	29.6
	Program for Appropriate Pricing and Effective Collecting of Water Royalty	ABHT	10.3
Participatory integrated water resources management	Program for Formulation of Collaboration and Decision - Making Framework for Water Resources Management	ABHT	7.0
	Program for Activation and Capacity Development of Water Users Association	ORMVAH, DPA	2.0
	Program for Public Awareness on Water Saving and Conservation	ABHT	41.5
Total	Whole Master Plan	Whole Related Agencies	4,086.3
Sub-total	Programs / Projects of ABHT	ABHT	277.3

5.6 Evaluation of the Master Plan

5.6.1 Basic Concepts of the Evaluation

The main purpose of the Master Plan is to realize the appropriate management of the groundwater which is necessary to guarantee continuously and stably the utilization of the water resources on the inhabitant's life and the agricultural production, in consideration of supply and demand of the groundwater in the Haouz plain. In other words, the most efficient method for the water resources development is not looked for; the appropriate use of the limited water resources in the Haouz plain is considered. Particularly, considering the exhaustion of the groundwater symbolized by the fall of the groundwater level, the water resources which have been not managed suitably so far are analyzed; the principal object is put on the water balance, and the most suitable improving measures are groping. This is to say, the Master Plan is not a plan to find effect and efficiency on the investments for purpose of economic growth or economic returns.

Hence, the focus of the project evaluation becomes mainly to the contribution for the improvement of the water balance through the new water resources development and the water demand reduction (effect on saving water) by the appropriate technology. Main indexes are considered the fall of the groundwater level and the amount of saving water. The Master Plan is composed of the followings: 1) New water resources development and surface water management plan, 2) Groundwater management plan, 3) Water quality management plan, 4) Water demand reduction plan, 5) Reinforcement plan of organization and institution, and 6) Participatory water resources management plan. From the

viewpoint of the economic evaluation, the economical contribution from the improvement of the water balance by the implementation of the Master Plan is analyzed. And, from the viewpoint of the financial evaluation, the financial validity of the irrigation farmer which is the biggest stakeholder is also analyzed. Furthermore, the approval possibility of the Master Plan by stakeholders and the implementing ability of the executive agencies become important, too. This is to say, by the implementation of the Master Plan, the realistic execution possibility and economic validity are analyzed with possibility of the achievement of the appropriate water resources management and the sustainable utilization of the groundwater. In other words, the implementation of the Master Plan is analyzed quantitatively and qualitatively how much it contributes to the achievement of the object of the Master Plan and what kind of impact to the socio-economy in the project evaluation.

5.6.2 Methodology and Conditions of the Evaluation

The methodology of the evaluation for the Master Plan is as follows:

a. The quantitative evaluation is analyzed for the whole Master Plan and for the individual programs / projects. All cost of each program / project is considered as execution cost, but in the case of benefit, the tangible benefits generated by the agricultural sector projects which are the largest water user, and those generated from the tourism sector are estimated.
b. The economic effects are analyzed for the whole Master Plan in case that the programs / projects will be executed as an integral plan.
c. Burden Ability of Farmers are analyzed for the Program for Drip Irrigation Introduction and Dissemination
d. The financial ability capacity of ABHT is analyzed as the implementation capacity of the executing agency.
e. Economic contribution is evaluated for major projects

The conditions for the project evaluation are as follows:

a. The period for evaluation will be 13 years, which is the period from the beginning of implementation to the target year of the Master Plan.
b. The currency used for the estimation is the Moroccan Dirham (DH).
c. The foreign exchange rate used is US$ 1.00 = DH 8.059794, which was the exchange rate of the Bank for Foreign Trade on May 28, 2007.
d. For the prices of agricultural production input and of construction materials for projects are used for the prices of delivery prices at the production and construction sites.

5.6.3 Project Benefits

The beneficiaries by the realization of the appropriate management of the groundwater as the main object of the Master Plan which is necessary to guarantee continuously and stably the utilization of the water resources on the inhabitant's life and the agricultural production, are city inhabitants, regional industry including the tourism sector, agricultural producer, etc. But, the relations between the fall of the groundwater level or the amount of saving water and the influences on the regional industry are very complicate and it can not be calculated clearly. In other words, the relations between the supply amount of the water resources and the economic development are greatly different by each industrial activity, and it can not be simplified like a case of the drinking water. The project benefit by the implementation of the Master Plan is not just in proportion of the water volume to guarantee, it influences the regional socio-economy as secondary effects. Especially, the effects on the tourism sector and the processing industries which support the regional economy are complicated, and it is difficult to estimate quantitatively the benefits by the implementation of the Master Plan.

Moreover, the project benefits consist of tangible benefits (monetary benefits) and intangible benefits (non-monetary benefits). Therefore, the tangible benefits which can be estimated are analyzed quantitatively in the possible range with the economic evaluation and the financial evaluation for the agricultural sector which consumes most of the water resources and tourism sector. The intangible benefits are analyzed qualitatively for the socio-economic effects.

The tangible benefits of the agriculture sector derived by the implementation of the Master Plan refer

to the difference of economic loss expected between with-project (Scenario of Major Actions) condition and without-project (Scenario of Continuation) condition through the whole period of the Master Plan. In other words, because of the implementation of the Master Plan, it is understood the decrease of economic loss. It is calculated by average depth of the groundwater table, dried out aquifer surface, number of dried out boreholes and number of unemployed persons (it is economized applying the minimum wage of the agriculture sector.) when are appraised on the consideration of the scenarios. Naturally, the other directly or indirect benefits (intangible benefits) are existed, but it make represent with the aforementioned tangible benefits.

The indexes to quantize the economic loss and tangible benefits are as follows:

Economic Loss and Project Benefit (MDH)

Item	Indexes	Without Project	With Project	Project Benefit
Fall of the groundwater level (/1,000 m^3)	0.0025	4,673	1,998	2,675
Dried out aquifer surface (/ha)	0.049	448	177	271
Dried out borehole (/well)	0.140	253	40	213
Unemployed person (/ha) (/person)	0.473 0.027	116	46	70
Total		5,490	2,261	3,229

Source: Reference to 4.8.5

The difference (Project Benefit) between with project and without project conditions is estimated 3,229 MDH for the whole project period.

On the other hand, the tangible benefit from the tourism sector can be estimated as follows:

According to the World Travel & Tourism Council (WTTC), tourism industry of Morocco in 2007 is expected to generate USD 13,767.6 million of economic effects (total demand). Morocco's tourism economy (direct and indirect impact) in 2007 is expected to account for 17.9% of GDP and 15.5% of total employment. This sector is expected to grow 4.0% in 2007 and by 4.0% per annum, in real terms, between 2008 and 2017. On the other hand, the truism sector of Marrakech region occupied 35% of all country by the tourist night number of hotels in 2006, and contributes largely to the regional economy. Appling the same ratio, the 2007 economic effect of the tourism sector in the Marrakech region is estimated approximately USD 4.8 billion (38.7 billion DH).

The Master Plan considers the distribution of water for domestic use of tourists, service water for hotels and restaurants, water used in swimming pools and leisure facilities, irrigation water for gardens and golf courses, water for tourism related industries, and will not hamper the growth of the tourism sector, of which the government attaches priority. Thus the distribution of water will not largely impact the trend of the growing tourism sector in Marrakech. On the other hand, through it is obvious that securing water for the tourism sector has a large effect on the growth of the sector; it is difficult to quantify the contribution of water to economic growth. Based on the assumption that the 4% growth rate in the tourism sector will further continue, the total production in the year 2020 will be approximately 1.7 times more than that of 2007. With the assumption that the securing of water will contribute as 3% of this growth, the accumulated benefit between 2007 and 2020 will reach some 637 million USD (5,054 MDH). This accounts for some 51% of the total implementation cost of the Master Plan (4,086 million USD).

5.6.4 Project Costs

The total project cost of the Master Plan is estimated approximately 4,086 MDH, the annual mean of 13 years of the implementation period is approximately 314 MDH. Among these, the Reclaimed Water Supply Project, the Program for Drip Irrigation Introduction and Dissemination and the Water Supply Leakage Control Project that will contribute directly to the improvement of the water balance of the groundwater as the object of the Master Plan, are existing plans, they were budgeted by each executing agencies, and some part of the projects was already started.

On the other hand, the Program for Drip Irrigation Introduction is the project which the beneficiaries of farmers bear a part of project cost; the 60% of the total cost is bone by the farmers and 40% is supported from the government). In addition, the Reclaimed Water Supply Project is the project which

is expected the income from the sale of reclaimed water. Therefore, all of the project cost does not become the burden of the executing agencies. Thus the actual cost to be burdened by the relevant agencies is lower than the total project cost, making it easier for implementation.

5.6.5 Viewpoint of Economic Evaluation

When the project cost and the project benefit of the Master Plan are compared, the tangible benefit from the sectors of agriculture and tourism count up to 8,283 MDH, which is more that twice of the implementation cost (4,086 MDH). Considering the object of the Master Plan, the sufficient project benefit will expect with the implementation of the Master Plan. Because of that, it is considered that the implementation of the Master Plan will contribute sufficiently to the achievement of the object of the Master Plan from the viewpoint of economic evaluation.

5.6.6 Viewpoint of Financial Evaluation

(1) Fiscal Burden Ability of Executing Agency (ABHT)

The total project cost for the 11 projects which ABHT will become the executing agency is approximately 277 MDH, and the annual mean of 13 years in the implementation period is approximately 21 MDH. This amount is lower in comparison with the annual budget of ABHT at 2007, which is approximately 64 MDH, and the budget of the Action Plan 2004-2007: implementation period was 4 years, total project number was 13, total project cost was 170.6 MDH and the annual mean of the total cost was 42.7 MDH. Therefore, it is considered to be appropriate as investment in the projects related to the water resource management, and the fiscal burden ability of ABHT is appraised as sufficient.

(2) Burden Ability of Farmers

By the burden of farmers who consume 90% or more of the water resource, participation ability to the Master Plan is appraised from the viewpoint of the financial evaluation. Increase of the production cost when the water saving measure is not done (additional excavation of well, re-installation of borehole pump for deep well, increase of operational expense - electric cost, etc.) and when the irrigation system of water saving type is introduced (60% of drip irrigation facility cost, replacement cost of facilities, decrease of operational expense, etc.) are compared. The calculated figures indicated that production cost with the implementation of the program (34,556 DH/ha) is approximately 8% lower than the production cost without project implementation. Therefore, it is considered that that not only there is no burden increase and no reduction in the farmer's income, the profit of farmers will increase through cost reduction by the introduction of the water saving irrigation system. Therefore, acceptance ability of project by farmers is appraised sufficiently. Furthermore, according as increase of the proportion of the government subsidy to the irrigation facilities (actually 40%), the project benefit of the farmers will be augmented more.

Production Cost in Each Scenario (Olive: Exotic variety and Intensive culture)

(Unit: DH/ha)

Item	Actual Condition	Continuation Scenario	Major Actions Scenario
Material Cost	2,960	2,960	2,960
Labor Cost	8,040	8,040	8,040
Pumping Cost	22,500	25,244	17,956
Drip Irrigation Facility Cost			5,600
Well Rehabilitation Cost		1,346	
Sub-total of Irrigation Cost	22,500	26,590	23,556
Total Production Cost	33,500	37,590	34,556

Source: Reference to 4.8.5

5.6.7 Socio-economic Effects

The executive effects of the Master Plan, besides the direct tangible benefits which are mentioned in the previous section, will generate also secondary, indirect and intangible benefits. Such intangible or secondary and indirect benefits are also important in appraising the propriety of project execution. The principal intangible benefits are as follows:

The target of the Master Plan is to preserve water resources and to realize sustainable use of groundwater. This will largely contribute to the target of the PDAIRE prepared under the water law enacted in 1995. Moreover, the Master Plan can be utilized in other basins as a model for water resources management, promoting the basic policies of the government.

The continuation of agricultural activities will maintain the largest employment sector in the regional society, securing employment opportunities for small scale farmers and agricultural laborers and seize the increase of unemployment. Particularly, prioritized distribution of water will secure the growth of the tourism sector, which is expected to create more employment opportunities, and will reduce the high rate of unemployment in the areas. This, all together, will contribute to the improvement of living standards of the people and stabilization of people's welfare.

It was reported that more than 8.7 billion DH is invested for the 150 hotel business in the truism sector of Marrakech and in its region, in 2007 and 2008 (July 06, 2007, Forum Marocain du Tourisme). Development of truism contributes to employment generation largely. It is assumed that the opening of these business will result in the creation of 8.491 direct employments in 2006 ~ 2008. Unemployment rate of Morocco of 2007 2nd quarter of 9.4% is high; The unemployment rate of urban area from 13.3% of last year to 15.0% approximately 2% rose, and in the rural area from 2.4% to 3.4%, 1% rose. Especially, unemployment rate of the 15 ~ 34 year in the rural area from 12.3% to 14.9% 2.6% rose (August 8, 2007, Haut Commissariat au Plan). For that, employment generation by the tourism sector contribute largely to the development of regional economy.

On the other hand, development of tourism is not restricted to just direct employment generation, but has brought secondary effects to other sectors such as handicraft, construction, transportation, food industry and service sectors such as hotels and restaurants. If the present situation of water balance continues, it can be predicted that factors related to water may obstruct development of the tourism sector. The Master Plan has strongly considers the importance of securing drinking water and water supply to the tourism sector. Therefore, it is evaluated that economic benefit by the imprecation of the Master Plan is very large as a socio-economic effect, even though it is difficult to quantify all economic effects bared by securing water resources required for the tourism sector.

The implementation of the Master Plan will secure sustainable use of water resources, and is expected to promite investment in the sectors of agriculture and tourism and vitalize the regioanl economy. The growth in the tourism sector will particularly have large positive influence to related sectors.

The execution of the program / project of ABHT which dose not generate the direct tangible benefit, will result in strengthening / improvment of capacities for water resources management, dissemination of technology and improvement of technical capacities of relevant institutions, and contribute as prerequisite to execute the main projects generating tangible benefits. Furthermore, these program / project are not only necessary to achieve the goal of the Master Plan, but also as to being a model case for the implementation of similar plans in other areas.

5.6.8 Environmental and Social Considerations (Environmental and Social Impact Assessment)

Possible negative impacts that may occur due to the implementation of the Master Plan are identified as follows.

Predicted Causes and Level of Negative Environmental and Social Impacts

Causes	Estimated Level of Impact
Impact derived from Controlled Pumping	Predicted Level of Impact: B In order to realize sustainable use of limited groundwater resources, the Master Plan includes activities for control of groundwater extraction based on scientific researches. Furthermore, introduction of groundwater fee is also planned for appropriate groundwater management. Depending on the level of restriction on groundwater extraction and price of groundwater fee, negative impact may occur for items such as: Local economy such as employment and livelihood, etc.; The poor, indigenous and ethnic people; Local conflict of interests; and Water Usage or Water Rights and Rights of Common. In order to avoid / mitigate the negative impact, appropriate rate of groundwater fee and realistic levels of restrictions on groundwater extraction must be examined. This should be done through conducting detailed socio-economic studies. Extension of agricultural technologies to maximize benefit produced from limited water resource must also be done to further mitigate the impact. In parallel, educational activities on the importance of water saving should be conducted.

Impact derived by Introduction of Water Saving Irrigation Methods (Drip Irrigation	Predicted Level of Impact: C As means of water saving irrigation, introduction of drip irrigation is considered in the Master Plan. Drip irrigation systems shall be installed by individual farmers and therefore may bear economic burdens for the farmers. This may affect the farmers in regard of items such as: Local economy such as employment and livelihood, etc.; and The poor, indigenous and ethnic people. Such impact will be mitigated to some level through government subsidies. Furthermore, extension of agricultural technologies to maximize benefit produced from limited water resource will also work as a mitigation measure.
Impact derived by Change in Hydrologic Conditions	Predicted Level of Impact: C The target area of the Master Plan is located in the middle reaches of the Tensift River. Therefore, changes in the amount of water use may affect downstream areas through items such as: Land use and utilization of local resources; Misdistribution of benefit and damage; Water Usage or Water Rights and Rights of Common; Hydrological conditions; Flora, Fauna and Biodiversity; and Water Pollution. However, results of groundwater simulation conducted in the Study shows that preservation of groundwater resources will increase the amount of water flowing out to the downstream area through increased outflow from the aquifer to the rivers. Therefore, the negative impact is considered minor. However, in order to confirm this, monitoring of river flows shall be done by utilizing the hydraulic observation systems that will be improved through the Master Plan.
Impact derived by Rehabilitation Works of Water Distribution Network	Predicted Level of Impact: C There is a possibility that the rehabilitation works for the water distribution system may partially take place in the "Old City" of Marrakech, which is registered as a World Heritage. In this case, negative impact on: Cultural Heritage may occur. This should be mitigated by preparing rehabilitation plans avoiding works in the Old City as much as possible, and by using existing underground openings for the current water distribution system.
Impact derived by Promotion of Intensive Agriculture	Predicted Level of Impact: C Introduction of water saving irrigation, together with intensive farming methods may lead to increase of soil salinity and have negative impact on: Soil Contamination. However, areas with relatively high danger of salinization in the Study Area is limited. The impact of salinization can be minimized through appropriate management of agricultural chemicals and water. This should be realized through extension of agricultural technology, which is a component of the Master Plan.

