

EURO-MEDITERRANEAN REGIONAL PROGRAMME
for Local Water Management ME8/AIDCO/2001/0515/59763-P 016

ISIIMM project:

Case studies synthesis

M o r o c c o



Institutional and Social Innovations in Irrigation Mediterranean Management

ISIIMM

“Promoting an integrated and balanced management of water resources by reconciling respect for the environment with economically viable irrigated agriculture» is the objective of a local dialogue operation between farmers, development professionals, scientists and various stakeholders. This concept has served as a reference for the Institutional and Social Innovations in Irrigation Mediterranean Management project (ISIIMM) led by Agropolis International (France).

ISIIMM is a Euro-Mediterranean regional project funded by the European Commission “EU-MEDA Water” involving six countries: Egypt, France, Italy, Lebanon, Morocco and Spain. The aim of the ISIIMM project was to share experiences, knowledge and build new perspectives for sustainable water management in Mediterranean agriculture, based on a common understanding of six key mechanisms: Social, Institutional, Historical, Agricultural, Territorial, Hydrological/Hydraulic.

A comparative, progressive and participatory approach was adopted between different stakeholders coming from the eleven selected study areas where water is a central topic issue to social and economic life.

The ambitious and challenging activities of the ISIIMM project were built upon a framework of regional network co-operation systems. Many multi-national and multi-sectoral teams worked together with the support and organisational efforts of project partners.

With a primary objective to help local rural communities adapt to the emerging problems resulting from pressures on water resources, two priorities guide the project: a) working with local irrigation organisations; and b) working with the development professionals.

Three main activities were developed with the participation of the target groups.

Diagnosics for action in each of the 11 river basins (national and local case studies) leading to new water-sharing behaviours and institutional innovations. This was focused on a statement of conditions and aims for each river basin and country using a participatory approach and based on existing documentation plus the scientific assessment of the ISIIMM experts.

Social and institutional innovations have been approached through the **concrete actions** on the ground and a wide series of **training workshops and exchange seminars** complemented by field visits with farmers, managers of public organisations and canal managers. In total, 19 international workshops and seminars and around 35 local and national meetings and trainings

were organised with participation of more than 1500 persons to enable the target groups to gain a wider vision of the problems in Mediterranean irrigation management and more references to solve them in more suitable ways. Concrete actions (SWaMMA (Solid Waste Management in Mostafa Agha) micro-project in Egypt, AIRMF (*Association des Irrigants des Régions Méditerranéennes Françaises*) in France, Irrigators association in Lebanon, wider stakeholder participation in decision making in Morocco, pluri-stakeholders involvement at regional and local level in Italy and Spain) have been initiated with local stakeholders and will be continued thanks to the strong relations developed.

An **extensive information and data base system called OSIRIS** has been developed to enable target groups to access information about the ISIIMM case studies and compare this with their own situations (www.isiimm.agropolis.fr).

In addition, a concerted effort was being coordinated to distribute this information through books, films, newsletters, guides and other media. ISIIMM has been contributed to mutual learning and knowledge transfer at local, national and regional scales.

The EU Partners are:

- In France: Chambre Régionale d’Agriculture du Languedoc-Roussillon (CRALR), VERSeau Développement
- In Italy: Autorità di Bacino dei fiumi Isonzo, Tagliamento, Livenza, Piave, Brenta-Bacchiglione (ABAA), Fondazione Eni Enrico Mattei (FEEM)
- In Spain: Universidad Politecnica de Valencia (UPV), Unidad Sindical de Usuarios del Júcar (USUJ)

The MEDA Partners are:


- In Egypt: Center for Rural Development Researches and Studies (CRDRS), Egyptian Association for Sustainable Rural Development (EARSUD)
- In Lebanon: Chambre de Commerce, d’Industrie et d’Agriculture de Zahle et de la Bekaa (CCIAZ)
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Case studies synthesis

M o r o c c o

*Case of the Haouz of Marrakech
and of the Aït Bougmez valley*

Final Report by

Mohammed El Faïz

*In collaboration with Mohamed El Gouch
and Abdelaziz El Gueroua*

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INTRODUCTION

The ISIIMM project has built a considerable amount of knowledge on the approach of institutional and social innovations in irrigation in Morocco. Observations in the field based on the hands-on experience of communities of irrigators, the number of appraisals carried out on different aspects of irrigation, regional and international exchanges, student dissertations, have all contributed to our understanding of the socio-historical, economic and institutional foundations of modern hydro-agricultural structures, and has helped us to place them within the comparative framework of the ISIIMM project's partner countries.

