

MANAGEMENT OF IRRIGATION SYSTEMS IN HAOUZ REGION
CASE STUDY ON UPPER TESSAOUT (MODERN IRRIGATION SYSTEM)
AND TALGHOUMT (TRADITIONAL IRRIGATION SYSTEM)

by

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1. PRESENTATION OF ORMVAH HAOUZ SCHEME

1.1 Physical and geographic characteristics

ORMVAH scheme is spread over an area of 663,000 ha. Arable lands represent 473,000 ha out of which about 310,000 ha are irrigable. The irrigable lands are broadly divided into two areas: the Central Haouz in the South-West and the Tessaout (upstream and downstream) in the North-East of the area. (Refer map on page 23.)

The scheme is represented in the following map. It is bounded in the North by the « Jbilet » and « Tensift Oued », and further East by « Oum Errbia », in the South by the foothill of High Atlas, in the East by El abid Oued and in the West by N'fis Oued (from West to North-East approx. 180km).

Marrakech town is situated at 450 m elevation, and the large hydraulic schemes located with in elevation between 300 and 500 m above mean sea level.

1.2 Climatic characteristics

Haouz experiences a continental type Mediterranean climate of hot and dry condition which falls in between arid and semi-arid climates. The climatic characteristics associated with low and varying rainfall, high mean temperature, low relative humidity and very high evaporation rates.

a. Rainfall pattern:

Wet season in winter from October to May, and a drastic drought during summer. The annual average rainfall is about 240 mm as a result of 40 days of rainfall. Inter annual variability is high and ranges from 1 to 3.

Watersheds of the Atlas mountain are having of course more abundant rainfall, 530 to 760 mm/year on central Oueds.

(NOTE: Oued = Flushy streams in North-Africa)

b. Temperatures:

The annual average is about 20°C, the average of the max in July, is 37°C and the average of the min in January is 4°C.

c. Evaporation and relative humidity:

Annual evaporation is about 2300 mm, with a minimum of 64 mm in January and a maximum of 350 mm in August.

In conclusion, extreme harshness of climatic conditions in the Haouz, does not allow perennial crops without irrigation and optimal management of water resource.

1.3 Water resources

Mobilized water resources are:

- ⇒ Surface water (run-off) in Tensift'Oued for an annual supply (mean) 700 Mm³ out of which 85 Mm³ are regulated through Lalla Takerkoust Dam.
- ⇒ Surface water (run-off) in Tessaout watershed, representing an average annual supply 800 Mm³ out of which 610 Mm³ are regulated by Moulay Youssef Dam (260 Mm³) and Hassan 1er Sidi Driss Dam (350 Mm³).
- ⇒ Surface water (run-off) in watershed of El Abid Oued, regulated by Bine El Ouidane Dam out of which 235 Mm³ are allocated to Lower Tessaout.
- ⇒ Groundwater, mainly in the Central Haouz and in the Upper Tessaout. They represent a mobilizable quantity of 175 Mm³ and 65 Mm³.

2. IRRIGATION IN HAOUZ SCHEME

2.1 Traditional irrigation

Haouz has a very long tradition of irrigated agriculture from surface water as well as from ground water. A severe climate constraints the development to rely on irrigation.

Three systems are cohabiting: the «*seguias*» for mobilization and surface water distribution, the «*Khettaras*» and the pumpings for groundwater.

a. The Seguias (canals):

Seguia system was already present in 3/4 of the area before the recent large hydraulic projects (about 210 000 ha).

They consist of a simple offtake on the Oued (river), an earthen canal to transport water, and a downstream area of distribution. The command areas are varying from few dozen to several thousands hectares.

Along the downstream part of the *seguia*, water is distributed to a network of *mesrefs*, according to a rotation schedule, defined locally within the command area of the *seguia*.

Seguia was initially present in the upstream part of the *oueds* (flushy streams) at their junction with the plain (*foums*).

This system has been later on extended in the plain.

b. The Khettaras:

« The *Khettara* is a drainage of the groundwater, the slope of which is lower than that of the natural land and the watertable ».