* Evaluation A: Likely to have significant negative impact
B: Likely to have negative impact but with less significance
C: Likely to have minor impact or to have negative impact depending on the contents of the plan

Possible negative social and environmental impacts that may occur among implementation of the Integrated Groundwater Resources Management Plan and assumed countermeasures

Item	Evaluation*	Remarks	Possible countermeasures assumed at the point of scoping
Local economy such as employment and livelihood, etc.	B	Controlling the amount of groundwater extraction may negatively impact the livelihood of farmers who depend their production on groundwater resources. Initial investment for the introduction of water saving (drip) irrigation system may negatively impact the household economy of farmers.	- Establish appropriate fees for groundwater usage - Dissemination of agricultural technology to improve profitability - Increased financial support for introduction of drip irrigation
Land use and utilization of local resources	C	Promoting the use of water from major rivers, including artificial recharge may negatively impact water use in the down stream areas.	- Monitoring of river flows utilizing improved hydraulic observation systems - Necessary considerations to secure the amount of water to be released to the lower streams will be discussed and agreed among the Stakeholders through the Program for Formulation of Collaboration and Decision - Making Framework for Water Resources Management.
The poor, indigenous and ethnic people	B	Controlling the amount of groundwater extraction may negatively impact the livelihood of farmers dependant on groundwater resources. Initial investment for the introduction of water saving (drip) irrigation system may negatively impact the household economy of farmers.	- Establish appropriate fees for groundwater usage - Dissemination of agricultural technology to improve profitability - Increased financial support for introduction of drip irrigation

Cultural heritage	C	The Old City of Marrakech is designated as a World Heritage. Construction activities in the Old City is basically not included in the Master Plan. However, there is a possibility of a part of leakage control projects. This may result in affect through improvement of water pipes.	- Construction plan avoiding construction within the Old City. - Utilization of existing ditches for water supply and sewage.
Misdistribution of benefit and damage	C	Promoting the use of water from major rivers, including artificial recharge may negatively impact water use in the down stream areas.	- Monitoring of river flows utilizing improved hydraulic observation systems - Necessary considerations to secure the amount of water to be released to the lower streams will be discussed and agreed among the Stakeholders through the Program for Formulation of Collaboration and Decision - Making Framework for Water Resources Management.
Local conflict of interests	B	Controlling the amount of groundwater extraction may induce competition on limited surface water resources.	- Dissemination / educational activities on the situation of water resources to local residents - Planning of surface water distribution through a participatory approach.
Water Usage or Water Rights and Rights of Common	B	Controlling the amount of groundwater will limit conventional use of groundwater, which is regarded as a water right. Promoting the use of water from major rivers, including artificial recharge may negatively impact water use in the down stream areas by decrease in amount.	- Dissemination / educational activities on the situation of water resources to local residents - Planning of surface water distribution through a participatory approach. - Monitoring of river flows utilizing improved hydraulic observation systems - Necessary considerations to secure the amount of water to be released to the lower streams will be discussed and agreed among the Stakeholders through the Program for Formulation of Collaboration and Decision - Making Framework for Water Resources Management.
Hydrological conditions	C	Promoting the use of water from major rivers, including artificial recharge may negatively impact the ecosystem of the down stream areas by decrease in amount.	- Monitoring of river flows utilizing improved hydraulic observation systems - Necessary considerations to secure the amount of water to be released to the lower streams will be discussed and agreed among the Stakeholders through the Program for Formulation of Collaboration and Decision - Making Framework for Water Resources Management.
Flora, Fauna and Biodiversity	C	Promoting the use of water from major rivers, including artificial recharge may negatively impact the ecosystem of the down stream areas by decrease in amount.	- Monitoring of river flows utilizing improved hydraulic observation systems - Necessary considerations to secure the amount of water to be released to the lower streams will be discussed and agreed among the Stakeholders through the Program for Formulation of Collaboration and Decision - Making Framework for Water Resources Management.
Water Pollution	C	Promoting the use of water from major rivers, including artificial recharge may negatively impact the water quality of major rivers by decreased capacity of self-purification (dilution of pollutants).	- Monitoring of river flows utilizing improved hydraulic observation systems - Treatment of wastewater flowing in to rivers - Monitoring of quality and quantity of waters in major rivers
Soil Contamination	C	Water saving irrigation, which will be practiced with intensive farming methods, may induce salinization of soils.	- Appropriate use of agro-chemicals - Dissemination of appropriate irrigation techniques - Selection of water source for irrigation

* Evaluation A: Likely to have significant negative impact
B: Likely to have negative impact but with less significance
C: Likely to have minor impact or to have negative impact depending on the contents of the plan

Possible Negative Impacts on Social and Natural Environment

	No.	Likely Impacts	Overall Evaluation	Surface water sources development and managemen			Groundwater management		Water quality management	Water demand reduction					Organizational and institutional improvement				Participatory integrated water resources management		
				Artificial Groundwater Recharge Project	Reclaimed Water Supply Project	Hydrological Observation Network Reinforcement Project	Program for Groundwater Facility Registration Management	Program for Scientific Estimation of Available Groundwater	Program for Water Quality Monitoring	Program for Drip Irrigation Introduction and Dissemination	Program for Seguia and Water Management Improvement	Program for Accumulation and Distribution of Technical Information for Water Saving Farming and Irrigation	Water Supply Leakage Control Project	Program for Water Saving Dissemination	Program for Water Resources Management Capacity Development of ABHT	Program for Legal and Institutional Frameworks Improvement for Water Law Implementation	Program for Water Police System Enhancement	Program for Appropriate Pricing and Effective Collecting of Water Royalty	Program for Formulation of Collaboration and Decision – Making Framework for Water Resources Management	Program for Activation and Capacity Development of Water Users Association	Program for Public Awareness on Water Saving and Conservation
Social Environment	1	Involuntary Resettlement																			
	2	Local economy such as employment and livelihood, etc.	B					B		C		C						B			
	3	Land use and utilization of local resources	C	C	C																
	4	Social institutions such as social infrastructure and local decision-making institutions																	*	*	*
	5	Existing social infrastructures and services									*		*		*						
	6	The poor, indigenous and ethnic people	B					B		C		C					C	B			
	7	Misdistribution of benefit and damage	C	C																	
	8	Cultural heritage	C		C								C								
	9	Local conflict of interests	B					B													
	10	Water Usage or Water Rights and Rights of Common	B	C				B			*										
	11	Sanitation																			
	12	Hazards (Risk) Infectious diseases such as HIV/AIDS																			
	13	Gender issues																			
Natural Environment	14	Topography and Geographical features																			
	15	Soil Erosion																			
	16	Groundwater	*	*																	
	17	Hydrological Situation	C	C																	
	18	Coastal Zone																			
	19	Flora, Fauna and Biodiversity	C	C	C																
	20	Meteorology																			
	21	Landscape	C	C	C																
	22	Global Warming																			
Pollution	23	Air Pollution																			
	24	Water Pollution	C	C	*																
	25	Soil Contamination	C							C											
	26	Waste																			
	27	Noise and Vibration																			
	28	Ground Subsidence																			
	29	Offensive Odor																			
	30	Bottom sediment																			
	31	Accidents																			

a Major impact expected
b Moderate impact may occur
c Impact uncertain (examination is needed, impacts may become cleare as study progress)
* Possible positive impact is expected

(2) Necessity of EIA Under Legislation of Morocco

Under the current legislation of Morocco, the construction of artificial groundwater recharge facilities will be the only item in the Master Plan of which EIA is required.

(3) Stakeholder Meetings

A series of workshops were held at various stages of the Study in order to share information and understandings on water resources management issues among various stakeholders. In the workshops, environmental and social issues were explained as a part of the process of Master Plan preparation. Through such workshops, comments of farmers representing the local residents were collected.

Stakeholder Meetings Held during the Study

Meeting	Date of Meeting and Main Subject
First Stakeholder Meeting	Date: 17 Nov. 2006 Results of basic survey / Progress Report 1
Second Stakeholder Meeting	Date: 16 Feb. 2007 Explanation on Draft Integrated Water Resources Management Strategy
Third Stakeholder Meeting	Date: 24 Jul. 2007 Explanation on Draft Plan for Integrated Groundwater Management / Progress Report 2
Fourth Stakeholder Meeting	Date: 27 Nov. 2007 Explanation on Study results (Integrated Water Resources Management Strategy, Integrated Groundwater Management Plan, Action Plan) / Draft Final Report

Major comments relating to environmental and social issues, which were raised in the Stakeholder Meetings are summarized in the following.

Major Comments on Environmental and Social Considerations and Measures taken in the Master Plan

Comment	Corresponding Program / Project
Preservation of water source areas in the upstream of the Haouz Plain should be promoted	The water source areas in the upstream of the Haouz Plain is not included in the Target Area of the Master Plan. Therefore, management of these areas are included in the Integrated Water Resources Management Strategy, but not in the Master Plan.
Indiscreet development of water sources should be controlled	Program for Groundwater Facility Registration Management Program for Scientific Estimation of Available Groundwater Program for Water Police System Enhancement
Wells for water supply should be protected	Program for Water Police System Enhancement
Crop type and breed should be examined for water saving agriculture	Program for Accumulation and Distribution of Technical Information for Water Saving Farming and Irrigation
Overuse of agro-chemicals should be controlled	Program for Public Awareness on Water Saving and Conservation
Water fee should be set with due consideration to the socially vulnerable	Program for Appropriate Pricing and Effective Collecting of Water Royalty Program for Formulation of Collaboration and Decision – Making Framework for Water Resources Management
Influence of up stream water use on downstream areas should be examined	Groundwater simulation results indicate that the outflow to the downstream areas will increase with the implementation of the Master Plan.
Wastewater from factories should be treated as appropriate	Program for Public Awareness on Water Saving and Conservation
Educational activities should be done in each sector	Program for Public Awareness on Water Saving and Conservation
Fair and equal distribution of water should be examined	Program for Formulation of Collaboration and Decision – Making Framework for Water Resources Management

(4) Alternatives

Examination of alternatives of the Master Plan in regard of Environmental and Social Considerations has been done with the information available at the point of scoping. The examined alternatives were: 1) No implementation of the Master Plan, 2) Implementation of all activities of the Master Plan, and 3) Implementation of activities only with minor environmental and / or social impact.

1) No implementation of the Master Plan: Regardless of the harsh natural conditions with evaporation largely exceeding precipitation, the load on limited on limited water resources are

increasing due to recent decrease of rainfall, expansion of modern irrigation technology with pumps and rapid increase of water demand due to the burst of urban population. The water balance in the aquifer is currently negative, and the groundwater table is likely to continue decreasing in regard of the planned urban / tourism development activities. In order to realize sustainable use of groundwater recourses in the Study Area, the implementation of a Master Plan for Integrated Groundwater Resource Management is essential.

2) Implementation of all activities of the Master Plan: The Master Plan largely consists of two pillars of actions: 1) manage the supply of water and 2) manage the demand of water at the users side. Along with this, the Master Plan also incorporates institutional strengthening and participatory water management to realize the two pillars. The implementation of these activities contribute to improve the water balance in the Study Area by maximizing the efficiency of usage of limited water resources as well as appropriately distribute the available water resources. Implementation of some activities incorporated in the Master Plan, such as controlling of groundwater extraction, artificial groundwater recharge, and introduction of drip irrigation may induce negative social and environmental impacts at some extent. However, the negative impacts can be mitigated a limited extent through measures indicated in 3.3.2 (2).

3) Implementation of activities only with minor environmental and / or social impact: Activities incorporated in the Master Plan with minor negative environmental and / or social impacts are institutional strengthening, groundwater monitoring, dissemination of water saving technologies excluding drip irrigation, and other educational activities. Implementations of such activities are expected to contribute at some extent to improving the water balance in the Study Area. However, these activities are mostly indirect measures, and do not include direct actions to secure usable water sources or decrease water use. In regard of the current water balance in the Study Area, more direct actions including those such as controlling of groundwater extraction is required.

For the above examination, it may be concluded that in order to avoid exhaustion of groundwater resources and to realize sustainable use of water resources in the Haouz Plain, implementation of the Master Plan along with necessary countermeasures to mitigate negative impacts would be most appropriate.

5.6.9 Comprehensive Evaluation

By the implementation of the Master Plan, the appropriate management of the groundwater which is necessary to guarantee continuously and stably the utilization of the water resources on the inhabitant’s life and the agricultural production will be realized. As a result, the equilibrium of water balance of the groundwater in the Haouz plain will be achieved by 2020 of the target year, and the improvement and maintenance of water balance become possible. Moreover, the implementation of the Master Plan will be expected to contribute to the life stability of the inhabitant in the object area, guaranty of economic activity and acquisition of employment opportunity, consequently, it is expected that contributes greatly to the regional economy. Furthermore, as a influence effect, it is foreseen that it will decrease the further fall of the groundwater level.

From the above, it can be said that the implementation of the Master Plan is sufficiently appropriate due to the results of the economic analysis and financial analysis that were appraised by the tangible benefit that are obtained from the damage reduction of the agriculture sector and the economic growth in the tourism sector, which will be prioritized for water distribution, by the improvement of the fall of the groundwater level. And the socio-economic effects that were analyzed as intangible benefits could also be sufficiently expected. Moreover, as major adverse environmental and social impacts were not identified in its assessment, and essentially, the Maser Plan can be appraised as a plan aiming at environmental improvement / maintenance. The risks for the implementation are also considered manageable. On the one hand, the Master Plan is also viable in terms of technical feasibility and is proper plan even in the organizational management aspect. Thus, the implementation of the Master Plan is evaluated to be valid.

5.6.10 Direct Contribution of Major Projects / Programs to the Groundwater Balance and their Economic Contribution

The direct contribution of the Major Projects (Artificial Groundwater Recharge Project, Reclaimed Water Supply Project and Program for Drip Irrigation Introduction and Dissemination) to the balance of the aquifer is summarized in the following. Thought the implementation of the Major Projects is the direct cause of such impacts, it should be noted that implementation of relevant activities such as surface water management and institutional strengthening at the right time and scale is required as the basis for implementation.

Direct Contribution of Major Projects on Groundwater Balance

Project	Type of Contribution	Annual Contribution at Target Tear (Mm^3/year)	Accumulated Contribution during Master Plan Period (Mm^3)
Artificial Groundwater Recharge	Development of new sources	14.3 (13.4%)	95 (10.8%)
Reclaimed Water Supply	Development of new sources	19.2 (18.0%)	211 (24.1%)
Drip Irrigation Introduction and Dissemination	Reduction of water demand	73.0 (68.5%)	572 (65.2%)
Total		107 (100%)	878 (100%)

The contribution by projects indicate that the program for Drip Irrigation Introduction and Dissemination accounts for 69% of the annual contribution at the target year and 65% of the accumulated contribution, reaching two thirds of the total contribution. The remaining contribution consists of the artificial groundwater recharge project and reclaimed water supply project. The reclaimed water supply project has more accumulated contribution because its effect starts right after its implementation.

Transition of Direct Contribution of the Major Projects

Unit: Mm^3

Project	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Annual													
Artificial Groundwater Recharge	0.0	0.0	2.1	2.1	2.1	5.0	5.0	10.5	10.5	14.3	14.3	14.3	14.3
R'Dat			2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Rheraya						2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Zat								5.5	5.5	5.5	5.5	5.5	5.5
Ourika										3.8	3.8	3.8	3.8
Reclaimed Water Supply	0.0	0.0	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
Phase 1			19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
Drip Irrigation Introduction and Disseminatio	7.2	14.5	21.7	29.0	36.2	41.6	47.0	45.3	57.7	63.1	66.4	69.7	73.0
GH Sectors (Priority Areas)	4.0	7.9	11.9	15.9	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8
GH Sectors (Other Areas)	0.0	0.0	0.0	0.0	0.0	2.1	4.2	6.3	8.3	10.4	10.4	10.4	10.4
PMH Sectors	3.3	6.6	9.9	13.1	16.4	19.7	23.0	19.2	29.6	32.9	36.1	39.4	42.8
Accumulated													
Artificial Groundwater Recharge	0	0	2	4	6	11	16	27	37	52	66	80	95
Reclaimed Water Supply	0	0	19	38	58	77	96	115	134	154	173	192	211
Drip Irrigation Introduction and Disseminatio	7	22	43	72	109	150	197	243	300	363	430	499	572

Note: Results of groundwater simulation include both the development of Wirgan and Taskourt Dam and Increase of water demand in the water supply sector. Improvement of the annual balance of water in the target year is $100Mm^3$, and the accumulated improvement is $1,021Mm^3$ (refer to Section 4.8.4)

The direct contribution of the Major Projects and implementation cost is compared in the following table. While the artificial groundwater recharge projects show high efficiency against its implementation cost, the amount of direct contribution is low because of the limited number of potential sites and the necessity of pilot projects before implementation.

Cost of Major Projects to Improve Groundwater Balance

Project	Accumulated Contribution during Master Plan Period (Mm^3)	Implementation Cost (MDH)	Cost for Improving Groundwater Balance (DH/m^3)
Artificial Groundwater Recharge	95	106	1.12
Reclaimed Water Supply	211	637	3.01
Drip Irrigation Introduction and Dissemination	572	2,715	4.74

On the other hand, the amount of newly developed water sources and reduced water demand will also have economic value. Taking into consideration the policy of the government, the Strategies for Integrated Water Resources Management attaches priority to potable water supply, which is a basic need for the regional population, and to the tourism sector, which supports the regional economy. In this regard, it can be said that the water developed / saved by the implementation of the Major Projects have the following economic values.

(1) Artificial Groundwater Recharge Project

This project will be implemented in order to secure the sources of potable water supply, which is expected to further increase along with the population and economical development of Marrakech. Top priority will be attached to water for the sources for potable water supply. In this regard, the water newly developed (the contribution of the project) can be compared with the raw water developed by dams. With the unit price of raw water from dam set as 2.58 DH/m^3 (Great Dam Connection Concept Report), the economic benefit from this project will be 244 MDH (2.58 DH/m^3 x 94.5Mm^3). The economic Internal Rate of Return (IRR) of the project based on the benefit and project cost (106 MDH) is 41.4% for the 13 year implementation period.

(2) Reclaimed Water Supply Project

This project will be implemented to cope with the water demand of the tourism sector in Marrakech, particularly for the water to maintain golf courses and gardens. In this regard, the water newly developed can be compared with the water cost burdened by the tourism sector (Hotels, 8.58 DH/m^3, RADEEMA). In regard of the cost for treatment, conveyance, royalty of ABHT, RADEEMA, tax, etc., the unit price is set as half of the water fee for Hotels (4.29DH/M^3). With the assumption that the project life is 22 years (duration of operation: 20years, construction 2 years), the economic benefit will be 1,647 MDH (4.29DH/m^3 x 384 Mm^3 x 20 years). The IRR of the project based on the benefit and project cost (990 MDH) is 14.1% for the 22 year project life.

(3) Program for Drip Irrigation Introduction and Dissemination

This program is implemented to efficiently utilize water resources in the agriculture sector, which consumes 90% of the total water used in the Haouz Plain. In this regard, the reduction in water demand can be compared with the potential value of newly developed water. If the unit price of the value of water is set at 4.13 DH/m^3 (summer vegetables and winter vegetables, refer to Section 5.6.6), the economical benefit from the program will be 2,362 MDH (4.13 DH/m^3 x 572Mm^3). Furthermore, in regard of the pumping cost reduced through the introduction of drip irrigation, an additional 1,447 MDH (unit pumping cost x amount pumped: 2.53 DH/m^3 x 572Mm^3) can be regarded. This will total up to 3,809 MDH as the economical benefit of the Prigram. The IRR of the project based on the benefit and program cost (2,715 MDH) is 13.7% for the 13 year implementation period.