In line with the goals of this summary, we have decided to present irrigation as the recommended pathway towards agricultural development and to underline its consequences (chapter 1). The two case studies, that of the Haouz of Marrakech (chapter 2) and that of the Ait Bougmez valley (chapter 3) allow us both to confirm the trends recorded on a national scale and to understand local adaptations. The most important institutional innovation of the past two decades stems from the experience gained in the creation of the agricultural water users' Association (AUEA). How was this experiment carried out in such contrasting landscapes as the plains and mountains? What lessons can we draw from it, not only for Morocco, but also for those partner countries that are bathed in the same water culture?

1. IRRIGATION IN MOROCCO: A RECOMMENDED PATHWAY FOR AGRICULTURAL DEVELOPMENT AND ITS CONSEQUENCES

If we are to speak of irrigation in Morocco, we must first consider that it is one of the greatest hydraulic potentials in North Africa. We must then look at its development, the roots of which dig deep into the past, through different periods that have left their combined contributions: pre-colonial (before 1912), colonial (1912-1956) and post-independence (1956-2006).

1.1. IRRIGATION AS A VECTOR OF AGRICULTURAL DEVELOPMENT

1.1.1. A large, but irregular and unequally distributed hydraulic potential

Morocco lies in the most western part of the Arab World, (a sort of Far West), and most of its land is dominated by a semi-arid and arid climate. The structural constraint of its unpredictable climate has weighed heavily upon the country's past since the beginnings of the first dynasties in the 19th century. Rainfall maps afford us an idea as to the sharp contrast between the wet and dry zones of Morocco.