This infrastructure includes:

- ⇒ An underground upstream section:
 - First, mainly for draining
 - Then transporting water in the downstream part.
- ⇒ Free surface storage because drainage is continuous whereas the use of water is varying.

Then the system is made of distribution canals.

The first *Khettara* of the Haouz was built during XIth century A.D. Before the modern project era, *Khettaras* supplied about 20% of irrigated areas.

The depletion of the water table, the increasing cost of construction and maintenance (drainage section particularly) of *Khettaras* lead to a diminution of their numbers and at present less than one hundred is available.

c. Wells and pumpings:

Equipped with animal powered lifting devices (*noria* or *ghargour*), wells always deliver a limited discharge and supply is confined to limited area.

Pumping of groundwater had progressively replaced *Khettaras* and wells, (costly, and with a low yield for wells).

Collective pumpings constructed with the help of the State, within PMM program (small and medium scheme), are thus irrigating 19 schemes, totaling about 5000 ha and withdrawing 2.4m³/s. However, most of pumping units are under private control. Their number is estimated at about 15 000, located mainly in the central Haouz.

2.2 Modern irrigation structures (large schemes)

Most of large schemes had been designed and built after the independence. They are spread from West to East and South to North :

- The Central Haouz
- The Upper Tessaout
- The Lower Tessaout

a. The Upper Tessaout:

It is one of the first largest schemes in the Haouz, built between 1969 and 1978. The irrigated area is 52,000 ha out of which 30,000 ha are using modern techniques and 22,000 ha traditional irrigation improved in the frame of the PAGI - Z. The irrigation supply to the project is from Tessaout Oued, regulated through Moulay Youssef Dam (250 Mm³/year).

b. The Central Haouz:

It covers an area of 245,000 ha bounded by the Tensift Oued in the North, the foothill of High Atlas in the South, the Upper Tessaout scheme in the East and Oued N'fis irrigated areas in the West. This scheme is to be modernized in several steps under the "Director Plan" of 1996:

- The first part of the project (PTI) covers 50,000 ha out of which 21 000 ha are already realized (Right Bank N'Fis). Projects of other sectors are on-going. Water resources for PTI are Lakhder'Oued water regulated by Moulay Hassan 1er Reservoir and conveyed by the Canal de Rocade. Rough volume allocated to the area is about 340 Mm³.

- The second part (STI), planned that on a long term run, 60 000 ha will be irrigated using water from new reservoirs on the central part oueds, and for part of the area by pumping out of the groundwater.

c. The Lower Tessaout:

It covers an area of 70 000 ha, and includes two hydraulic units:

- The area upstream the T2 Canal (6500 ha) supplied by water from Lakhdar and Tessaout Oueds (46 Mm³/year), already equipped.
- The area downstream the T2 canal (37 500 ha), where equipment is ongoing, supplied by a transfer of water through GM Tadla Canal and Canal T2, from El abid Oued regulated at Bin El Ouidane Reservoir (235 Mm³/year).

2.3 State of irrigated areas

At the completion of the project, there will be:

- 206 000 ha equipped by large schemes;
- 34 000 ha equipped by small and medium schemes.

Currently, the equipped area reaches 105 600 ha in large schemes. It is planned to reach 146 000 ha before year 2000.

3. MANAGEMENT OF MODERN IRRIGATION SYSTEMS: THE CASE OF THE UPPER TESSAOUT

3.1 Upper Tessaout presentation

a. Geography:

Located in the East of the Haouz plain, between Atlas and Jbilets mountains.

b. Areas:

- Gross area: 54 000 ha
- Modern equipped area: 30 000 ha
- Old area supplied: 22 000 ha
- Area supplied by pumping: 2 000 ha

c. Land tenure:

- *Melk*: 44%
- Collectif: 43%
- State owned + *Habous*: 13%

d. Agricultural development:

Modern equipment had contributed to the development of cotton, niora, tobacco and pickles, as well as crop forage, olive trees and cereals. Crop pattern is as follows:

- Olive trees:	10 000 ha	(37%)
- Cereals:	10 000 ha	(37%)
- Forages:	2 600 ha	(10%)
- Cotton:	2 000 ha	(7%)
- Vegetables:	1 500 ha	(5%)
- Niora:	1 200 ha	(4%)

3.2 Hydraulic infrastructures

Moulay Youssef Reservoir is the unique supply for Upper Tessaout Scheme (52 000 ha out of which 30 000 are equipped with modern irrigation).