Table 5.5.1 Schedule of the Master Plan (1/2)

	Project and Implementation Items	Implementing Agency	Year 2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Surface Water Sources Development and Surface Water Resources Management Plan	Artificial Groundwater Recharge Project	ABHT													
	Preparation works (pilot project & formal project)														
	General design (pilot project & formal project)														
	Detailed design (pilot project & formal project)														
	Construction (pilot project & formal project)														
	Maintenance works & Evaluation (pilot project & formal project)														
	Reclaimed Water Supply Project	RADEEMA													
	Reclaimed water supply planning, design, tender & contract														
	construction of tertiary treatment plant and water distribution facilities														
	Commissioning and adjustment of reclaimed water supply facilities														
	Operation of reclaimed water supply facilities														
	Hydrological Observation Network Reinforcement Project	ABHT													
	The selection of the new observation facilities establishment place														
	The establishment work (water level gauge establishment, vertical crossing measurement and HQ curve preparation) of the new observation														
	Observation using the new observation facilities														
	Improvement for existing and new observation facilities (Introduction of the self-water gauge)														
Groundwater Management Plan	Program for Groundwater Facility Registration Management	ABHT													
	Execution for application, permission & registration for construction & rehabilitation of wells														
	Inventory & preparation of database of registered and unregistered wells														
	Monitoring of utilization status of wells														
	Inventory & preparation of database of groundwater intake facilities other than wells														
	Computer set for database of groundwater intake facilities														
	Program for Scientific Estimation of Available Groundwater	ABHT													
	Accumulation of new hydrological data in the upper part of the aquifer														
	Accumulation of cultivation land information														
	Accumulation of new deep hydro geological data														
	Accumulation of data on water level														
	Accumulation of database of groundwater uses														
	Staff reinforcement & procurement of groundwater analysis tools														
	Performing scientific mean groundwater analysis														
	Determine available pumping volume., control Pumping volume														
	Preparation of groundwater management manual														
Water Quality Management Plan	Program for Water Quality Monitoring	ABHT													
	Review of water quality sampling point and determination														
	Formulation of water quality monitoring improvement plan														
	Continuation of present water quality monitoring operation														
	Implementation of new water quality monitoring operation														
	Vehicle for water sampling and O&M cost														
Water Demand Reduction Plan	Program for Drip Irrigation Introduction and Dissemination	ORMVAH													
	N'Fis perimeter with pressure water supply on right river side（Irrigation area : 16,102ha)														
	PMH irrigation area（Irrigation area : 56,000ha）														
	Other GH irrigation area (irrigation area : 10,000ha)														
	Program for Seguia and Water Management Improvement	ORMVAH													
	Study for clarifying the function of groundwater recharge from seguias														
	Reinforcement of the canal cleaning, maintenance control activities by water users association														
	The maintenance of the monitor ring system of water volume of seguia intake and paddy field by water users association														
	Program for Accumulation and Distribution of Technical Information for Water	ORMVAH													
	The development of the water saving irrigation technology and the accumulation of the technical information														
	The development of the water saving cultivation technology and the selection of the kind, list of articles														
	Diffusion, enlightenment activities about the water saving agriculture & water saving irrigation														
	Water Leakage Control Project	RADEEMA/ ONEP													
	Preparation of water leakage control plan														
	Preparation of water distribution network efficiency improvement plan														
	Regular water leakage detection survey & repair works														
	Water distribution network improvement works														
	Program for Water Saving Measures	RADEEMA/ ONEP													
	Public information using Mass-medias														
	Water saving seminar to the urban water user														
	Water saving seminar to the rural water user														

Table 5.5.1 Schedule of the Master Plan (2/2)

		Implementing Agency	Year												
			2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Organizational and Institutional Improvement Plan	Program for Water Resources Management Capacity Development of ABHT	ABHT													
	Materials, data joint ownership, one former control and materials room establishment														
	Information joint ownership from related organization, transmission system maintenance														
	Web site building and information sending to stakeholder														
	Reinforcement of the consultation and the cooperation with the concerned stakeholders on the water resources management														
	The simplification and speed up of the application procedure and the permission														
	Business ability reinforcement for the charge department office of the permission and examination														
	Development of royalty collection system														
	Water resources control plan , execution, monitoring and improvement in the evaluation ability														
	Program for Legal and Institutional Frameworks Improvement for Water Law	ABHT													
	To enhance the actual effect of the water law, the maintenance of the necessary statute and the execution of detailed regulations														
	The improvement of the procedure concerned with an application for well digging & intake water permission and the thoroughness of the place permission items observance														
	Public relations about the water law and that related bill														
	Program for Water Police System Enhancement	ABHT													
	Information on the activities of the water police to the stakeholders in particular to the local authorities														
	Elaboration of the term of references and the text of application to fix the modality of the water police implementation														
	The adoption of water police works, staff member, and training														
	Securing of the executing materials and financial treatment														
	The execution of the watching activities for the water supply														
	Water police business training for the in charge person of the local administrated organization														
	The escalating execution of water police works by the local administration organization														
	The execution of the illegal watching activities for the water supply by AUEA														
	Program for Appropriate Pricing and Effective Collecting of Water Royalty	ABHT													
	An examination about the setup of the water fee and method of collection														
	Elaboration and proclamation of the texts of application related to the water pricing and the collection modality														
	Holding of the explanation meeting to the user and relevant organizations at the local level about the water fee and that way of paying it and public relations														
	Building of the water fee levy system														
	The establishment of the water resources control fund														
Participatory Groundwater Management Plan	Program for Formulation of Collaboration and Decision - Making Framework for Water Resources Management	ABHT													
	The establishment and conference of Tensift basin control committee														
	The establishment and conference of the subcommittee by the subject														
	The establishment of the prefecture water committee (CPPE) and activation														
	The establishment and conference of the commune water control committee														
	The partial assignment of the water resources control authority to the commune														
	Program for Activation and Capacity Development of Water Users Association	ORMVAH /DPA													
	The organization management of the target association office and reinforcement training of control ability for the financial affairs														
	Financial capacities reinforcement of the AUEA by the contributions of members														
	Improvement of the information diffusion system by the organization of general assembly of the AUEA														
	Relationship reinforcement with the ORMVAH and the DPAs														
	The diffusion training of the water saving irrigation technology														
	Inspection and opinion exchange in the excellent activities and advanced AUEA														
	Program for Public Awareness on Water Saving and Conservation	ABHT													
	The plan decision of the enlightenment and communication														
	Local authority, water resources control understanding to the local government and the tradition village autonomy organization														
	The diffusion enlightenment of water saving agriculture														
	Illegal digging of the wells and the prevention of intake water														
	The common knowledge of the water law and the related legal system														
	Understanding and common knowledge for charge of groundwater use														
	Repression of water consumption at the hotel and resort facilities														
	Using reclaimed water at the golf courses														
	School education (a curriculum about the control of water resources and the preservation)														
	The poster preparation and notice which made problem and water saving about the water resources as a theme														
	Water control and water saving contest														
	The enlightenment of water saving in the mosque using worship														
	The enlightenment of the water resources control and using water saving through Mass-medias														

Table 5.5.2 Implementation Cost of the Master Plan (1/2)

	Project and Implementation Items	Implementing Agency	Cost (MDH)	Year												
				2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Surface Water Sources Development and Surface Water Resources Management Plan	Artificial Groundwater Recharge Project	ABHT	106.0	2.50	4.00	4.00	11.00	6.00	7.00	11.50	9.00	13.50	10.00	11.50	8.00	8.00
	Preparation works (pilot project & formal project)		2.50	2.50												
	General design (pilot project & formal project)		31.50		4.00	4.00	5.50	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
	Detailed design (pilot project & formal project)		28.00				2.50	4.00	4.00	5.50	2.00	2.00	2.00	2.00	2.00	2.00
	Construction (pilot project & formal project)		24.00				1.50		1.00	4.00	4.00	5.50	2.00	2.00	2.00	2.00
	Maintenance works & Evaluation (pilot project & formal project)		20.00				1.50				1.00	4.00	4.00	5.50	2.00	2.00
	Reclaimed Water Supply Project	RADEEMA	636.5	3.50	185.33	94.67	35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30
	Reclaimed water supply planning, design, tender & contract		3.50	3.50												
	construction of tertiary treatment plant and water distribution facilities		278.00		185.33	92.67										
	Commissioning and adjustment of reclaimed water supply facilities		2.00			2.00										
	Operation of reclaimed water supply facilities		353.00				35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30
	Hydrological Observation Network Reinforcement Project	ABHT	3.0	0.00	0.50	0.00	0.00	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	The selection of the new observation facilities establishment place		0.00													
	The establishment work (water level gauge establishment, vertical crossing measurement and HQ curve preparation) of the new observation		0.50		0.50											
	Observation using the new observation facilities		0.00													
	Improvement for existing and new observation facilities (Introduction of the self-water gauge)		2.50					2.50								
Groundwater Management Plan	Program for Groundwater Facility Registration Management	ABHT	5.7	1.22	1.12	1.12	0.12	1.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
	Execution for application, permission & registration for construction & rehabilitation of wells		1.56	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
	Inventory & preparation of database of registered and unregistered wells		3.00	1.00	1.00	1.00										
	Monitoring of utilization status of wells		0.00													
	Inventory & preparation of database of groundwater intake facilities other than wells		1.00					1.00								
	Computer set for database of groundwater intake facilities		0.10	0.10												
	Program for Scientific Estimation of Available Groundwater	ABHT	18.2	7.00	2.10	1.60	0.60	1.10	0.60	0.60	1.10	0.60	0.60	1.10	0.60	0.60
	Accumulation of new hydrological data in the upper part of the aquifer		0.00													
	Accumulation of cultivation land information		1.30	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	Accumulation of new deep hydro geological data		3.50	1.50	1.00	1.00										
	Accumulation of data on water level		6.07	1.30	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
	Accumulation of database of groundwater uses		0.00													
	Staff reinforcement & procurement of groundwater analysis tools		4.12	4.10												
	Performing scientific mean groundwater analysis		1.20		0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	Determine available pumping volume., control Pumping volume		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Preparation of groundwater management manual		2.00		0.50			0.50			0.50			0.50		
Water Quality Management Plan	Program for Water Quality Monitoring	ABHT	44.5	0.58	0.58	3.94	3.94	3.94	3.94	3.94	3.94	3.94	3.94	3.94	3.94	3.94
	Review of water quality sampling point and determination		0.00													
	Formulation of water quality monitoring improvement plan		0.00													
	Continuation of present water quality monitoring operation		1.15	0.58	0.58											
	Implementation of new water quality monitoring operation		40.88			3.72	3.72	3.72	3.72	3.72	3.72	3.72	3.72	3.72	3.72	3.72
	Vehicle for water sampling and O&M cost		2.46			0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Water Demand Reduction Plan	Program for Drip Irrigation Introduction and Dissemination	ORMVAH	2,715.0	185.10	281.70	281.70	281.70	281.70	245.00	208.30	208.30	208.30	208.30	148.30	88.30	88.30
	N'Fis perimeter with pressure water supply on right river side (Irrigation area : 16,102ha)		967.0	96.70	193.40	193.40	193.40	193.40	96.70							
	PMH irrigation area (Irrigation area : 56,000ha)		1,148.0	88.40	88.30	88.30	88.30	88.30	88.30	88.30	88.30	88.30	88.30	88.30	88.30	88.30
	Other GH irrigation area (irrigation area : 10,000ha)		600.0						60.00	120.00	120.00	120.00	120.00	60.00		
	Program for Seguia and Water Management Improvement	ORMVAH	2.0	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Study for clarifying the function of groundwater recharge from seguias		2.00	1.00	1.00											
	Reinforcement of the canal cleaning, maintenance control activities by water users association		0.00													
	The maintenance of the monitor ring system of water volume of seguia intake and paddy field by water users association		0.00													
	Program for Accumulation and Distribution of Technical Information for Water Saving Farming and Irrigation	ORMVAH	19.5	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
	The development of the water saving irrigation technology and the accumulation of the technical information		6.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
	The development of the water saving cultivation technology and the selection of the kind, list of articles		6.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
	Diffusion, enlightenment activities about the water saving agriculture & water saving irrigation		6.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
	Water Leakage Control Project	RADEEMA/ ONEP	403.0	24.00	8.00	56.00	55.50	55.50	25.50	25.50	25.50	25.50	25.50	25.50	25.50	25.50
	Preparation of water leakage control plan		16.00	16.00												
	Preparation of water distribution network efficiency improvement plan		16.00	8.00	8.00											
	Regular water leakage detection survey & repair works		280.50			25.50	25.50	25.50	25.50	25.50	25.50	25.50	25.50	25.50	25.50	25.50
	Water distribution network improvement works		90.50			30.50	30.00	30.00								
	Program for Water Saving Measures	RADEEMA/ ONEP	31.0	2.00	2.00	2.00	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
	Public information using Mass-medias		13.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Water saving seminar to the urban water user		13.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Water saving seminar to the rural water user		5.00				0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50

Table 5.5.2 Implementation Cost of the Master Plan (2/2)

		Implementing Agency	Cost (MDH)	Year												
				2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Organizational and Institutional Improvement Plan	Program for Water Resources Management Capacity Development of ABHT	ABHT	5.0	0.1	1.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	Materials, data joint ownership, one former control and materials room		0.03	0.01		0.01		0.01		0.01		0.01		0.01		
	Information joint ownership from related organization, transmission system maintenance		0.47	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
	Web site building and information sending to stakeholder		0.47	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
	Reinforcement of the consultation and the cooperation with the concerned stakeholders on the water resources management		0.00													
	The simplification and speed up of the application procedure and the permission		2.64			0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
	Business ability reinforcement for the charge department office of the permission and examination		0.02		0.01			0.01			0.01			0.01		
	Development of royalty collection system		0.02			0.01			0.01			0.01			0.01	
	Water resources control plan , execution, monitoring and improvement in the evaluation ability		1.39		1.34		0.01		0.01		0.01		0.01		0.01	
	Program for Legal and Institutional Frameworks Improvement for Water Law	ABHT	6.5	0.22	3.83	1.55	0.00	0.22	0.00	0.22	0.00	0.22	0.00	0.22	0.00	0.00
	To enhance the actual effect of the water law, the maintenance of the necessary statute and the execution of detailed regulations		1.33		1.33											
	The improvement of the procedure concerned with an application for well digging & intake water permission and the thoroughness of the place permission items observance		1.33			1.33										
	Public relations about the water law and that related bill		3.82	0.22	2.50	0.22		0.22		0.22		0.22		0.22		
	Program for Water Police System Enhancement	ABHT	29.6	0.00	1.29	1.57	0.94	3.43	2.89	2.80	2.89	2.80	2.89	2.80	2.89	2.80
	Information on the activities of the water police to the stakeholders in particular to the local authorities		0.00													
	Elaboration of the term of references and the text of application to fix the modality of the water police implementation		0.00													
	The adoption of water police works, staff member, and training		5.76		0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48
	Securing of the executing materials and financial treatment		1.44		0.72	0.72										
	The execution of the watching activities for the water supply		3.69			0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
	Water police business training for the in charge person of the local administrated organization		0.10					0.10								
	The escalating execution of water police works by the local administration organization		18.10					2.48	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.95
	The execution of the illegal watching activities for the water supply by AUEA		0.53		0.09		0.09		0.09		0.09		0.09		0.09	
	Program for Appropriate Pricing and Effective Collecting of Water Royalty	ABHT	10.3	0.00	1.63	3.12	0.40	2.98	0.00	0.22	0.00	0.22	1.33	0.22	0.00	0.22
	An examination about the setup of the water fee and method of collection		1.33		1.33											
	Elaboration and proclamation of the texts of application related to the water pricing and the collection modality		0.00													
	Holding of the explanation meeting to the user and relevant organizations at the local level about the water fee and that way of paying it and public		5.02		0.30	3.12	0.40	0.32		0.22		0.22		0.22		0.22
	Building of the water fee levy system		2.66					1.33					1.33			
	The establishment of the water resources control fund		1.33					1.33								
Participatory Groundwater Management Plan	Program for Formulation of Collaboration and Decision - Making Framework for Water Resources Management	ABHT	7.0	0.06	0.23	0.18	0.23	0.68	0.73	0.68	0.73	0.68	0.73	0.68	0.73	0.68
	The establishment and conference of Tensift basin control committee		0.30		0.05		0.05		0.05		0.05		0.05		0.05	
	The establishment and conference of the subcommittee by the subject		0.78	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
	The establishment of the prefecture water committee (CPPE) and activation		1.44		0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
	The establishment and conference of the commune water control committee		3.13					0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
	The partial assignment of the water resources control authority to the commune		1.35					0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
	Program for Activation and Capacity Development of Water Users Association	ORMVAH /DPA	2.0	0.00	0.41	0.00	0.26	0.00	0.41	0.00	0.26	0.00	0.41	0.00	0.26	0.00
	The organization management of the target association office and reinforcement training of control ability for the financial affairs		0.79		0.13		0.13		0.13		0.13		0.13		0.13	
	Financial capacities reinforcement of the AUEA by the contributions of members		0.00													
	Improvement of the information diffusion system by the organization of general assembly of the AUEA		0.00													
	Relationship reinforcement with the ORMVAH and the DPAs		0.00													
	The diffusion training of the water saving irrigation technology		0.79		0.13		0.13		0.13		0.13		0.13		0.13	
	Inspection and opinion exchange in the excellent activities and advanced AUEA		0.44		0.15				0.15				0.15			
	Program for Public Awareness on Water Saving and Conservation	ABHT	41.5	11.79	5.31	4.96	2.58	1.26	3.01	1.57	2.27	1.21	3.37	1.26	2.22	0.72
	The plan decision of the enlightenment and communication		1.00	1.00												
	Local authority, water resources control understanding to the local government and the tradition village autonomy organization		2.10	1.80	0.30											
	The diffusion enlightenment of water saving agriculture		7.07	2.97	0.25	0.47	0.25	0.47	0.25	0.47	0.25	0.47	0.25	0.47	0.25	0.25
	Illegal digging of the wells and the prevention of intake water		3.82	2.72		0.22		0.22		0.22		0.22		0.22		
	The common knowledge of the water law and the related legal system		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Understanding and common knowledge for charge of groundwater use		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Repression of water consumption at the hotel and resort facilities		3.55	3.30		0.05		0.05		0.05		0.05		0.05		
	Using reclaimed water at the golf courses		0.15					0.05			0.05			0.05		
	School education (a curriculum about the control of water resources and the preservation)		4.83			3.75	0.36			0.36			0.36			
	The poster preparation and notice which made problem and water saving about the water resources as a theme		3.00		0.50		0.50		0.50		0.50		0.50		0.50	
	Water control and water saving contest		6.00		1.00		1.00		1.00		1.00		1.00		1.00	
	The enlightenment of water saving in the mosque using worship		0.60		0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	The enlightenment of the water resources control and using water saving through Mass-medias		9.40		3.21	0.42	0.42	0.42	1.21	0.42	0.42	0.42	1.21	0.42	0.42	0.42
Total Project Cost (MDH)			4,086.4	240.54	501.94	458.23	396.89	400.05	328.82	295.07	293.74	296.71	296.81	235.26	172.19	170.49