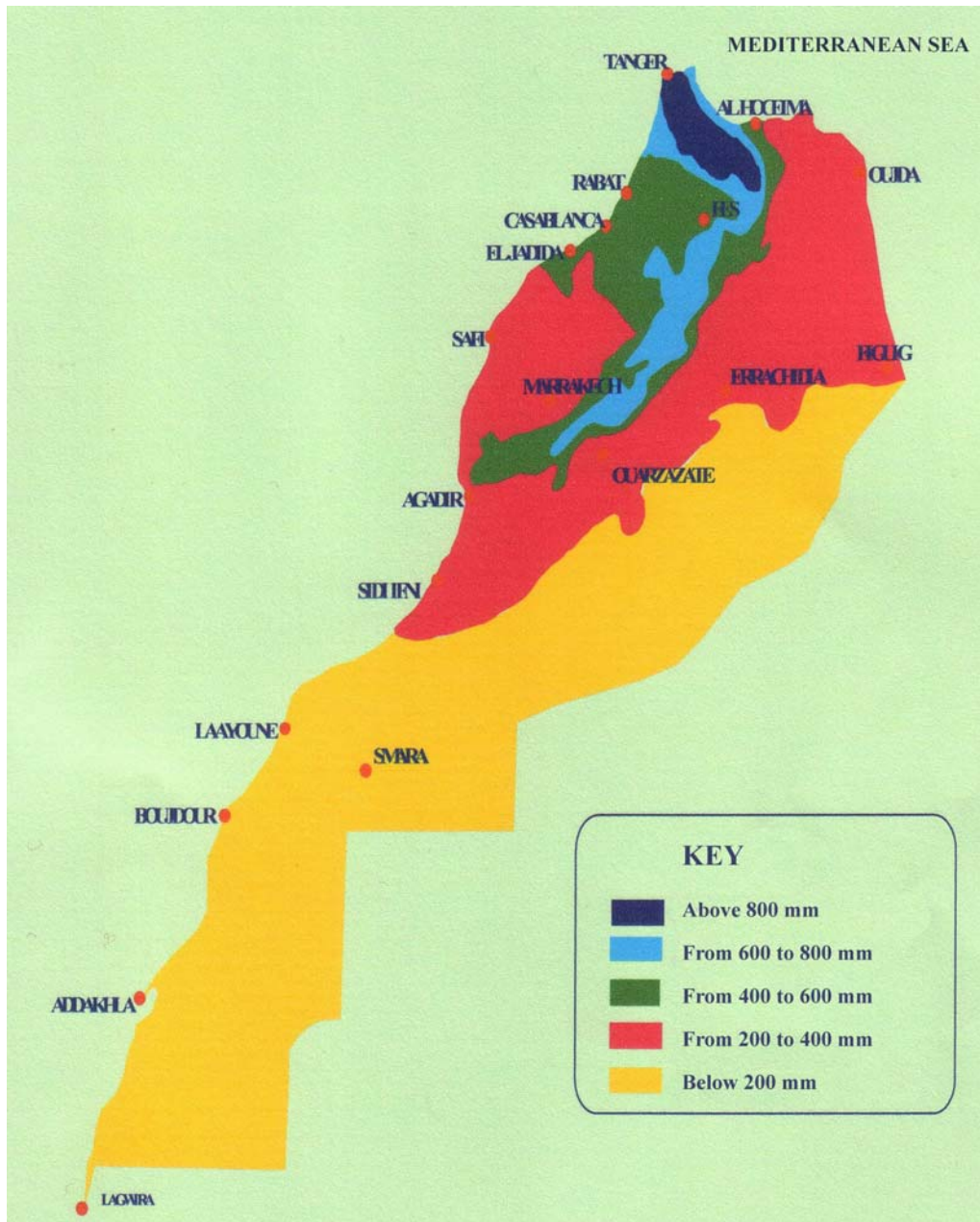


Figure 1. Rainfall averages

Rainfall distribution is as follows:

- Above 800 mm in the well-watered zone of the north-west.
- From 600 to 800 mm in the northern zone and in the atlas zone.
- From 400 to 600 mm in the Sebou, Bouregreg and Oum Rbia zone.
- From 200 to 400 mm in the Tensift, Souss Massa and l'Oriental.
- Below 200 mm in the south atlas zones and the Sahara.

Rainfall supply is unequally distributed throughout the country.

Although the regions of the North and of the Sebou basin occupy a mere 8.5% of the total surface area of the country, they receive over 59.5% of overall rainfall, whereas the Moulouya basin, that covers only 8.2% of this surface area, receives only 4.8% of overall rainfall.

Generally speaking, most of the Moroccan territory receives a mean annual rainfall that is below 300 mm. There is also a clear contrast between water-rich areas (the mountainous north-west > 2000mm/year) and sparse areas (such as the Sahara which benefits from less than 50mm/year).

In certain years, the lack of rainfall combined with its poor distribution can lead to an 84% drop in production as compared to average (case of the 1996-1997 agricultural campaign). Irrigation is dependant upon annual rainfall and its contribution to agricultural added value can vary according to dry and wet years.

The irregular nature of rainfall explains the chequered evolution and fluctuating trends of agricultural production, especially in pluvial agriculture zones

Maréchal Lyautey, a resident general in Morocco during the French protectorate, summed up the impact of climate conditions in his famous phrase: "In Morocco, to govern is to rain"; the expression itself, although "too good to be true", is not as strange as the fact that it is now pronounced as an indisputable truth by certain Moroccan leaders.

Without falling into "rainfall determinism" we may say that Morocco possesses a hydraulic potential that could lessen the effect of the unpredictable climate. This potential, amongst the largest in North Africa, is generated by its mountain ranges, above all the High Atlas, and by its large Wadis. Available water resources are estimated at around 20 billion m³, divided into surface water (16Mds) and underground water (4Mds).