Moulay Youssef Reservoir and Tinimoutine regulator Dam which is associated, are used to produce electricity in peak hours.

The infrastructure includes:

- Storage and regulator reservoir: Moulay Youssef Dam regulates 260 Mm³.
- Tinimoutine regulator reservoir is 7 Mm³.
- Offtake main structure, Agadir, Bouâachiba, equipped with an AVIO gate and baffles (max discharge is 17 m³/s).
- Partition structure « Point K », where two 2 canals are started (East and West) and secondary canals D1 and G1. This structure is equipped with an Amil gate at the head of East canal and with baffles at the three other canals inlets.
- The West canal, 16 km long, designed for 8 m³/s and supplies 15 secondary canals each equipped with baffles. Water level along the canal being control by a broad crested weir (Giraudet).
- The East canal, 8 km long, 11 m³/s, feeding the 'Ouled Gaid' and ending at the partition point between right and left bank main canals. All secondary canals on this branch are fed by controlled intakes, water level being maintained by Amil gates.
- Tertiary canal inlets are equipped with baffles.
- Infrastructure for flood protection and drainage, 190 km long.

As the irrigation canals are upstream controlled, high quality functioning therefore, heavily relies on the precision in the control of discharge and strict adherence to the schedule of irrigation.

3.3 Upper Tessaout scheme management

Management implies operation and maintenance.

a. Operation of canals:

Two aspects are considered here: allocation and distribution of irrigation water.

Allocation of irrigation water is made for the agricultural season on a 12 months basis, specifying availability of water and its distribution in time. ORMVA of the Haouz region, in consultation with other users (ONE, MTP), prepares an allocation program, validated later on by a technical committee and notified to farmers and their representatives. Revision of initial allocation plan is made during the campaign. Deliveries are made on the basis of the planned cropping pattern; in case of shortage, restriction are modulated per crop.

Farmers are informed by ORMVAH of the situation with respect to the available resources (likely restriction or not, etc.).

Farmers are more and more responsible for their cropping pattern. Small farmers are likely to stay on a subsistence level farming whereas large farms are likely to evolve towards speculative crops, the choice of which depends on the market and the water availability.

The application of the validated allocation plan is under the responsibility of ORMVAH in association with Water User Associations (WUA).

The two aspects of the distribution of water:

- users management: defining the scheduling and the basis for pricing.
- hydraulic management: set-up of hydrograms for secondary and tertiary canals.

On the basis of the monthly schedule, rotational distribution is organized considering the following:

- area of irrigated crops.
- crop water requirement.
- time lag between two irrigations (15 days in off season and 7 days in peak demand period).

Thus to establish the rotational schedule, following actions have to be carried out monthly in advance:

- computation of required irrigation duration for each field, then addition of duration per farmers and per tertiary.
- aggregation of needs for secondary canals, taking into consideration:
 - * a continuous discharge at the head of secondary canals should be achieved to avoid variation of discharge at the main sluice.
 - * no opening of canals during off-period of workers.
 - * integration of network constraints.
- computation of main sluice discharge.

Responsibility of the Office encompasses the transport of water down to the tertiary canal inlets, along the secondary canals, and the computation of irrigation time for each farmers.

Water Users' Associations (WUAs) are responsible for distribution within blocks, on the rotational basis established by the Office. This set-up allows better considerations of local issues.

The current management type is a participatory management. All the users of the Upper Tessaout are organized in 38 agricultural water users associations (WUA).