CHAPTER 6 ACTION PLAN

6.1 Understanding of the Master Plan as a whole and selection of Programs / Projects for the Action Plan

6.1.1 Understanding of the Master Plan as a whole

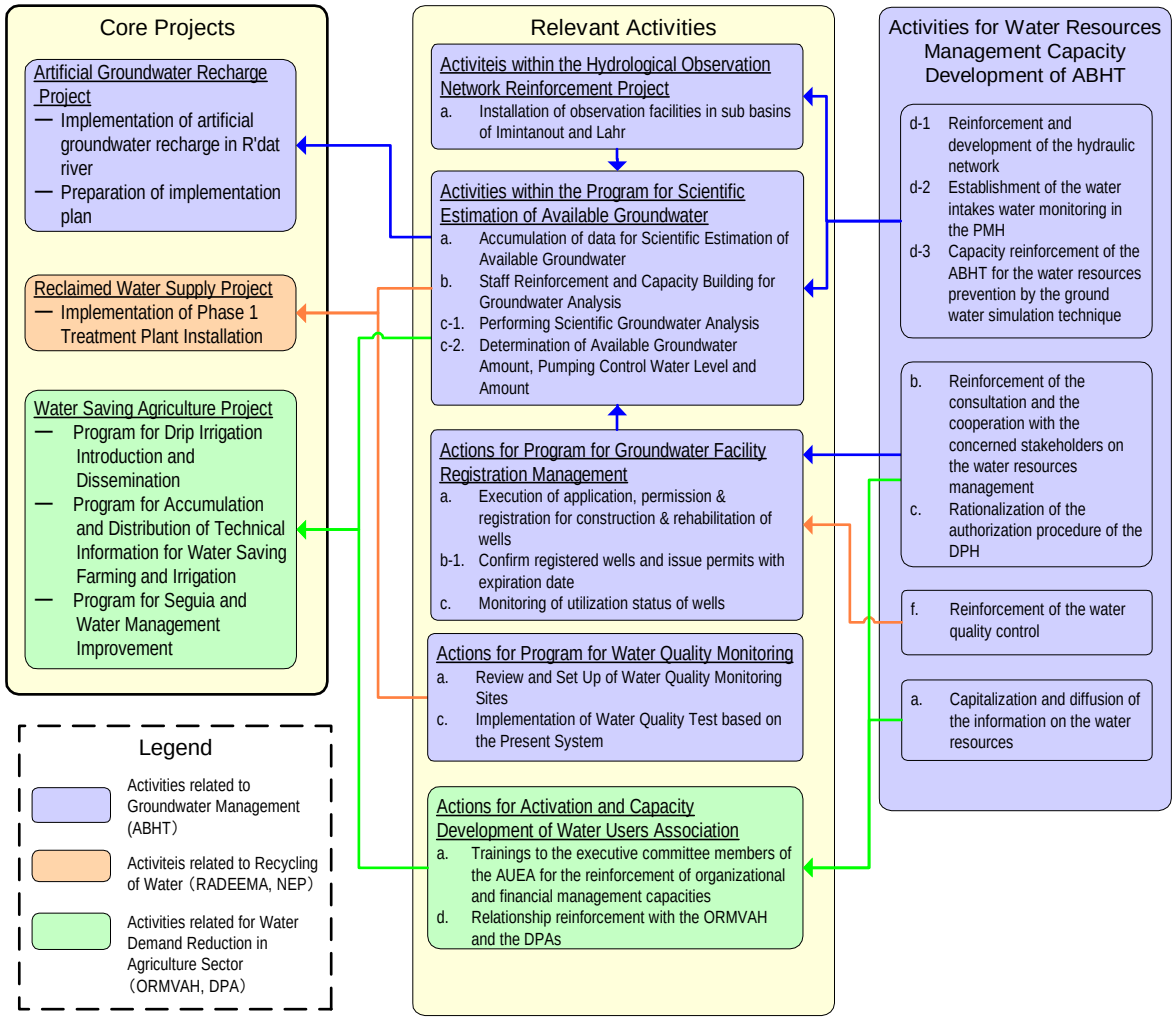
Ensuring the implementation of the programs and projects encompassed in the Master Plan for Integrated Groundwater Resources Management is requisite to secure stable and sustainable water use for both livelihood and agricultural production. Such programs and projects will be implemented based on the comprehensive implementation schedule indicated in the Master Plan. The main pillars of the Master Plan are the "Surface Water Sources Development and Surface Water Resources Management Plan" and "Water Demand Reduction Plan", which directly approach the improvement of the water balance in the Haouz Plain. These Plans are regarded as the "Core Projects", because they not only contribute to realizing the objectives of the Master Plan, but also stand as a model for water balance improvement, which can be applied technically to the water resource management plans in other regions. The Core Projects will involve various stakeholders including RADEEMA, ONEP, ORMVAH, DPAs and ABHT as well as individual farmers and Water User's Associations. Furthermore, the Core Projects will have significant impact in the Implementation of the Master Plan regarding its relatively large scales.

6.1.2 Structure of the Action Plan

The activities, implementing agencies and stakeholders of the Master Plan cover a wide range, where each of the activities are mutually related in order to realize sustainable groundwater use. The action plan targets the implementation of "Core Projects", which are the Projects and Programs that directly contribute to the improvement of the balance of groundwater. Therefore, the Action Plan consists of activities of the Core Projects and other projects / programs to implement the Core Projects, which are to be implemented with in 5 years after the start of the Master Plan.

- Activities needed to be implemented urgently in order to accomplish the goals of the Master Plan
  - The Core Projects of the Master Plan are projects / programs that directly contribute to the improvement of the balance of groundwater. Delay in the implementation of such activities will increase the accumulated loss of the balance within the period of the Master Plan. As result, the groundwater balance may not reach a sustainable state even if the annual water balance is achieved in the Target Year. The effect of activities for development of new water sources and reduction of water demand may take time to actualize, and therefore, should be implemented as soon as possible. The Core Projects, grouped by their implementing agencies are categorized as follows:
    - Artificial Groundwater Recharge and relevant activities
    - Reclaimed Water Supply and relevant activities
    - Water Saving Agriculture (Program for Drip Irrigation Introduction and Dissemination, Program for Seguia and Water Management Improvement, Program for Accumulation and Distribution of Technical Information for Water Saving Farming and Irrigation) and relevant activities.
- Activities required for the effective and efficient implementation of the Master Plan
  - ABHT is the central actor for water resources management in the Haouz Plain, and is in the position to manage the implementation of the Master Plan by coordinating with all other implementing agencies. The administrative role of ABHT is essential for effective and efficient implementation of activities for new water source development and demand reduction by agencies such as RADEEMA, ONEP, ORMVAH and DPAs. Therefore, development of water resources management capacity of ABHT is regarded as one of the most important issues, along with the implementation of the Core Projects. In this regard, the following activities must be carried out.
    - Water Resources Management Capacity Development of ABHT and relevant activities

- Furthermore, the following activities should also be implemented to support the implementation of the Core Projects, to understand their effects for improvement of groundwater balance, and to realize sustainable use of groundwater.
  - ✧ Activities within the Hydrological Observation Network Reinforcement Project, relevant to the Core Projects.
  - ✧ Activities within the Program for Scientific Estimation of Available Groundwater, relevant to the Core Projects.
  - ✧ Activities within the Program for Groundwater Facility Registration Management, relevant to the Core Projects.
  - ✧ Activities within the Program for Water Quality Monitoring, relevant to the Core Projects.
  - ✧ Activities within the Program for Activation and Capacity Development of Water Users Association, relevant to the Core Projects.
- The relations of the Core Projects and relevant activities are shown in the following figure. Furthermore, the list of relevant programs are shown in Table 6.1.1.



Core Projects and Relevant Activities

- Activities required for the implementation structure of the Action Plan
  - As earlier mentioned, the activities of the Master Plan are mutually related with each other in order to realize sustainable use of groundwater. A wide range of stakeholders are involved, including; ABHT, ORMVAH, DPA, RADEEMA, ONEP, Wilaya, Communes, other local

authorities and rural / urban habitants. Therefore, the structuring of a framework coordination / collaboration of such stakeholders is essential for the effective and efficient implementation of the Master Plan. In this regard, the Action Plan will include the following activities in addition to the aforesaid Core Projects and relevant activities.

- ✧ Program for Formulation of Collaboration and Decision - Making Framework for Water Resources Management

6.2 Contents of the Action Plan

The Action Plan for each sector, consisting of components of the Core Projects and relevant activities to be implemented by the year 2012, which is the review period, is as follows

6.2.1 Action Plan for Groundwater Management

(1) Actions for Artificial Groundwater Recharge Project

1) Implementing agency: ABHT

2) Relevant agencies: DRHT

3) Implementation Target: To install artificial groundwater recharge facilities in R'dat River by the year 2010 as a pilot project in order to implement artificial groundwater recharge projects by 2020.

4) Actions

a. Artificial Recharge Project in R'Dat river (pilot project)

a-1. Preparation of Plan for Pilot Project
a-2 Installation of Facilities for Pilot Project
a-3. Monitoring and evaluation of effect for groundwater recharge

b. Preparation of implementation Plan

b-1. Preparation of implementation Plan for the remaining three rivers (Rerhaya, Ourika, and Zat) based on the results of the pilot project in R'dat

(2) Actions for Hydrological Observation Network Reinforcement Project

1) Implementation Agency: ABHT

2) Relevant agencies: RADEEMA, ONEP, ORMVAH, DPA

3) Implementation Target: To install hydrological observation facilities in 2 points where there is no observation being carried out, in order to improve the accuracy of hydrological observation.

4) Actions

a. Installation of observation facilities in the sub-basins of Imintanout River and Lahr River

a-1. Selection of observation points
a-2. Installation of water Marks
a-3. Preparation of observation
a-4. Execution of observation

(3) Actions for Program for Groundwater Facility Registration Management

1) Implementing Agency: ABHT

2) Relevant agencies: Wilaya, Communes

3) Implementation Target: Realize the application, examination and registration of new wells and prepare a database for existing registered and unregistered wells in order to realize registration and monitoring of 100% of groundwater intake facilities in the future.

4) Actions

a. Execution of application, permission & registration for construction & rehabilitation of wells

a-1. Publicize the procedures for the application for new well construction / rehabilitation
a-2. Prepare system for preliminary examination by local authorities
a-3. Prepare database for application and examination results
a-4. Issue permits for well construction / rehabilitation

b. Inventory & preparation of database of registered and unregistered wells

b-1. Confirm registered wells and issue permits with expiration date

c. Monitoring of utilization status of wells

c-1. Regular monitoring of the use of wells

d. Inventory & preparation of database of groundwater intake facilities other than wells

d-1. Realize application, registration and monitoring of all groundwater intake facilities including springs, sub flow and Ketthara

(4) Actions for Program for Scientific Estimation of Available Groundwater

1) Implementing Agency: ABHT

2) Relevant agencies: -

3) Implementation Target: Performing the accurate groundwater analysis by scientific means supported with adequate information

4) Actions

a. Accumulation of data for Scientific Estimation of Available Groundwater

a-1. Accumulation of new Hydro geological Data in the Upper Part of the Aquifer (water level measurement and elevation survey)
a-2. Accumulation of Cultivated Land Information (confirm groundwater irrigated area)
a-3. Accumulation of new hydro geological data (surveys for clarifying the relation of the calcareous layer beneath the aquifer)
a-4. Accumulation of water level data, Leveling of observation wells, Installation of automated piezometers and Observation of groundwater level
a-5. Accumulation of information on groundwater use

b. Staff Reinforcement and Capacity Building for Groundwater Analysis

b-1. Procurement of tools for groundwater analysis
b-2. Training for staff on groundwater analysis and GIS software

c. Performing Scientific Groundwater Analysis

c-1. Performing Scientific Groundwater Analysis
c-2. Determine Available Groundwater Amount, Pumping Control Water Level and Amount

(5) Actions for Program for Water Quality Monitoring

1) Implementing Agency: ABHT

2) Relevant agencies: IRATEE

3) Implementation Target: Implementation of water quality test by 4 times per year for the respective water quality monitoring site

4) Actions

a. Review and Set Up of Water Quality Monitoring Sites
b. Preparation of Improvement Plan of Water Quality Monitoring
c. Implementation of Water Quality Test based on the Present System
d. Implementation of Water Quality Test based on New System

(6) Actions for Program for Water Resources Management Capacity Development of ABHT

1) Implementing agency: ABHT

2) Relevant agencies: -

3) Implementation Target: Improvement and reinforcement of the institutional and technical capacities of the ABHT

4) Actions

a. Capitalization and diffusion of the information on the water resources

a-1 Share and Uniform management of the documents and the data in the ABHT, Installation of the documentation center
a-2 Development of the common information diffusion system in the ABHT
a-3 Development of the common information diffusion system between the concerned structures
a-4 Web site creation and information diffusion to the stakeholders

b. Reinforcement of the consultation and the cooperation with the concerned stakeholders on the water resources management

b-1 Establish a framework for consultation and the cooperation with the concerned stakeholders on the water resources management

c. Rationalization of the authorization procedure of the DPH

c-1 Simplification and promptitude of the authorization procedure
c-2 Quick checking of the declaration and the control of the observation of authorization granting process
c-3 Capacity reinforcement of the service in charge of the authorization deliberation

d. Reinforcement of the monitoring and the evaluation of the water resources

d-1 Reinforcement and development of the hydraulic network
d-2 Establishment of the water intakes water monitoring in the PMH
d-3 Capacity reinforcement of the ABHT for the water resources prevention by the ground water simulation technique

e. Reinforcement of the water quality control

e-1 Reinforcement of the activities and the personnel in charge of the water quality analysis
e-2 Function of the water analysis laboratory

(7) Environmental and Social Considerations

The following are expected as possible impacts that may occur from the implementation of the Action Plan for Groundwater Management.

Changes in Hydrologic Conditions: Artificial groundwater recharge facilities will retain certain amounts of water in the riverbeds of R'dat, Rerhaya, Ourika and Zat. Due to this, the amount of total down flow from these rivers will decrease by some 14.3 million m^3 / year. However, it should be noted that the major portion of water to be recharged is that during floods, which are expected to flow out of the Target Area without being used. Therefore, impact regarding water use in the adjacent areas is expected to be limited. Furthermore, the total amount of river flow exiting from the Target Area to the lower stretches of Tensift River is expected to increase through preservation of groundwater resources, which will be realized through the implementation of the whole Master Plan. In order to confirm that impact due to changes in hydraulic conditions is at a minimum level, monitoring of river flows should be conducted by utilizing the hydrological observation network of ABHT, which will be reinforced through the implementation of this Action Plan. Moreover, in order to avoid future conflicts among the Target Area and the down-stream areas, discussions should be made on the amount of water to be discharged to the down-stream areas through the Collaboration and Decision – Making Framework for Water Resources Management, which will be formulated in the course of implementing the Action Plans.

Groundwater Pumping Control: Management of groundwater resources based on scientific estimation of available groundwater is essential in means of sustainable use of limited groundwater resources. In controlled pumping of groundwater resources, potable water supply will have top priority. On the other hand, users utilizing groundwater for economical activities such as farmers are expected to have certain influence from pumping control. The negative impact by introduction of groundwater pumping control should be mitigated through the provision of technical support to farmers through the implementation of the Program for Drip Irrigation Introduction and Dissemination, which is included in the Action Plans. Also, realistic levels of pumping control should be examined through the Collaboration and Decision – Making Framework for Water Resources Management, which will be formulated in the course of implementing the Action Plans.

(8) Total Estimated Cost: 55.5MDH

(9) Possible Financial Sources

The total cost for the Action Plan for Groundwater Management is 55.53 MDH with the annual expenditure of some 10 MDH. In regard of the scale of activities carried out by ABHT, it may be said that the cost for this Action Plan is not extremely large. In regard of financial aspects, the Action Plan may be carried out within the Moroccan budget. On the other hand, many of the activities involve technical aspects such as decisions based on the situation of water resources and results of analysis. Furthermore, strengthening of the technical capacity of ABHT holds an integral part of the activities. In this regard, it may be more efficient for the strengthening of ABHT to be carried out through technical assistance schemes from donor countries.

(10) Implementation Cost and Schedule

Unit: Million DH

		2008	2009	2010	2011	2012	Remarks
Actions for Artificial Groundwater Recharge Project							
a. Artificial Recharge Project in R'Dat river (pilot project)	Schedule						
	Cost	2.50	4.00	4.00	5.50	2.00	
b. Preparation of implementation Plan	Schedule						
	Cost				4.50		
Cost subtotal	22.5.00	2.50	4.00	4.00	10.00	2.00	
Actions for Hydrological Observation Network Reinforcement Project							
a. Installation of observation facilities in the sub-basins of Imintanout River and Lahr River	Schedule						
	Cost		0.5				
Cost subtotal	0.5		0.5				
Actions for Program for Groundwater Facility Registration Management							
a. Execution of application, permission & registration for construction & rehabilitation of wells	Schedule						
	Cost	0.12	0.12	0.12	0.12	0.12	
b. Inventory & preparation of database of registered and unregistered wells	Schedule						
	Cost	1.10	1.00	1.00			
c. Monitoring of utilization status of wells	Schedule						To be implemented through normal works of ABHT
	Cost	-	-	-	-	-	
d. Inventory & preparation of database of groundwater intake facilities other than wells	Schedule						
	Cost					1.00	
Cost subtotal	4.70	1.22	1.12	1.12	0.12	1.12	
Actions for Program for Scientific Estimation of Available Groundwater							
a. Accumulation of data for Scientific Estimation of Available Groundwater	Schedule						
	Cost	2.90	1.50	1.50	0.50	0.50	
b. Staff Reinforcement and Capacity Building for Groundwater Analysis	Schedule						
	Cost	4.10					
c. Performing Scientific Groundwater Analysis	Schedule						
	Cost		0.60	0.10	0.60	0.10	
Cost subtotal	12.40	7.00	2.10	1.60	1.10	0.60	

Actions for Program for Water Quality Monitoring							
a. Review and Set Up of Water Quality Monitoring Sites	Schedule	■					To be implemented through normal works of ABHT
	Cost	-					
b. Preparation of Improvement Plan of Water Quality Monitoring	Schedule		■				To be implemented through normal works of ABHT
	Cost		-				
c. Implementation of Water Quality Test based on the Present System	Schedule	■	■				
	Cost	0.58	0.58				
d. Implementation of Water Quality Test based on New System	Schedule			■	■	■	
	Cost			3.94	3.94	3.94	
Cost subtotal		12.98	0.58	0.58	3.94	3.94	3.94	
Actions for Program for Water Resources Management Capacity Development of ABHT							
a. Capitalization and diffusion of the information on the water resources	Schedule	■	■	■	■	■	
	Cost	0.077	0.072	0.077	0.077	0.072	
b. Reinforcement of the consultation and the cooperation with the concerned stakeholders on the water resources management	Schedule	■	■	■	■	■	To be implemented through normal works of ABHT
	Cost	-	-	-	-	-	
c. Rationalization of the authorization procedure of the DPH	Schedule			■	■	■	
	Cost			0.24	0.24	0.24	
d. Reinforcement of the monitoring and the evaluation of the water resources	Schedule		■		■		
	Cost		1.34		0.01		
e. Reinforcement of the water quality control	Schedule			■	■	■	To be implemented through actions for water quality monitoring
	Cost			-	-	-	
Cost subtotal		2.45	0.077	1.412	0.317	0.318	0.321	
Total Cost		55.53	11.38	9.71	10.98	15.48	7.98	

6.2.2 Action Plan for Reclaimed Water Supply

(1) Actions for Reclaimed Water Supply Project

1) Implementing Agency: RADEEMA

2) Relevant agencies: ONEP, ABHT

3) Implementation Target: To start producing 52,600m^3/day of treated waste water usable for the irrigation of golf courses by 2010

4) Actions

a. Installation of Water Treatment Plant (Phase 1)

a-1 Reclaimed water supply planning, design, tender & contract
a-2 Construction of tertiary treatment plan
a-3 Construction of water distribution facilities
a-4 Operation of reclaimed water supply facilities

(2) Environmental and Social Considerations

The following are expected as possible impacts that may occur from the implementation of the Action Plan for Reclaimed Water Supply.