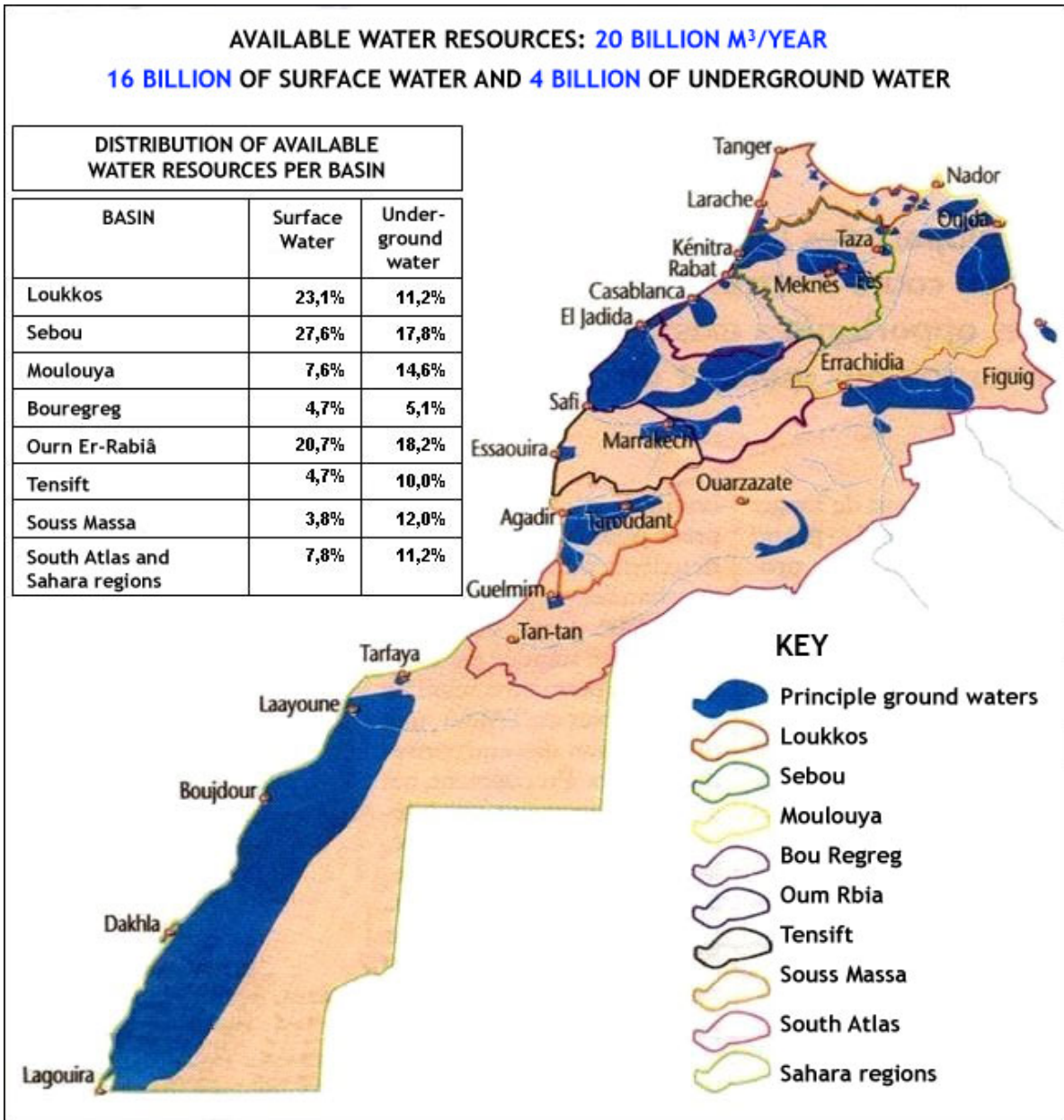


Figure 2.

The annual supply in available surface water reaches some 15,755 million m³. This amounts to several million m³ for the most lacking basins such as the Sahara basins, the Souss Massa (564 m³), the south Atlas basins (848 m³) and in billions of m³ for the Loukkos and Mediterranean coastal basins (2,492 m³), Sebou (4,464 m³), Oum Rbiâa (3,996 m³). Although these last three basins cover only 13.4% of the entire country, they concentrate over 69% of available resources.

As for underground waters, these are an important part of the national hydraulic heritage. The available potential is estimated at 4 billion m³ spread over almost 126 identified water tables, of which 2.7 million m³ are currently tapped.