In canal operation, WUA:

- participate to prepare rotational scheduling.
- implement and monitor the rotational distribution.
- collect the irrigation fees.
- look after their irrigation systems.

Goals of participatory approach are:

- continuous dialogue between administration and WUA in order to better manage the use of the water resource.
- maintaining the community spirit which prevailed in the area before the project.
- flexibility and effectiveness in interventions (financial autonomy).
- minimizing of management costs by carrying out some works by themselves.

b. Canal maintenance:

The maintenance of canals are so far done mainly by the Office. Water users' participation is limited to simple works such as cleaning of canals and replacement of padlocks and small gates.

Preventive maintenance is carried out to avoid major crisis in the system functioning. Curative maintenance is also carried out on demand.

Programming activities of maintenance are based on an information system, collecting and storing data on failures.

Maintenance works can be realized in four ways:

- ⇒ By office staff.
- ⇒ By outside contractor.
- ⇒ By WUA.
- ⇒ By mixed interventions of the above three.

4. TRADITIONAL IRRIGATION SCHEME: TALGHOUMT

4.1 Traditional management type in the Haouz region

Farming in the Haouz region has a very long and rich history on hydraulic infrastructure. Water rights, for example, have very ancient roots and are still in use.

The right were either 'long term practiced type' (*orf*) or Musliim type (*charia*).

Two types of association were historically running the area, depending on the availability of water compared to demand:

- * Water abundant type
- * Water deficit type

In the first case, irrigation is practiced on demand with a flexible set-up, whereas in the second case, the more frequent, the organization is much more structured.

4.2 Talghoumt scheme

a. Geography and climate:

770 ha, located South-East of Marrakech, semi-arid climate, with an average rainfall of 414 mm.

b. Water resources:

It is a river diversion scheme on the 'Ourika Oued', characterized by high floods and perennial flow limited to snow smelting period.

Talghoumt scheme is authorized to withdraw 3.4 Mm³/year.

c. Infrastructure:

- Diversion point.
- A feeder canal.
- A distribution network.

4.3 Management in Talghoumt scheme

a. Distribution among 'sequias':

37 sequias (canals) are fed by the 'Ourika oued'. Water withdrawal rights and priorities are defined by the law. The ORMVAH is in charge of its application on site.

b. Distribution within each sequia:

Water rights are linked to the land. The sharing variable is time as each shareholder receives the full discharge of the *sequia*. The unit of time is called '*Ferdia*' (12 hours). Each *ferdia* serves an area of 50 ha.

c. Operation:

- * Operation at headworks. The main task is to watch the discharge diverted by the Talghoumt *segua*, in accordance with the *oued* discharge. The setting of the main gate is ensured by an ORMVAH employee.
- * Sharing/rotation: several types of sharing methods are practiced depending on the availability/demand ratio:
 - In flood period: no strict rotation pattern (on demand distribution is possible).
 - Off-flood period with low demand: partial on demand distribution is still possible.
 - Off-flood period + high demand (March to May): strict rotation applies starting downstream.
 - In very low flow period: upstream '*mesref*' have the priority to use available water.

A person is nominated by the *segja* users '*Amazal*' to look after the application of the rules. He cannot be a landlord within the area.

d. WUA of Talghoumt:

Regrouping of all users in one single WUA was made in 1991 : 478 users for 770 ha.

e. Canal service organization:

The WUA is fully in charge of the service works, in which the *Amazal* plays a key role.

Assistance of ORMVAH have to be asked for important works.

f. Service cost: The expenses undertaken by the WUA are threefold:

- Supplies and equipment
- Labour cost
- Outside intervention.

Service and maintenance costs are based on 1% of the investment:

- Investment: 6 880 000 DH
- Service and maintenance: 69 000 DH/year
which represents 100 DH/year/ha

Accordingly fee will be 100 Dh/ha/year (12 USD).

g. Cost for the investment:

The State is bearing 90% of the investment cost, leaving 10% to the association. We can estimate that the resulted fee will be 80 DH/year/ha.

Including the operational cost, total amounts to **207 DH/ha/year.**