The planned distribution route at this moment is mainly along roads. Therefore, the issue of land acquisition is expected to be minor. Furthermore, majority of the surrounding area are agricultural fields and effect of construction works to the living environment of local residents are also expected to be limited. In general, the impact of this Action Plan is expected to be minor. However, to further minimize the impact, considerations should be made for items such as; watering of construction sites to minimize dust, installation of fences around the work site, appropriate maintenance of construction machines, restriction of construction works during night time, etc.

(3) Total Estimated Cost: 354.1MDH

(4) Possible Financial Sources

Currently, RADEEMA is planning / implementing a project for sewerage treatment in Marrakech.

This project is already aiming at selling treated water to the golf courses. Depending on the price of the treated waste water, the cost for installation of the tertiary treatment and distribution facilities can be covered from with the water selling. The cost for this Action Plan is 354.1 MDH and is considerably large. However, this is not extremely high compared o the operation scale of RADEEMA, and it is assumed that it is possible to be carried out through Moroccan Budget or by Loans from other donor countries.

(5) Implementation Cost and Schedule

Unit: Million DH

		2008	2009	2010	2011	2012	Remarks
Actions for Reclaimed Water Supply Project							
a. Installation of Water Treatment Plant (Phase 1)	Schedule						Budget for tertiary plant and distribution network only, because current project covers the secondary treatment level.
	Cost	3.50	185.33	94.67	35.30	35.30	
Cost subtotal	354.10	3.50	185.33	94.67	35.30	35.30	
Total Cost	354.10	3.50	185.33	94.67	35.30	35.30	

6.2.3 Action Plan for Water Efficient Agriculture

(1) Actions for Program for Drip Irrigation Introduction and Dissemination

1) Implementing agency: ORMVAH

2) Relevant agencies: DPA, AUEA, ABHT

3) Implementation Target: To install drip irrigation systems to 100% of pressurized GH sector in the right bank of N'Fis (uby 2021) and PMH in the left bank of N'Fis (including pump irrigation area in N4 sector, by 2009), in order to realize installation of drip irrigation system to 70,000ha by 2012. In addition to the above, drip system will also be installed to PMH sectors at 3,000 ha / year

4) Actions

a. Defining Priority Area for and Introduction Plan for Drip Irrigation (PMH sector in left bank of N'Fis)

a-1 Installation of drip irrigation system in 100% of the pressurized GH sector in the right bank of N'Fis

a-2 Installation of Pipeline and Outlet (Pressurized GH sector on N'Fis right bank)

b. Defining Priority Area for and Introduction Plan for Drip Irrigation (PMH sector irrigated by groundwater)

b-1 Installation of drip irrigation system in 100% of the PMH sector on the left bank of the N'Fis river (including pump irrigation area in N4 sector)

b-2 Installation of drip irrigation system in 3,000 ha/year of the other PMH area using groundwater for irrigation

c. Subsidies for Installing Drip Irrigation

c-1 Improvement of system for subsidy application (simplification of procedure, loosen mortgage regulations, speed up process)

c-2 Providing subsidy

d. Supports for Procedures of Subsidy and Establishment of Consultation Desk

d-1 Strengthen consultation functions of ORMVAH and DPA

d-2 Support for procedures by ORMVAH and DPA

e. Extension and Guidance of Water Saving Irrigation

e-1 Preparation of guidance / dissemination plan

e-2 Implementation of guidance / dissemination plan

(2) Actions for Program for Accumulation and Distribution of Technical Information for Water Saving Farming and Irrigation

1) Implementing agencies: ORMVAH

2) Relevant agencies: DPA, AUEA, ABHT

3) Implementation Target: To develop and accumulate a technology on water saving agriculture, to transmit information to farmers, and to establish a framework for dissemination of water saving irrigation.

4) Actions

a. Development of the techniques of the water saving irrigation and accumulation of the technical information

a-1 Development of the techniques of the water saving irrigation and accumulation of the technical information

b. Development of the techniques of the water saving farming and selection of crop/variety

b-1 Development of the techniques of the water saving farming and selection of crop/variety

c. Extension and enlightening of water saving farming and irrigation

c-1 Establishment of structure for extension, centering CMV, CTE and CV
c-2 Preparation of plan for extension and enlightening of water saving farming and irrigation
c-3 Implementation of plan for extension and enlightening of water saving farming and irrigation

(3) Actions for Program for Seguia and Water Management Improvement

1) Implementing agency: ORMVAH

2) Relevant agencies: DPA, AUEA, ABHT

3) Implementation target: To examine the functions of seguias on groundwater recharge and to strengthen the capacity of WUAs for operation and maintenance, in order to improve water management efficiency of surface water use.

4) Actions

a. Survey for the clarification of the groundwater recharge function of seguias

a-1 Survey for the clarification of the groundwater recharge function of seguias

b. Strengthening of Activities of WUAs for Operation and Maintenance of Seguias

b-1 Program for strengthening and vitalizing WUAs
b-2 Execution of operation and maintenance activities by WUAs

c. Establishment of Monitoring System for Water Use in Seguias System by WUAs

c-1 Program for strengthening and vitalizing WUAs
c-2 Establishment of monitoring structure (location of personnel, installation of necessary equipment / material)
c-3 Execution of monitoring

(4) Actions for Activation and Capacity Development of Water Users Association

1) Implementing agency: ORMVAH

2) Relevant agencies: DPA, AUEA, ABHT

3) Implementation Target: Capacities Reinforcement of the water management by the training of management and technique

4） Actions

a. Trainings to the executive committee members of the AUEA for the reinforcement of organizational and financial management capacities

a-1 Trainings to the executive committee members of the AUEA for the reinforcement of organizational and financial management capacities

b. Relationship reinforcement with the ORMVAH and the DPAs

b-1 Relationship reinforcement with the ORMVAH and the DPAs

(5) Environmental and Social Considerations

The following are expected as possible impacts that may occur from the implementation of the Action Plan for Water Efficient Agriculture.

Introduction of Water Saving (Drip) Irrigation: It is expected that introduction of drip irrigation will bare economic burden to individual farmers. Currently, the government is providing subsidies for introduction of drip irrigation, and is also planning a raise in the amount of subsidy. However, due to difficult conditions for application and timing of delivery, this mechanism is not fully utilized. The procedure of this subsidy shall be improved through the activities of this Action Plan. Moreover, economical burden of the farmers shall be further mitigated through the Program for Accumulation and Distribution of Technical Information for Water Saving Farming and Irrigation, disseminating agricultural technology to bear maximum benefit from limited amount of water.

(6) Total Estimated Cost: 1,321.7MDH

(7) Possible Financial Sources

The cost for the Action Plan for Water Demand Reduction in the Agriculture Sector is 1,321.7. The majority of this massive budget is required for the introduction of drip irrigation system to priority areas. In regard of its importance to water balance and the economic benefits to farmers (section 5.6.7), the introduction of drip system may be implemented by Moroccan budget or by loans from other donor countries. On the other hand, other programs with relevantly small costs and significant technical aspects can be implemented by Moroccan budget or through technical assistance schemes from other donor countries.

(8) Implementation Cost and Schedule **Unit: Million DH**

		2008	2009	2010	2011	2012	Remarks
Actions for Program for Drip Irrigation Introduction and Dissemination							
a. Defining Priority Area for and Introduction Plan for Drip Irrigation (PMH sector in left bank of N'Fis)	Schedule						
	Cost	96.70	193.40	193.40	193.40	193.40	
b. Defining Priority Area for and Introduction Plan for Drip Irrigation (PMH sector irrigated by groundwater)	Schedule						
	Cost	88.40	88.30	88.30	88.30	88.30	
c. Subsidies for Installing Drip Irrigation	Schedule						To be implemented through normal works
	Cost	-	-	-	-	-	
d. Supports for Procedures of Subsidy and Establishment of Consultation Desk	Schedule						To be implemented through normal works
	Cost	-					
e. Extension and Guidance of Water Saving Irrigation	Schedule						To be implemented through normal works
	Cost	-	-	-	-	-	
Cost subtotal	1311.90	185.10	281.70	281.70	281.70	281.70	
Actions for Program for Accumulation and Distribution of Technical Information for Water Saving Farming and Irrigation							
a. Development of the techniques of the water saving irrigation and accumulation of the technical information	Schedule						
	Cost	0.50	0.50	0.50	0.50	0.50	

b. Development of the techniques of the water saving farming and selection of crop/variety	Schedule						
	Cost	0.50	0.50	0.50	0.50	0.50	
c. Extension and enlightening of water saving farming and irrigation	Schedule						
	Cost	0.50	0.50	0.50	0.50	0.50	
Cost subtotal	7.50	1.50	1.50	1.50	1.50	1.50	
Actions for Program for Seguia and Water Management Improvement							
a. Survey for the clarification of the groundwater recharge function of seguias	Schedule						
	Cost	1.00	1.00				
b. Strengthening of Activities of WUAs for Operation and Maintenance of Seguias	Schedule						To be implemented by efforts of WUAs
	Cost	-	-	-	-	-	
c. Establishment of Monitoring System for Water Use in Seguias System by WUAs	Schedule						To be implemented by efforts of WUAs
	Cost	-	-	-	-	-	
Cost subtotal	2.00	1.00	1.00				
Actions for Activation and Capacity Development of Water Users Association							
a. Trainings to the executive committee members of the AUEA for the reinforcement of organizational and financial management capacities	Schedule						
	Cost		0.13		0.13		
b. Relationship reinforcement with the ORMVAH and the DPAs	Schedule						To be implemented through normal works
	Cost	-	-	-	-	-	
Cost subtotal	0.26		0.13		0.13		
Total Cost	1,321.66	187.60	284.33	283.20	283.33	283.20	

6.2.4 Implementation Structure of the Action Plan

The activities of indicated in the Action Plans will be basically carried out within the framework of the Master Plan. In other words, the Action Plan will be implemented by individual implementing agencies with close coordination with ABHT. On the other hand, a framework for consultation and decision making among stakeholders including implementing agencies, relevant agencies and residents shall be formulated to enable smooth implementation of the Action Plan.

(1) Formulation of Collaboration and Decision - Making Framework for Water Resources Management

1) Implementing agency: ABHT

2) Relevant agencies: Stakeholders of water resources management in the Tensift Basin (refer to section 4.6.1)

3) Implementation Target: Establishment of the framework of the consultation and decision-making with participation of the concerned stakeholders

4) Framework for consultation and decision making

The framework for consultation and decision making for the implementation of the Action Plan is basically the same with that indicated in the "Program for Formulation of Collaboration and Decision – Making Framework for Water Resources Management" under the Master Plan (Section 5.4.6 (1)). Out of this framework, the activities required for the smooth implementation of the Core Projects and relevant activities indicated in the Action Plan in summarized. However, it should be noted that other activities within the framework should also be implemented as required.

a. Establishment of the Tensift Basin Committee

The Tensift Basin Committee shall be established and the following issues should be discussed.

- To establish a consultation framework of the water resources management in the Haouz plain with the participation of all stakeholders;
- To clarify the responsibility and the role of the stakeholders;

- To share and diffuse the information on the water resources situation;
- To examine and approve the proposals elaborated by the thematic commissions;
- To examine and approve the adequate necessary countermeasures for the management and the control of the water resources;
- To concert, examine, approve and sign the agreement of the ground water management (contract de nappe);
- To formulate a report on the project of the Master Plan of the Integrated Water Resources Development (PDAIRE) before its tender to the governmental authorities concerned with the water management;

The Tensift Basin Committee will be chaired by the Wali of the Marrakech-Tensift-Al Haouz Region; it will meet by the convocation of its president and at least once all two (2) years. The secretariat of the Committee will be ensured by the ABHT.

The members of the Tensift Basin Committee will be fixed by joint decision of the Minister of Land Management, Water and Environment (MATEE) and the Minister of Interior, after opinions of the Minister of Agriculture, Rural Development and Martine Fishery, and the Minister of Finance and Privatization, and the High commissioner of Water and Forest and to combat against Desertification. The members will be envisaged in the following table.

The members of the Tensift Basin Committee (Project)

Administrative structures	Local Communities	Water users and socio-professional Associations, Private sectors, NGO
ABHT, ORMVAH, DPA (Marrakech and Chichaoua）, ONEP, RADEEMA, ONE, DREF, Urban Agency of Marrakech, DPE, Regional Delegation of the Plan, DRT and DPT, INRA	CRMTH, Provinces (Water Service), CPPE, Local Authorities, Communal Council Representation	AUEA, AEP, Agricultural Chamber, Commerce and Industry Chamber, CNCA, Associations for the development, NGO

b. Establishment of the Thematic Commissions

Thematic commissions shall be established under the Tensift Basin Committee to discuss important issues among the relevant stakeholders. The thematic commissions related to the implementation of the Action Plan are as follows.

Thematic Commissions to be Established for the Implementation of the Action Plan

Thematic Commissions	Envisaged members of commissions	Roles and activities of commissions
Valorization of water in the agricultural sector	ORMVAH 、 ABHT, DPA (Marrakech/Chichaoua), Agricultural Chamber AUEA, CNCA, INRA	・To examine the strategy for the generalization and conversion of the drip irrigation system (simplification of a system of the subsidy procedure, diffusion method etc); ・To examine the varieties and the farming techniques which are more draught-resistant and high economical values
Water saving in the tourist and urban sectors	ABHT, DRT, CRT, Chamber of Commerce and Industry, Hotel Association, Urban Agency, CRMTH, Provinces, ONEP, RADEEMA	・To examine the strategy and the approaches for the water saving in the tourist sector (Golf, Hotel etc); ・To examine the strategy and the approaches for the water saving in the green spaces, the parks and the habitats
Enlightenment and communication	ABHT, CRMTH, Willaya / MHT, Provinces	・To elaborate a Plan of enlightenment and communication of the integrated water resources management; ・To elaborate the tools and the supports of communication for the water saving and the integrated water resources management (Presses, Articles in the newspapers and magazines, Posters, Booklets, Stickers, Spots, Web site, Radio and TV transmissions etc); ・To elaborate a program of the school establishments on the water resources management (schools, colleges etc); ・To examine the implementation approach for the information and the enlightenment campaign on the integrated water resources management to general public; ・To conceptualize and prepare the manuals on the water saving techniques (Irrigation, tourism, industry, domestic)

(2) Implementation Cost and Schedule

ABHT, in consultation with the Wilaya of Marrakech, Tensift Al Haouz region will be in charge the establishment of the framework for consultation and decision making for the implementation of the Action Plan. The required cost and schedule is summarized below.

Unit: Million DH

		2008	2009	2010	2011	2012	Remarks
Formulation of Collaboration and Decision – Making Framework for Water Resources Management							
a. Establishment of the Tensift Basin Committee	Schedule						
	Cost		0.05		0.05		
b. Establishment of the Thematic Commissions	Schedule						
	Cost	0.04	0.04	0.04	0.04	0.04	
Total Cost	0.30	0.04	0.09	0.04	0.09	0.04	

6.3 Implementation Schedule of the Action Plan

The schedule for the Action Plans mentioned in this Chapter, including the Formulation of Collaboration and Decision - Making Framework for Water Resources Management is summarized in the following table.

	2008	2009	2010	2011	2012
Actions for Artificial Groundwater Recharge Project					
a. Artificial Recharge Project in R'Dat river (pilot project)					
b. Preparation of implementation Plan					
Actions for Hydrological Observation Network Reinforcement Project					
a. Installation of observation facilities in the sub-basins of Imintanout River and Lahr River					
Actions for Program for Groundwater Facility Registration Management					
a. Execution of application, permission & registration for construction & rehabilitation of wells					
b. Inventory & preparation of database of registered and unregistered wells					
c. Monitoring of utilization status of wells					
d. Inventory & preparation of database of groundwater intake facilities other than wells					
Actions for Program for Scientific Estimation of Available Groundwater					
a. Accumulation of data for Scientific Estimation of Available Groundwater					
b. Staff Reinforcement and Capacity Building for Groundwater Analysis					
c. Performing Scientific Groundwater Analysis					
Actions for Program for Water Quality Monitoring					
a. Review and Set Up of Water Quality Monitoring Sites					
b. Preparation of Improvement Plan of Water Quality Monitoring					
c. Implementation of Water Quality Test based on the Present System					
d. Implementation of Water Quality Test based on New System					
Actions for Program for Water Resources Management Capacity Development of ABHT					
a. Capitalization and diffusion of the information on the water resources					
b. Reinforcement of the consultation and the cooperation with the concerned stakeholders on the water resources management					
c. Rationalization of the authorization procedure of the DPH					
e. Reinforcement of the monitoring and the evaluation of the water resources					
f. Reinforcement of the water quality control					
Actions for Reclaimed Water Supply Project					
a. Installation of Water Treatment Plant (Phase 1)					
Actions for Program for Drip Irrigation Introduction and Dissemination					
a. Defining Priority Area for and Introduction Plan for Drip Irrigation (PMH sector in left bank of N'Fis)					
b. Defining Priority Area for and Introduction Plan for Drip Irrigation (PMH sector irrigated by groundwater)					
c. Subsidies for Installing Drip Irrigation					
d. Supports for Procedures of Subsidy and Establishment of Consultation					

Desk						
e. Extension and Guidance of Water Saving Irrigation						
Actions for Program for Accumulation and Distribution of Technical Information for Water Saving Farming and Irrigation						
a. Development of the techniques of the water saving irrigation and accumulation of the technical information						
b. Development of the techniques of the water saving farming and selection of crop/variety						
c. Extension and enlightening of water saving farming and irrigation						
Actions for Program for Seguia and Water Management Improvement						
a. Survey for the clarification of the groundwater recharge function of seguias						
b. Strengthening of Activities of WUAs for Operation and Maintenance of Seguias						
c. Establishment of Monitoring System for Water Use in Seguias System by WUAs						
Actions for Activation and Capacity Development of Water Users Association						
a. Trainings to the executive committee members of the AUEA for the reinforcement of organizational and financial management capacities						
b. Relationship reinforcement with the ORMVAH and the DPAs						
Formulation of Collaboration and Decision – Making Framework for Water Resources Management						
a. Establishment of the Tensift Basin Committee						
b. Establishment of the Thematic Commissions						

6.4 Implementation Cost of the Action Plan

The Cost for the Action Plans mentioned in this Chapter, including the Formulation of Collaboration and Decision - Making Framework for Water Resources Management is summarized in the following table.

Unit: Million DH

		2008	2009	2010	2011	2012	Remarks
Actions for Artificial Groundwater Recharge Project							
a. Artificial Recharge Project in R'Dat river (pilot project)		2.50	4.00	4.00	5.50	2.00	
b. Preparation of implementation Plan					4.50		
Cost subtotal	17.00	2.50	4.00	4.00	10.00	2.00	
Actions for Hydrological Observation Network Reinforcement Project							
a. Installation of observation facilities in the sub-basins of Imintanout River and Lahr River			0.5				
Cost subtotal	0.5		0.5				
Actions for Program for Groundwater Facility Registration Management							
a. Execution of application, permission & registration for construction & rehabilitation of wells		0.12	0.12	0.12	0.12	0.12	
b. Inventory & preparation of database of registered and unregistered wells		1.10	1.00	1.00			
c. Monitoring of utilization status of wells		-	-	-	-	-	To be implemented through normal works of ABHT
d. Inventory & preparation of database of groundwater intake facilities other than wells						1.00	
Cost subtotal	4.70	1.22	1.12	1.12	0.12	1.12	
Actions for Program for Scientific Estimation of Available Groundwater							
a. Accumulation of data for Scientific Estimation of Available Groundwater		2.90	1.50	1.50	0.50	0.50	
b. Staff Reinforcement and Capacity Building for Groundwater Analysis		4.10					
c. Performing Scientific Groundwater Analysis			0.60	0.10	0.60	0.10	
Cost subtotal	12.40	7.00	2.10	1.60	1.10	0.60	
Actions for Program for Water Quality Monitoring							
a. Review and Set Up of Water Quality Monitoring Sites		-					To be implemented through normal works of ABHT
b. Preparation of Improvement Plan of Water Quality Monitoring			-				
c. Implementation of Water Quality Test based on the Present System		0.58	0.58				
d. Implementation of Water Quality Test based on New System				3.94	3.94	3.94	
Cost subtotal	12.98	0.58	0.58	3.94	3.94	3.94	

Actions for Program for Water Resources Management Capacity Development of ABHT							
a. Capitalization and diffusion of the information on the water resources		0.077	0.072	0.077	0.077	0.072	
b. Reinforcement of the consultation and the cooperation with the concerned stakeholders on the water resources management		-	-	-	-	-	To be implemented through normal works of ABHT
c. Rationalization of the authorization procedure of the DPH				0.24	0.24	0.24	
e. Reinforcement of the monitoring and the evaluation of the water resources			1.34		0.01		
f. Reinforcement of the water quality control				-	-	-	To be implemented through actions for water quality monitoring
Cost subtotal	2.45	0.077	1.412	0.317	0.317	0.322	
Actions for Reclaimed Water Supply Project							
a. Installation of Water Treatment Plant (Phase 1)		3.50	185.33	94.67	35.30	35.30	Budget for tertiary plant and distribution network only, because current project covers the secondary treatment level.
Cost subtotal	354.10	3.50	185.33	94.67	35.30	35.30	
Actions for Program for Drip Irrigation Introduction and Dissemination							
a. Defining Priority Area for and Introduction Plan for Drip Irrigation (PMH sector in left bank of N'Fis)		96.70	193.40	193.40	193.40	193.40	
b. Defining Priority Area for and Introduction Plan for Drip Irrigation (PMH sector irrigated by groundwater)		88.40	88.30	88.30	88.30	88.30	
c. Subsidies for Installing Drip Irrigation		-	-	-	-	-	To be implemented through normal works
d. Supports for Procedures of Subsidy and Establishment of Consultation Desk		-					To be implemented through normal works
e. Extension and Guidance of Water Saving Irrigation		-	-	-	-	-	To be implemented through normal works
Cost subtotal	1311.90	185.10	281.7	281.7	281.7	281.7	
Actions for Program for Accumulation and Distribution of Technical Information for Water Saving Farming and Irrigation							
a. Development of the techniques of the water saving irrigation and accumulation of the technical information		0.50	0.50	0.50	0.50	0.50	
b. Development of the techniques of the water saving farming and selection of crop/variety		0.50	0.50	0.50	0.50	0.50	
c. Extension and enlightening of water saving farming and irrigation		0.50	0.50	0.50	0.50	0.50	
Cost subtotal	7.50	1.50	1.50	1.50	1.50	1.50	
Actions for Program for Seguia and Water Management Improvement							
a. Survey for the clarification of the groundwater recharge function of seguias		1.00	1.00				
b. Strengthening of Activities of WUAs for Operation and Maintenance of Seguias		-	-	-	-	-	To be implemented by efforts of WUAs
c. Establishment of Monitoring System for Water Use in Seguias System by WUAs		-	-	-	-	-	To be implemented by efforts of WUAs
Cost subtotal	2.00	1.00	1.00				
Actions for Activation and Capacity Development of Water Users Association							
a. Trainings to the executive committee members of the AUEA for the reinforcement of organizational and financial management capacities			0.13		0.13		
b. Relationship reinforcement with the ORMVAH and the DPAs		-	-	-	-	-	To be implemented through normal works
Cost subtotal	0.26		0.13		0.13		
Formulation of Collaboration and Decision – Making Framework for Water Resources Management							
a. Establishment of the Tensift Basin Committee			0.05		0.05		
b. Establishment of the Thematic Commissions		0.04	0.04	0.04	0.04	0.04	
Cost subtotal	0.30	0.04	0.09	0.04	0.09	0.04	
Total Cost	1,731.59	202.52	479.46	388.89	334.20	326.52	

Table 6.1.1 Relation of the Activities of the Master Plan with the Core Projects

Project / Program	Activities to be implemented in early stage	Artificial Groundwater Recharge Project	Reclaimed Water Supply Project	Water Saving Agriculture Project
Artificial Groundwater Recharge Project				
a. Artificial Recharge Project in R'Dat river (pilot project)	a-1. Preparation of Plan for Pilot Project	○		
	a-2. Installation of Facilities for Pilot Project	○		
	a-3. Monitoring and evaluation of effect for groundwater recharge	○		
	a-4. Continuation of artificial recharge by pilot project	○		
b. Preparation of implementation Plan	b. Preparation of implementation Plan	○		
c. Implementation of Artificial Recharge Project	c. Implementation of Artificial Recharge Project			
Reclaimed Water Supply Project				
a. Installation of Water Treatment Plant (Phase 1)	a-1. Reclaimed water supply planning, design, tender & contract		○	
	a-2. Construction of tertiary treatment plan		○	
	a-3. Construction of water distribution facilities		○	
	a-4. Operation of reclaimed water supply facilities		○	
b. Installation of Water Treatment Plant (Phase 2)	b-1. Enhancement of treatment planed			
	b-2. Enhancement of distribution facilities			
	b-3. Operation of reclaimed water supply facilities			
Hydrological Observation Network Reinforcement Project				
a. Installation of Observation Facilities in the Sub-basins of Imintanout and Lahr	a-1. Selection of observation point	○		
	a-2. Installation of watermarks	○		
	a-3. Preparation of observation	○		
	a-4. Observation	○		
b. Installation of automated measurement devices	b. Installation of automated piezometers at 5 observation points			
Program for Groundwater Facility Registration Management				
a. Execution for application, permission & registration for construction & rehabilitation of wells	a-1. Publicize the procedures for the application for new well construction / rehabilitation	○		
	a-2. Prepare system for preliminary examination by local authorities	○		
	a-3. Prepare database for application and examination results	○		
	a-4. Issue permits for well construction / rehabilitation	○		
b. Inventory & preparation of database of registered and unregistered wells	b-1. Confirm registered wells and issue permits with expiration date	○		
	b-2. Re-issue permit every 5 to 10 years			
c. Monitoring of utilization status of wells	c-1. Regular monitoring of the use of wells	○		
d. Inventory & preparation of database of groundwater intake facilities other than wells	d-1. Realize application, registration and monitoring of all groundwater intake facilities including springs, sub flow and Ketthara			
Program for Scientific Estimation of Available Groundwater				
a. Accumulation of data for Scientific Estimation of Available Groundwater	a-1. Accumulation of new Hydro geological Data in the Upper Part of the Aquifer (water level measurement and elevation survey)	○	○	○
	a-2. Accumulation of Cultivation Land Information (confirmation of groundwater irrigated area)	○	○	○
	a-3. Accumulation of new hydro geological data (surveys for clarifying the relation of the calcareous layer beneath the aquifer)	○	○	○
	a-4. Accumulation of water level data	○	○	○
	a-4-1. Leveling of observation wells	○	○	○
	a-4-2. Installation of automated piezometers	○	○	○
	a-4-3. Observation of groundwater level	○	○	○
	a-5. Accumulation of information on groundwater use	○	○	○
b. Staff Reinforcement and Capacity Building for Groundwater Analysis	b-1. Procurement of tools for groundwater analysis	○	○	○
	b-2. Training for staff on groundwater analysis and GIS software	○	○	○
c. Performing Scientific Groundwater Analysis	c-1. Performing Scientific Groundwater Analysis	○	○	○
	c-2. Determination of Available Groundwater Amount, Pumping Control Water Level and Amount	○	○	○
	c-3. Preparation of Groundwater Management Manual			
Program for Water Quality Monitoring				
a. Review and Set Up of Water Quality Monitoring Sites	a. Review and Set Up of Water Quality Monitoring Sites		○	
b. Preparation of Improvement Plan of Water Quality Monitoring	b. Preparation of Improvement Plan of Water Quality Monitoring			
c. Implementation of Water Quality Test based on the Present System	c. Implementation of Water Quality Test based on the Present System		○	
d. Implementation of Water Quality Test based on New System	d. Implementation of Water Quality Test based on New System		○	

Project / Program	Activities to be implemented in early stage	Artificial Groundwater Recharge Project	Reclaimed Water Supply Project	Water Saving Agriculture Project
Program for Drip Irrigation Introduction and Dissemination				
a. Defining Priority Area for and Introduction Plan for Drip Irrigation	a-1. Installation of drip irrigation system in 100% of the PMH sector on the left bank of the N'Fis river (including pump irrigation area in N4 sector)			○
	a-2. Installation of drip irrigation system in 100% of the pressurized GH sector in the right bank of N'Fis			○
	a-3. Installation of drip irrigation system in 3,000 ha/year of the other PMH area using groundwater for irrigation			
	a-4. Installation of drip irrigation system to 50% of the other GH sectors			
b. Installation of Pipeline and Outlet (Pressurized GH sector on N'Fis right bank)	b. Installation of Pipeline and Outlet (Pressurized GH sector on N'Fis right bank)			○
c. Subsidies for Installing Drip Irrigation	c-1. Improvement of system for subsidy application (simplification of procedure, loosen mortgage regulations, speed up process)			○
	c-2. Providing subsidy			○
d. Supports for Procedures of Subsidy and Establishment of Consultation Desk	d-1. Strengthen consultation functions of ORMVAH and DPA			○
	d-2. Support for procedures by ORMVAH and DPA			○
e. Administrative Guidance through Authorization of Well Construction	e-1 Administrative guidance through authorization of well construction			
f. Extension and Guidance of Water Saving Irrigation	f-1. Preparation of guidance / dissemination plan			○
	f-2. Implementation of guidance / dissemination plan			○
Program for Seguia and Water Management Improvement				
a. Survey for the clarification of the groundwater recharge function of seguias	a. Execution of survey for the clarification of the groundwater recharge function of seguias			○
b. Strengthening of Activities of WUAs for Operation and Maintenance of Seguias	b-1. Program for strengthening and vitalizing WUAs (Participatory water resources management plan)			○
	b-2. Execution of operation and maintenance activities by WUAs			○
c. Establishment of Monitoring System for Water Use in Seguias System by WUAs	c-1. Program for strengthening and vitalizing WUAs (Participatory water resources management plan)			○
	c-2. Establishment of monitoring structure (location of personnel, installation of necessary equipment / material)			○
	c-3. Execution of monitoring			○
Program for Accumulation and Distribution of Technical Information for Water Saving Farming and Irrigation				
a. Development of the techniques of the water saving irrigation and accumulation of the technical information	a. Development of the techniques of the water saving irrigation and accumulation of the technical information			○
b. Development of the techniques of the water saving farming and selection of crop/variety	b. Development of the techniques of the water saving farming and selection of crop/variety			○
c. Extension and enlightening of water saving farming and irrigation	c-1. Establishment of structure for extension, centering CMV, CTE and CV			○
	c-2. Preparation of plan for extension and enlightening of water saving farming and irrigation			○
	c-3. Implementation of plan for extension and enlightening of water saving farming and irrigation			○
Water Supply Leakage Control Project				
a. Urgent water leakage control measures	a-1 Organize an urgent water leakage control task team and carry out the intensive inspection			
	a-2 Requesting the residents in public information to report water leakage points			
	a-3 Repair of water leakage points			
b. Water leakage control measures by decreasing water distribution pressure	b-1 Survey the residual water pressure at the far end of the distribution pipes			
	b-2 Specify the water distribution blocks where the water distribution pressure is excessively high			
	b-3 Decrease the water distribution pressure tentatively for the specified water distribution blocks			
	b-4 Decrease water distribution pressure for necessary points			
c. Formulation of water leakage control plan	c-1 Define blocks for water leakage control plan			
	c-2 Survey each block and prepare implementation plan and budget plan for repair works			

Project / Program		Activities to be implemented in early stage	Artificial Groundwater Recharge Project	Reclaimed Water Supply Project	Water Saving Agriculture Project
d. Formulation of improvement plan to structure efficient water distribution network	d-1	Preparation of plan to structure efficient water distribution network enabling water distribution with minimum pressure and uniform distribution			
	d-2	Prepare improvement plan of replacement of aged pipes, installation of additional pipelines, water distribution block valves, water pressure meters & flow meters, to improve efficiency of the distribution network			
	d-3	Prepare and utilize distribution network information system			
e. Regular water leakage survey and repair works	e-1	Field survey using the water leakage detectors and the result of observation of water distribution pressure and flow rate. Analyze result and repair necessary points			

Project / Program		Activities to be implemented in early stage	Artificial Groundwater Recharge Project	Reclaimed Water Supply Project	Water Saving Agriculture Project
f. Water distribution network improvement work	f-1	Improvement of water distribution network including replacement of aged pipelines, additional pipelines, water distribution block valves, water pressure meters and flow meters			
Program for Water Saving Dissemination					
a. Development of water saving campaign through mass-medias	a-1	Preparation and implementation of water saving campaign through mass-medias			
b. Holding water saving seminars for water users in urban area	b-1	Preparation and holding of water saving seminars by ONEP and RADEEMA			
	b-2	Holding of seminars in urban areas			
c. Holding water saving seminars for water users in rural area	c-1	Preparation and holding of water saving seminars by by collaboration with Commune Council, MOUQUADAM, etc.			
Program for Water Resources Management Capacity Development of ABHT					
a. Capitalization and diffusion of the information on the water resources	a-1	Share and Uniform management of the documents and the data in the ABHT, Installation of the documentation center		○	○
	a-2	Development of the common information diffusion system in the ABHT		○	○
	a-3	Development of the common information diffusion system between the concerned structures		○	○
	a-4	Web site creation and information diffusion to the stakeholders		○	○
b. Reinforcement of the consultation and the cooperation with the concerned stakeholders on the water resources management	b-1	Establish a framework for consultation and the cooperation with the concerned stakeholders on the water resources management			○
c. Rationalization of the authorization procedure of the DPH	c-1	Simplification and promptitude of the authorization procedure			○
	c-2	Quick checking of the declaration and the control of the observation of the authorization granting			○
	c-3	Capacity reinforcement of the service in charge of the authorization deliberation			○
d. Reinforcement of the control of the illicit water use, Royalty collection	d-1	Implementation of the actions for control by the water police			
	d-2	Development of the royalty collection system			
e. Reinforcement of the monitoring and the evaluation of the water resources	e-1	Reinforcement and development of the hydraulic network	○	○	○
	e-2	Establishment of the water intakes water monitoring in the PMH	○	○	○
	e-3	Acknowledgment of the number, the distribution of the wells and the intake volume of the ground water			
	e-4	Capacity reinforcement of the ABHT for the water resources prevention by the ground water simulation technique	○	○	○
f. Reinforcement of the water quality control	f-1	Reinforcement of the activities and the personnel in charge of the water quality analysis		○	
	f-2	Function of the water analysis laboratory		○	

Project / Program	Activities to be implemented in early stage	Artificial Groundwater Recharge Project	Reclaimed Water Supply Project	Water Saving Agriculture Project
Program for Legal and Institutional Frameworks Improvement for Water Law Implementation				
a. Elaboration and application of the necessary texts of application for the effective implementation of the Water Law	a-1 The attributions and the modalities of the implementation of the water police			
	a-2 The prolongation of the declarations period to the existing wells			
	a-3 The threshold and the prohibited area of the digging wells and the ground water intaking inside the action zone of the ABHT			
	a-4 The modalities of fixing and collecting of the royalty for the water use, in particular ground water of the Public Hydraulic Domain			
	a-5 The obligation of the installation of the water meters and of the control of the water intake volume on the authorized wells			
	a-6 The obligation of the implementation of the drip irrigation systems for the granting authorization of the digging and the water intakes of the wells for agriculture			
	a-7 The framing of the digging works of the wells by the digging licenses, the confiscation application of the drilling machine or the digging equipment of wells without preliminary authorization			
	a-8 The standards of the water flows quality of the industrial plants			
	a-9 The creation and the modality of the implementation of the ground water resources management funds			
b. Improvement of the authorization procedure for the digging and the water intake of the wells, and the authorization observance	b-1 Study implementation on the improvement of the authorization procedure			
	b-3 Prolongation of the declaration period of the existing wells			
	b-4 Improvement of the authorization procedures of the wells digging and the water intakes			
	b-5 Standardization and the simplification of the authorization request forms			
	b-6 Clarification and observance of the number of days required for the authorization procedure			
	b-7 Quick verification on site of the authorization demand			
	b-8 Quick verification on site of the demand observance after the authorization delivery. In the event of the infringement, the observation, the recommendation and finally the application of the sanctions such as the withdrawal of the authorization will be applied			
b. Improvement of the authorization procedure for the digging and the water intake of the wells, and the authorization observance	b-9 Diffusion of the information on the authorization procedures and the implementation of the enlightenment activities aiming to promote the declaration of the existing wells			
	b-10 The well contractor shall get the legal authorization for well digging works. In the event of the illicit work and without authorization, the revocation of the license or the confiscation of the drilling machine or the well digging equipment will be enforced.			
c. Information on the Water Law 10-95 and the legal texts relating to the water	c. Preparation and implementation of plan for informing the Water Law 10-95 and the legal texts relating to the water			
Program for Water Police System Enhancement				
a. Information on the activities of the water police to the stakeholders in particular to the local authorities	a. Information on the activities of the water police to the stakeholders in particular to the local authorities			
b. Implementation of the water police by the ABHT	b. Implementation of the water police by the ABHT			
c. Competences transfer of the water police activities to the local communities, and Establishment of the water use control networks	c. Competences transfer of the water police activities to the local communities, and Establishment of the water use control networks			
Program for Appropriate Pricing and Effective Collecting of Water Royalty				
a. Examination and consultation on the water pricing and the collecting modality	a. Examination and consultation on the water pricing and the collecting modality			
b. Elaboration and proclamation of the texts of application related to the water pricing and the collection modality	b. Elaboration and proclamation of the texts of application related to the water pricing and the collection modality			
c. Explanations and information to the users and relevant organizations at the local level on the new water pricing	c. Explanations and information to the users and relevant organizations at the local level on the new water pricing			
d. Development of the royalty collection system	d. Development of the royalty collection system			
e. Establishment of the ground water resources management fund by the water royalty	e. Establishment of the ground water resources management fund by the water royalty			

Project / Program	Activities to be implemented in early stage	Artificial Groundwater Recharge Project	Reclaimed Water Supply Project	Water Saving Agriculture Project
Program for Formulation of Collaboration and Decision - Making Framework for Water Resources Management				
a. Establishment of the Tensift Basin Committee	a. Establishment of the Tensift Basin Committee			
b. Establishment of the Thematic Commissions	b. Establishment of the Thematic Commissions			
c. Constitution of the water management system at the provincial level by the enhancement of the Prefectural and Provincial Commissions of Water (CPPE)	c. Constitution of the water management system at the provincial level by the enhancement of the Prefectural and Provincial Commissions of Water (CPPE)			
d. Competences transfer of the water resources management at the communal level	d. Competences transfer of the water resources management at the communal level			
Program for Activation and Capacity Development of Water Users Association				
a. Trainings to the executive committee members of the AUEA for the reinforcement of organizational and financial management capacities	a. Trainings to the executive committee members of the AUEA for the reinforcement of organizational and financial management capacities			○
b. Financial capacities reinforcement of the AUEA by the contributions of members	b. Financial capacities reinforcement of the AUEA by the contributions of members			
c. Improvement of the information diffusion system by the organization of general assembly of the AUEA	c. Improvement of the information diffusion system by the organization of general assembly of the AUEA			
d. Relationship reinforcement with the ORMVAH and the DPAs	d. Relationship reinforcement with the ORMVAH and the DPAs			○
e. Training for the agricultural techniques in order to save the water (drip irrigation, varieties draught resistant)	e. Training for the agricultural techniques in order to save the water (drip irrigation, varieties draught resistant)			
f. Exchange with the advanced AUEA on the saving water activities	f. Exchange with the advanced AUEA on the saving water activities			
g. Financial support to the AUEA for the realization of the agricultural activities saving water	g. Financial support to the AUEA for the realization of the agricultural activities saving water			
Program for Public Awareness on Water Saving and Conservation				
a. Elaboration of the plan for enlightenment and communication	a. Elaboration of the plan for enlightenment and communication			
b. Implementation of the enlightenment and the communication activities on the water resources management	b. Implementation of the enlightenment and the communication activities on the water resources management			

CHAPTER 7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

The Haouz Plain is a part of the hydraulic basin of the Tensift River, which is located in the mid-west part of Morocco. The Plain belongs to the arid area, where annual mean rainfall is 160 to 350 mm. The Plain has historically relied for the major part of its water resources on groundwater. The demand of this groundwater for large scale irrigation agriculture, tourism development and rapid population growth has been increasing significantly in the recent years. This has caused the depreciation of groundwater level close to over-exploitation, This way, if a condition where the volume of water intake is more than the recharge volume of the groundwater continues, it is worried that further decrease of the groundwater level and exhaustion of the groundwater resources, urgent countermeasure should be required.

Consequently, it was necessary to plan as strategy the basic policies on the water resources management which will contribute to the efficient and appreciate distribution and sustainable use of limited water renounces, through the determination of concept and direction of use and management on the whole water resources in the Haouz Plain. The water use and groundwater management aiming to sustainable groundwater use is set up based on this Integrated Water Recourses Management Strategy and they are compiled into the Master Plan for the Integrated Groundwater Management Plan.

The Master Plan is consisted of five plan fields such as Surface Water Sources Development and Surface Water Resources Management Plan, Groundwater Management Plan, Water Quality Management Plan, Water Demand Reduction Plan, Organizational and Institutional Improvement Plan and Participatory Groundwater Management Plan, and 18 components with the target year of 2020. The components, i.e., programs and projects are interrelated, and shall be implemented systematically. The pillars of the Master Plan are the “Surface Water Sources Development and Surface Water Resources Management Plan” and “Water Demand Reduction Plan”, which directly contribute to the improvement of the water balance, and these Plans are regarded as the “Core Projects”.

On the other hound, the agency shouldering the central role in the management of the water resources in the Haouz Plain is ABHT, standing in the position to manage and supervise the implementation of the Master Plan in coordination with the agencies in charge of the implementation of the individual programs and projects formulating in the Master Plan. Therefore, it is indispensable to implement supporting activities to ensure the capacity of ABHT, which is the managing / supervising agency of the Master Plan, is priority required in order to implement the core projects effectively, and to achieve the object of the Master Plan.

By the implementation of the Master Plan, the appropriate management of the groundwater which is necessary to guarantee continuously and stably the utilization of the water resources on the inhabitant’s life and the agricultural production in the Haouz Plain will be realized. Consequently, the equilibrium of water balance of the groundwater will be achieved, and the improvement and maintenance of the water balance become possible. Furthermore, depending on the execution of the Action Plan proposed in the Master Plan, it is foreseen that it will decrease the further fall of the groundwater level. And, will largely contribute to the Integrated Water Resources Management in the Haouz Plain as a participatory water resources management plan through the participation of the stakeholders. Thus, it is important for this Master Plan for the Integrated Groundwater Management to be immediately implemented.

Finally, to achieve the sustainable water resources management, the important issues to approach more aggressive in the future are as follows:

1) Capacity development which aims to improve the organizational capability and management of the executing agencies.
2) Appropriate contents of the projects by the participation of stakeholders.
3) Cooperation and collaboration among multiple sectors such as agriculture, tourism, health and sanitation, regional development, etc.

4) Voluntary activities by local authorities, farmers, urban residents, NGO, etc.
5) Partnership between public sector and private sector.

7.2 Recommendations

The following recommendations are made for the smooth implementation of Integrated Water Resources Management.

(1) Implementation of the Master Plan with close coordination among relevant agencies

The Master Plan shall be implemented with close coordination among the relevant agencies and other stakeholders. Relevant agencies shall also implement its individual activities under the framework of such coordination.

As seen in the active discussions in the Technical Committees held during this Study, the coordination of concerned agencies including local administration is currently in a favorable situation. Such situation shall be maintained for the implementation of the Master Plan. Furthermore, as described in the Action Plan, a permanent structure of coordination among stakeholders should be established by clarifying the roles and responsibilities of the regional government, ministerial agencies and other stakeholders regarding water resources management.

(2) Initiate measures for new water resources at an early stage in order to cope with increased water demand in the future

The Master Plan aims to secure the water balance by the target year of 2020 by enabling coexistence of agriculture and tourism through maximum and efficient use of available water resources. Thus the measures proposed do not consider the continuous increase in water demand after the target year.

By 2020, there will be small room for further development of water resources in the area, and there is need to initiate necessary investigations to prepare measures for the increasing demand. The government of Morocco is currently conducting a study on the possibilities of inter-basin water diversion to the Haouz Plain. The results of such studies shall be realized at an early stage.

(3) Considerations to the vulnerable in implementing the Master Plan

The Master Plan proposes the regulation of groundwater extractions in PMH sectors and the capture zone for the water supply boreholes of ONEP. Information of such regulation shall be clearly noticed to the people who may be negatively effected, and implementation of the regulation shall be carried out with due considerations for these people.

The water royalties proposed in the Master Plan shall also be examined with considerations on the capacity of the vulnerable for payment.

Introduction of water saving irrigation is currently carried out with government subsidies. However, the many of the small scale farm households cannot apply this to their fields because they do not have the resource to pay their portion of the cost. Access to water saving irrigation methods should be improved through establishment of credit systems for such purposes.

(4) Structural studies on water saving agriculture in dry areas

Agricultural technologies are being studied and disseminated by the Ministry of Agriculture and Marine Fisheries. However, this is not necessarily resulting in an efficient way. Studies not only on water saving irrigation in dry areas, but also on improvement of farm economy such as introduction of high-profitable / high water-stress tolerant varieties shall be further studied.

(5) Technical assistance from other donor agencies

Currently, the German Technical Cooperation (GTZ) is carrying out activities centering capacity development in ABHT. The implementation of the Study for Integrated Water Resources Management in the Haouz Plain by JICA also provided technical transfer to the engineers of ABHT. Such schemes for technical cooperation and funding by foreign government agencies such as JICA and JBIC should be efficiently used for the smooth implementation of the Master Plan.

SCOPE OF WORK

FOR

THE STUDY

ON

THE INTEGRATED WATER RESOURCES MANAGEMENT PLAN

IN THE HAOUZ PLAIN IN THE KINGDOM OF MOROCCO

AGREED UPON BETWEEN

THE MINISTRY OF LAND MANAGEMENT, WATER AND ENVIRONMENT

AND

THE JAPAN INTERNATIONAL COOPERATION AGENCY

Rabat, September 27, 2005

Mr. Mohamed Ameur
Secretary General
Ministry of Land Management, Water
and Environment, Kingdom of Morocco

Pour le Ministre Chargé de l'Aménagement du Territoire, de l'Eau et de l'Environnement et par Délégation
Le Secrétaire Général
Signé: Mohammed. AMEUR

Mr. Nagata Kenji
Leader of the Preparatory Study Team
Japan International Cooperation Agency

I. INTRODUCTION

In response to the official request of development studies from the Government of Kingdom of Morocco (hereinafter referred to as "the Government of Morocco"), the Government of Japan decided to conduct technical cooperation for the Study on the Integrated Water Resources Management Plan in the Haouz Plain (hereinafter referred to as "the Study") in accordance with the relevant laws and regulations in force in Japan.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, will undertake the Study in close cooperation with the authorities concerned of the Government of Morocco.

The present document sets forth the scope of work with regard to the Study and will be valid after the notification of approval by the JICA headquarters through the JICA Morocco office to the Government of Morocco.

II. OBJECTIVES OF THE STUDY

The objectives of the Study are:

1. to formulate a master plan for the integrated water resources management in the Haouz Plain, and;
2. to transfer relevant skills and technologies to personnel concerned with the Study

III. STUDY AREA

The Study will cover the Haouz Plain as shown in Annex-1.

IV. SCOPE OF THE STUDY

The Study is divided into the following two (2) phases; Phase 1 is for understanding of present and future conditions, and Phase 2 is for formulation of the master plan for the integrated water resources management.

The scope of work for the Study shall cover the following items:

Phase 1: Understanding of Present and Future Conditions

1. Collection and review of existing data
   (1) Socio-economic conditions (administrative division, population, industry, etc.)
   (2) Socio-economic development plans and other development policies/ plans
   (3) Natural conditions (hydrogeology, meteorology, hydrology, land use, etc.)

(4) Present water use conditions
(5) Irrigation and water-use facilities as well as water users' association
(6) Actual conditions of farmer's water use and consciousness on water issue
(7) Groundwater level/flow, present abstraction amount and groundwater problems
(8) Traditional waterways (Khettara) and its usage
(9) Review of existing projects and studies concerning with water resources
(10) Existing legal framework for water resources development and management as well as water supply and sanitation
(11) Existing institutional framework for operation, maintenance and management relevant to water resources
(12) Existing database related to water resources management

2. Study on water resources potential

(1) Groundwater, surface water, rainwater, treated/untreated waste water
(2) Water quality
(3) Present groundwater recharge
(4) Numerical modeling of groundwater basin (groundwater aquifer modeling, hydro-geological coefficients, model calibration)
(5) Hydrological water balance
(6) Sustainable water resources potential

3. Water demand projection

(1) Domestic use
(2) Agricultural use
(3) Industrial use
(4) Others (such as tourism)

4. Water balance study between water demand and potential

5. Study on the negative impacts to groundwater caused by over abstraction and effluent discharge

(1) Groundwater level declination
(2) Depletion of groundwater potential
(3) Deterioration of groundwater quality
(4) Drying out of the existing wells
(5) Others

6. Stakeholder meetings (public participation)

✓ Problems and issues on groundwater management

Phase 2: Formulation of the Master Plan for the Integrated Water Resources Management

1. Setup of water resources management strategy

✓ Water resources development (groundwater, surface water, rainwater and treated/untreated waste water)
✓ Water supply and sanitation for urban and rural areas
✓ Irrigation water management
✓ Water resources conservation
✓ Groundwater management
✓ Possibility of wastewater reuse to irrigation
✓ Public participation into water resources management

2. Formulation of the master plan

(1) Proper groundwater utilization plan

✓ Definition of proper groundwater use concept to keep sound water cycle and natural/social environment as well as sustainable groundwater use
✓ Best mixed policy of water sources (groundwater and surface water) and water uses (agriculture, industry, people's lives, tourism, etc.)
✓ Formulation of groundwater utilization regulation
✓ Permission and prohibition on groundwater abstraction

(2) Groundwater monitoring plan

✓ Structure, distribution and number of monitoring wells
✓ Monitoring system
✓ Data arrangement and reporting
✓ Evaluation and recommendation

(3) Groundwater management plan

✓ Groundwater management method in cases of normal time, drought time and disaster time
✓ Possibility of artificial groundwater recharge
✓ Groundwater management manual
✓ Groundwater management system (responsible body/person for groundwater management, monitoring body/person, transmission of monitoring information, public relations and guidance)

(4) Plan for institutional and organizational strengthening

✓ Capacity development of Agency of the Tensift Hydraulic Basin (hereinafter

referred to as "ABHT")

- ✓ Plan for regulatory framework for water resources management especially conserving groundwater for sustainable use
- ✓ Public participation (communication and coordination among stakeholders, raising general awareness on water problems and solutions)
- ✓ Water demand management
- ✓ Saving of irrigation water use (improvement of irrigation efficiency, creating non-agriculture employment opportunities)

(5) Operation and maintenance plan

(6) Initial environmental examination (IEE)

Technical assistance on initial environmental examination (IEE) for environmental and social consideration (including public consultation with communities and stakeholders) shall be conducted for groundwater management.

(7) Implementation plan

(8) Cost estimate

3. Evaluation on the master plan

4. Proposal of action plans

(1) Selection of priority projects

(2) Action plans

5. Stakeholder meetings (public participation)

(1) Discussion on the master plan

(2) Discussion on the action plan

V. SCHEDULE OF THE STUDY

The Study will be carried out in accordance with the tentative schedule as attached in Annex-2. The schedule is tentative and subject to be modified when both parties agree upon any necessity that will arise during the course of the Study.

VI. REPORTS

JICA shall prepare and submit following reports in English to the Government of Morocco.

1. Inception Report:

Twenty (20) copies will be submitted at the commencement of the phase 1 work period in Morocco. This report will contain the schedule and methodology of the Study.

2. Progress Report I:

Twenty (20) copies will be submitted at the time of fourth (4th) month after the commencement of the phase 1 work period in Morocco.

3. Interim Report:

Twenty (20) copies will be submitted at the end of the phase 1 work period. This report will summarize the findings of the phase 1 of the Study. The discussion on it will be held at the beginning of the phase 2 work period.

4. Progress Report II:

Twenty (20) copies will be submitted at the time of about fourth (4th) month after the commencement of the phase 2 work period in Morocco.

5. Draft Final Report:

Twenty (20) copies will be submitted at the end of the phase 2 work period in Morocco. The Government of Morocco shall submit its comments within one (1) month after the receipt of the Draft Final Report.

6. Final Report:

Thirty (30) copies will be submitted within one (1) month after the receipt of the comments on the Draft Final Report.

VII. UNDERTAKINGS OF THE GOVERNMENT OF MOROCCO

1. To facilitate the smooth conduct of the Study; the Government of Morocco shall take necessary measures:
   a. to secure safety of the Japanese study team (hereinafter referred to as "the Team");
   b. to permit the members of the Team to enter, leave and sojourn in Morocco for the duration of their assignments therein, and exempt them from foreign registration requirements and consular fees;
   c. to exempt the members of the Team from taxes, duties and any other charges on equipment, machinery and other material brought into and out of Morocco for the implementation of the Study;
   d. to exempt the members of the Team from income tax and charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Team for their services in connection with the implementation of the Study;
   e. to provide necessary facilities to the Team for the remittance as well as utilization of the funds introduced into Morocco from Japan in connection with the implementation of the

Study;

f. to secure permission for the Team to enter into private properties or restricted areas for the implementation of the Study;

g. to secure permission for the Team to take all data and documents including photographs and maps related to the Study out of Morocco to Japan;

h. to provide medical services as needed. Its expenses will be charged on the members of the Team.

2. The Government of Morocco shall bear claims, if any arises, against the members of the Team resulting from, occurring in the course of, or otherwise connected with, the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the Team.

3. On the parts of the Government of Morocco, ABHT, under the Ministry of Land Management, Water and Environment, shall act as the counterpart agency to the Team for the Study and also as the coordinating body in relation to other governmental and non-governmental organizations concerned for the smooth implementation of the Study.

4. Ministry of Land Management, Water and Environment of Morocco shall, at its own expense, provide the Team with the following, in cooperation with other organizations concerned:

a. Security-related information on as well as measures to ensure the safety of the Team;

b. Information on as well as support in obtaining medical service;

c. Available data (including maps and photographs) and information related to the Study;

d. Counterpart personnel;

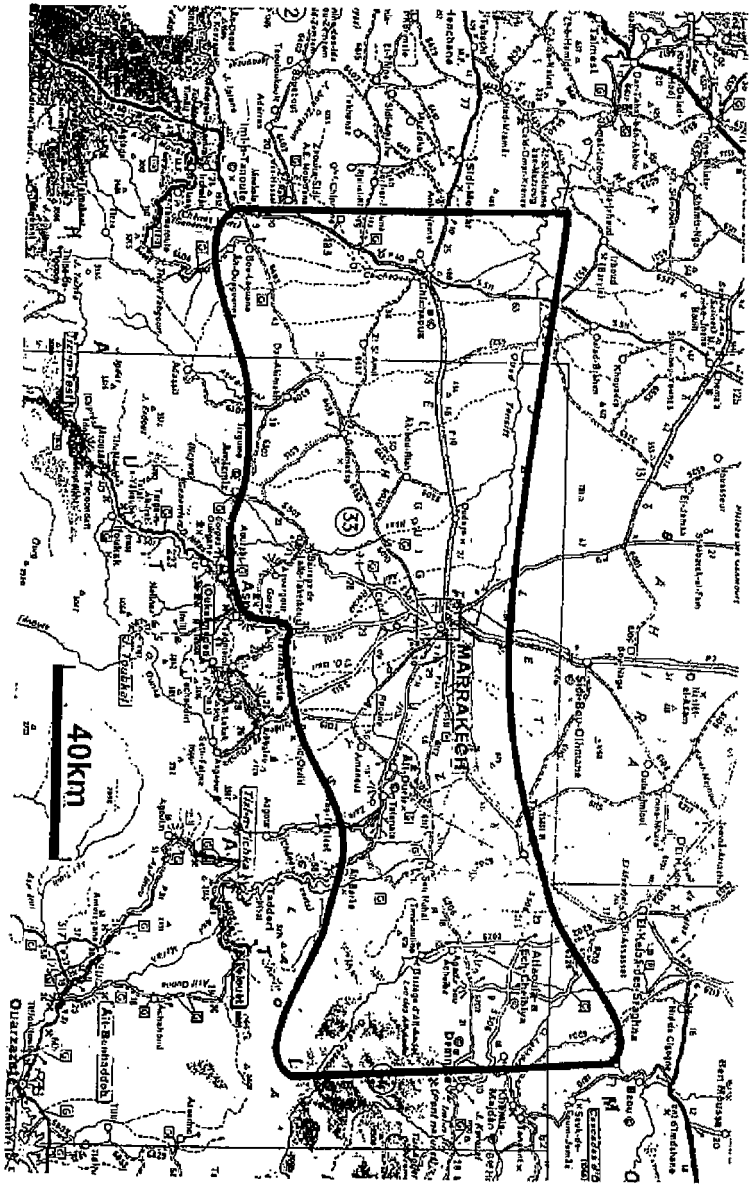
e. Suitable office space with necessary equipment; and

f. Credentials or identification cards.

VIII. CONSULTATION

JICA and the Ministry of Land Management, Water and Environment shall consult with each other in respect of any matter that may arise from or in connection with the Study.

Annex 1: Study Area with rough border



MINUTES OF MEETINGS

ON

THE SCOPE OF WORK

FOR

THE STUDY ON THE INTEGRATED WATER RESOURCES MANAGEMENT PLAN

IN THE HAOUZ PLAIN IN THE KINGDOM OF MOROCCO

AGREED UPON BETWEEN

THE MINISTRY OF LAND MANAGEMENT, WATER AND ENVIRONMENT

AND

THE JAPAN INTERNATIONAL COOPERATION AGENCY

Rabat, 27 September 2005

L'Inspecteur chargé de l'Aménagement
du Territoire, de l'Eau et de
l'Environnement et par Délégation
Le Secrétaire Général

Mohammed AMEUR

Mr. Mohamed Ameur
Secretary General
Ministry of Land Management, Water and
Environment, Kingdom of Morocco

Mr. Nagata Kenji
Leader of the Preparatory Study Team
Japan International Cooperation Agency

Annex-2: Tentative Schedule

Tentative Schedule

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Phase	Phase 1									Phase 2																
Work in Morocco																										
Work in Japan																										
Report Presentation	IC/R			PG/R1			IT/R						PG/R2						DF/R					F/R		

IC/R: Inception Report
PG/R1: Progress Report I
IT/R: Interim Report
PG/R2: Progress Report II
DF/R: Draft Final Report
F/R: Final Report

In response to the official request of the Government of the Kingdom of Morocco (hereinafter referred to as "the Government of Morocco"), the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Preparatory Study Team, headed by Mr. Nagata Kenji (hereinafter referred to as "the Team"), to Morocco from September 19 to October 8, 2005 to discuss the Scope of Work (hereinafter referred to as "S/W") for the Study on the Integrated Water Resources Management Plan in the Haouz Plain (hereinafter referred to as "the Study").

During its stay in Morocco, the Team carried out field surveys and held a series of discussion with the officials of Ministry of Land Management, Water and Environment (hereinafter referred to as "MATEE"), Agency of the Tensift Hydraulic Basin (hereinafter referred to as "ABHT"), and other authorities concerned with water resources. The list of those who attended these meetings is shown in the Appendix.

The Minutes of Meetings have been prepared for the better understanding of the S/W agreed upon between MATEE and the Team on September 27, 2005. The main items that were discussed and agreed by the Moroccan side and the Team (hereinafter referred to as "the Both Sides") are as follows.

1 STUDY AREA

The Both Sides agreed that the target area of the Study was Haouz Plain, which includes the administrative regions of Al Haouz Province, Marrakech Prefecture and parts of the provinces of Chichaoua and El Kelaa Sraghna.

2 STUDY IMPLEMENTATION FRAMEWORK

The Both Sides agreed that ABHT would organize and chair the steering committee, technical committee and counterpart team to coordinate the Moroccan institution for smooth implementation of the Study

1) Steering Committee

   The member would be MATEE and ABHT

2) Technical Committee

   The member would be ABHT, ONEP, ORMVAH, RADEEMA, DPA and other organizations relevant to water resources.

3) Counterpart Team

   Counterpart Team would be organized by ABHT.

3 SCOPE OF THE STUDY

The Both Sides confirmed that:

1) The master plan for the integrated water resources management in the Haouz Plain is formulated in order to find the procedure and measures to effectively and efficiently utilize various-but-limited water resources in the area, especially preventing depletion and difficulty in groundwater resources, and enabling sustainable use of groundwater resources for peoples' life and agriculture;

2) Groundwater resources management has to be considered in the integrated management for all the water resources. Thus the strategy of the integrated water resources management has to be carefully studied and formulated based on present/expected conditions on water resources potential/demand as well as stakeholders' opinions;

3) In the Study, structural measures and non-structural mensures should be proposed in a well-balanced manner, and have to be supported by the stakeholders.

4 STAKEHOLDERS' INVOLVEMENT IN WATER RESOURCES MANAGEMENT

The Both Sides shared the same opinion that stakeholders' involvement in water resources management is very important and should be positively introduced to formulate the master plan and the action plan. The Both Sides agreed that a stakeholders' meeting was one of the opportunities to participate in preparing the master plan and the action plan, and ABHT would lead stakeholders' meetings and the JICA would support them.

5 CAPACITY DEVELOPMENT FOR ABHT

The Moroccan Side emphasized necessity of the capacity development for ABHT not only in the technical aspect but also administrative aspect since ABHT was newly set up. The capacity development includes;

1) Training of counterpart personnel in Japan

   The Moroccan Side requested JICA to conduct training of counterpart personnel in Japan for the effective technology transfer. The Team admitted the needs of the counterpart training in Japan and promised to convey the request to the JICA Headquarters.

2) Seminars/Workshops

   The Moroccan Side requested that joint seminars and workshops would be held during the course of the Study for better understanding of the Study results. The Team recognized the necessity and agreed to convey this request to the JICA Headquarters.

3) Equipment for the Study

   The Moroccan Side requested JICA to support ABHT with equipment such as water quality measurement apparatus, automatic groundwater level recorders, vehicles to collect the data, and computers for data storage and analysis as well as technical software. The Team recognized the necessity of equipment that is needed for implementation of the study, and agreed to convey this request to the JICA Headquarters.

6 REPORTS

The Moroccan Side requested that all the reports including hard copies and soft copies shall be prepared not only in English but also in French. The Team recognized the necessity and agreed to convey this request to the JICA Headquarters. The numbers of the reports requested are as follows:

- Inception Report, Progress Report I and II, Interim Report and Draft Final Report: five (5) copies in English and twenty (15) copies in French;
- Final Report: ten (10) copies in English and thirty (20) copies in French.

7 SHORTENING OF THE STUDY PERIOD

The Moroccan Side requested that the period of the phase 1 should be shortened because the data and information was adequately accumulated through the studies and investigations on water resources in the Haouz Plain. The Team promised to consider the study period based on the investigation results of the preparatory study.

8 EARLY IMPLEMENTATION OF THE MASTER PLAN AND THE ACTION PLAN

The Moroccan Side said that it would like to realize priority projects/programs to be proposed in the master plan and the action plan as soon as possible, and requested JICA to assist the implementation of the priority projects/programs. The Team admitted the necessity of the early implementation of them and promised to convey this request to the JICA Headquarters.

9 DISCLOSURE OF INFORMATION

The Both Sides confirmed that the disclosure of information such as the study reports is necessary to ensure the participation and dialogues with various stakeholders.

10 S/W and M/M

The Both Sides agreed that the English versions of S/W and M/M would prevail, when there would be a discrepancy in the interpretation.

Appendix

List of Attendants

(Moroccan Side)

Ministry of Land Management, Water and Environment (MATEE) at Rabat

Mr. Mohamed Ameur	Secretary General
Mr. Benbiba Majid	Director of Water Research and Planning
Mr. Khabote Abdallah	Technical advisor of MATEE

Agency of the Tensift Hydraulic Basin (ABHT) at Marrakech

Mr. Mohammed Chtioui	Representatives of Director
Mr. Brahim Berjamy	Chief, Information System Communication and Cooperation Division
Mr. Mohammed El Hassan Aresmouk	Chief, Water Resources Development Division
Mr. Limam Nabil	Chief, Water Resources Management Service
Mr. Abdelmajid Naimi	Chief, Public Hydraulic Domain Division
Mr. Abderrahim Lachguer	Engineer of Water Quality

(Japanese Side)

Preparatory Study Team

Mr. Nagata Kenji	Leader
Ms. Yamashita Akira	Study Planning
Mr. Suga Makoto	Groundwater Management / Hydrogeology
Mr. Toyooka Nobuki	Institution / Environmental and Social Consideration

JICA Expert

Mr. Uemura Mitsuro	JICA Expert at Ministry of Land Management, Water and Environment, Kingdom of Morocco

JICA Morocco Office

Mr. Obata Eihiko	Deputy Manager

MINUTES OF MEETING
ON
PROGRESS REPORT (2)
FOR
THE INTEGRATED WATER RESOURCES MANAGEMENT PLAN
IN THE HAOUZ PLAIN
IN THE KINGDOM OF MOROCCO
AGREED UPON BETWEEN
MINISTRY OF LAND MANAGEMENT, WATER AND ENVIRONMENT
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

Marrakech, August 15, 2007

In accordance with the Scope of Work for the Study on the Integrated Water Resources Management Plan in the Haouz Plain in the Kingdom of Morocco (hereinafter referred to as "the Study"), the Government of Japan, through Japan International Cooperation Agency (hereinafter referred to as "JICA"), dispatched to the Kingdom of Morocco the Study Team, headed by Mr. Matsumoto Keiji, for the second field survey of the Study, during the period of May 8 to August 24, 2007.

The Study Team and Moroccan counterpart made discussion based on the draft Progress Report (2) at the office of the Agency of the Tensift Hydraulic Basin (hereinafter referred to as "ABHT") and at the third stakeholder meeting. Finally the Study Team submitted officially twenty five (25) copies in French and five (5) copies in English of the Progress Report (2). The Study Team had explained the integrated water resources management strategy, the draft Master Plan for the integrated groundwater management, the major contents of the draft final report and the basic concept of the action plan in the presence of Moroccan counterparts on August 15, 2007 at the ABHT. Annex shows the list of participants.

As a result of the explanations and exchange of opinions on the Progress Report (2), the Moroccan side and Japanese side agreed upon the following points:

1. ABHT confirmed that the contents of the Progress Report (2) were prepared based on the conditions set forth in the Scope of Work for the Study and accepted that the Study Team will proceed to the next stage of the preparation of the draft final report.

2 The ABHT will gather and transmit the comments on the Progress Report (2) to the Study Team by September 25, 2007 at the latest.

Mr. Chtioui Mohammed
Director
Agency of the Tensift
Hydraulic Basin

Mr. Matsumoto Keiji
Team Leader
Study Team
Japan International Cooperation
Agency

pour le Directeur
le Secrétaire Général

Signé : Jilali Mohamed

PARTICIPANTS LIST

(Moroccan Side)

Agency of the Tensift Hydraulic Basin (ABHT) at Marrakesh

Mr. Chtioui Mohammed	Director of ABHT
Mr. Jida Mohammed	Deputy Director of ABHT
Mr. Aresmouk Mohammed El Hassan	Chief, Water Resources Development Division
Mr. Naimi Abdelmajid	Chief, Public Hydraulic Domain Division
Mr. Berjamy Brahim	Chief, Information System Communication and Cooperation Division
M. LIMAM Nabil	Chief, Water Resources Management Service
Ms. Benrhanem Mounia	Chief, Master Planning Service

Technical Committee

Mr. Souhail Abdellah	ONEP
Mr. Adil Daoudi	RADEEMA

(Japanese Side)

Study Team

M. Matsumoto Keiji	Team Leader
M. Oshika Yusuke	Member
M. Bertone François	Member
M. Nozaki Yutaka	Member
M. Ono Takeshi	Member
M. Watanabe Naohito	Member
M. Tsuchida Kazuhiro	Member
M. Takasugi Masaharu	Member
Mr. Fukazawa Tomoo	Member

A2-2

MINUTES OF MEETING
ON
DRAFT FINAL REPORT
FOR
THE INTEGRATED WATER RESOURCES MANAGEMENT PLAN
IN THE HAOUZ PLAIN IN THE KINGDOM OF MOROCCO
AGREED UPON BETWEEN
THE STATE SECRETARY TO THE
MINISTRY OF ENERGY, MINES, WATER AND ENVIRONMENT, IN CHARGE
OF WATER AND ENVIRONMENT
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

Rabat, November 30, 2007

Mr. Benkiba Majid
Director
Water Research and Planning,
The State Secretary in Charge of Water and Environment,
Ministry of Energy, Mines,
Water and Environment,
Kingdom of Morocco

Mr. Matsumoto Keiji
Team Leader
Study Team
Japan International Cooperation Agency

Witnessed by

Mr. Chtioui Mohammed
Director
Agency of the Tensift
Hydraulic Basin

Mr. Nagata Kenji
Leader
Advisory Team
Japan International Cooperation Agency

In accordance with the Scope of Work for the Study on the Integrated Water Resources Management Plan in the Haouz Plain in the Kingdom of Morocco (hereinafter referred to as "the Study"), the Government of Japan, through Japan International Cooperation Agency (hereinafter referred to as "JICA"), dispatched to the Kingdom of Morocco the Study Team, headed by Mr. Matsumoto Keiji during the period of September 2006 to November 2007. After completion of the First and Second Field Survey of the Study, the Study Team has started the Third Field Survey of the Study in the Kingdom of Morocco from November 22, 2007. The Study Team officially submitted thirty (30) copies of the Draft Final Report, of which twenty five (25) are in French and five (5) are in English, to the Agency of the Tensift Hydraulic Basin (hereinafter referred to as "ABHT"), and presented the contents of the Draft Final Report in the presence of the JICA Advisory Team, headed by Mr. Nagata Kenji (hereinafter referred to as "Advisory Team"), to the Counterparts of ABHT and the Technical Committee on November 27, 2007 at the ABHT, and to the Steering Committee on November 29, 2007 at the State Secretary in Charge of Water and Environment. Annex shows the list of participants.

After presenting the contents of the Draft Final Report, the Study Team and Advisory Team (hereinafter referred to as "the Japanese side") exchanged opinions on the Draft Final Report with ABHT, Technical Committee and the Steering Committee (hereinafter referred to as "the Moroccan side"). As a result, both sides agreed upon the following points:

1. The Moroccan side confirmed that the contents of the Draft Final Report were prepared based on the conditions mentioned in the Inception Report, agreed upon and signed by the Moroccan side and Study Team on September 21, 2006.
2. Both sides agreed that the following points shall be reviewed and described in detail.
   - Design of the projects and programs of the Master Plan and the Action Plan including the concrete activities, timeframe, annual budget requirement and possible financial sources.
   - Evaluation of individual projects and programs indicated in the Master Plan and the Action Plan.
   - The selection of priority projects and programs for the Action Plan.
3. Remarks from the members of the Steering Committee regarding the Draft Final Report will be submitted in a written form to the Study Team by 30 December 2007.
4. The Draft Final Report will be revised based on the above and submitted by the Study Team to the Moroccan side in mid January of 2008.
5. The comments on the Revised Draft Final Report will be provided to the Study Team in written comments by mid February 2008. Based on these comments, the Study Team will prepare the Final Report of the Study.

ANNEX: PARTICIPANTS LIST
(Discussion at ABHT)

(Moroccan Side)

Agency of the Tensift Hydraulic Basin (ABHT)

Mr. Chtioui Mohammed	Director
Mr. Jida Mohammed	Deputy Director
Mr. Naimi Abdelmajid	Chief, Public Hydraulic Domain Division
Mr. Berjamy Brahim	Chief, Information System Communication and Cooperation Division, ABHT
Mr. Limam Nabil	Chief, Water Resources Management Service
Ms. Mounia Benzhanem	Master Planning Service

Technical Committee

Mr. Allali Ahmed	DDR, Wilaya of Marrakech
Mr. Sahhah Jiad	DCL, Wilaya of Marrakech
Ms. Hasni Yamna	DPA, Marrakech
Mr. Mohamed Tahiri	Water Service of Al Haouz Province
Ms. Najat Elhasnaoui	Water Service of Marrakech Prefecture
Mr. Farrazdak Abderrahim	ONEP, Marrakech
Mr. Abdellah Souhail	ONEP, Marrakech
Mr. Sghir Fathallah	ORMVAH
Mr. El Khaloufi Abdelghani	ORMVAH
Mr. Adil Daoudi	RADEEMA
Mr. Abderrahim Laarass	ONE, Takerkoust

(Japanese Side)

Advisory Team

Mr. Nagata Kenji	Team Leader
Ms. Yoshida Sanae	Cooperation Planning

Study Team

Mr. Matsumoto Keiji	Team Leader
Mr. Francois Bertone	Member
Mr. Ono Takeshi	Member
Mr. Watanabe Naohito	Member

(GTZ)

Mr. Miksch Siegfried	Technical Consultant, GTZ

ANNEX: PARTICIPANTS LIST
(Discussion at the State Secretary in Charge of Water and Environment)

(Moroccan Side)

State Secretary in Charge of Water and Environment

Mr. Benbiba Majid	Chairperson, Director of Water Research and Planning
Mr. Akrajai Lahoussine	Planning and Water Management Division / DRPE
Mr. Lahmouri Abddaim	Water Resources Division / DRPE
Mr. Benjelloun Omar	Planning and Water Management Division / DRPE
Ms. Lyazidi Rachida	Hydro-geologic Service / DRPE

Steering Committee

Mr.El Khiyari Abdelkrim	Chief of Water Resources Coordination Division, ONEP
El Boujdaini Najah	ONEP
Belghiti Mohamed	Administration of Rural Engineering / Ministry of Agriculture and Maritime Fisheries

Agency of the Tensift Hydraulic Basin (ABHT) at Marrakech

Mr. Limam Nabil	Chief, Water Resources Management Service

(Japanese Side)

Advisory Team

Mr. Nagata Kenji	Team Leader
Ms. Yoshida Sanae	Cooperation Planning

JICA Morocco Office

Mr. Egusa Toshifumi	Deputy Representative

Study Team

Mr. Matsumoto Keiji	Team Leader
Mr. Francois Bertone	Member
Mr. Ono Takeshi	Member
Mr. Watanabe Naohito	Member