Water resources currently vary from 180 m³/inhab./year, in areas renowned for their extremely poor water resources, located in the south of Morocco, to almost 1,850 m³/inhab./year for northern basins, with abundant water resources. There are already four watersheds, home to a population counting some 10 million inhabitants, where this level falls below the 1,000 m³/inhab./year threshold.

Both for rainfall and for available hydraulic potential, the unequal distribution of resources and endowment per inhabitant is to be noted alongside a significant contrast between the north and south of the country. The demographic pressure on water resources is also to be added to this unequal distribution.

Table1. Human pressure on the water potential per basin
Source: DRPE

	1971		1994		2000		2020	
	Number of basins	Population (millions of inhab.)	Number of basins	Population (millions of inhab.)	Number of basins	Population (millions of inhab.)	Number of basins	Population (millions of inhab.)
Above 1700 m ³ /inhab./year	5	8.4	1	2.1	1	2.4	-	-
Between 1700 and 1000 m ³ /inhab./year	1	0.9	4	14.4	4	15.6	3	8.6
Between 500 and 1000 m ³ /inhab./year	1	2.4	2	4.0	2	4.5	3	17
Below 500 m ³ /inhab./year	2	3.3	2	5.1	2	5.9	3	12

Over 61.8% of the population is to be found in the Loukkos, Sebou, Bouregreg and Oum Er Biâ basins which cover 16.2% of the country's surface area and provide 74.9% of average flow. 52.3% of the rural population and 70.7% of the city population are located within these basins.

Back in the eighties, Morocco crossed the threshold of 1000 m³/inhab./year of available resources. The demographic pressure on resources is aggravated by the constant deterioration of water quality.

Indeed, the quality of surface and underground water resources is threatened by numerous sources of pollution, the main ones being:

- Discharge of untreated waste water from a population exceeding 26 million inhabitants, of which 51% dwell in an urban environment. Almost 180 million m³ of collected city waste water is discharged into rivers or poured onto the ground without prior treatment, to which must be added the 130 million m³ that are not collected by the sewer network;

- Industrial waste waters discharged into the river system or poured onto the ground are estimated at 5.7 million of equivalent inhabitants;
- Solid household and industrial waste currently amounts to 4.8 million tonnes, of which 4 million tonnes are household waste and 0.8 million tonnes are industrial waste, the bulk of which is discarded in illegal rubbish tips, often located on river banks, or directly dumped into the countryside;

The deterioration of the resource is a great expense for Morocco. The cost is currently estimated at over 15 billion Dirham per year, i.e. 6% of the GNP.

In order to stand free from the hazards of its climatic and hydrological environment, Morocco has chosen irrigation as the privileged means by which to develop both agriculture and the economy in general. The “one million irrigated hectares” project has been on the agenda of Moroccan politicians for almost half a century (1956-2006), during which most of the country’s economic and financial means were dedicated to making this goal come true.

1.1.2. The legacies of irrigational history

a) Pre-colonial input

As soon as they settled in North Africa and in the Iberian Peninsula, the Arabs, supported by the Iberian-Berber community, managed to tap the waters of existing rivers and to use them for irrigation, for industrial facilities and to supply drinking water to the inhabitants of the new towns. Within this framework, irrigation became one of the principal sources of agricultural development.

The dams (*sadd,ouggugg* in Berber language) were not intended to block the Wadi flows and were connected to a widespread and complex network of “*Seguias*” (canals) that formed the main carrying and distribution system for irrigation water. These *seguias* were fitted with more or less refined distributors and were also used to run water mills. Large structures were also built to clear obstacles: aqueducts and siphons.

In addition to the structures built for the tapping, transport and distribution of water, hydraulic mechanization also played an important role; Documentary and archaeological evidence point to the extensive use of water wheels (*norias*), of bucket machines (*saniya*), of water mills and of other hydraulic equipment.

The real point of interest here does not reside in the technical aspects of this new hydraulics but more in its social sophistication. Water legislation is indeed a frequently neglected contribution of Arabic civilisation.

The secret behind the success of pre-colonial hydro-agricultural planning lies in the development of water distribution, regulatory and management modes adapted to the acquired technical level. The “Canal Agency” (*wakālat al-sâqiya*) was the eminent institution in charge of the network management in collaboration with the Valencia “water tribunal”. This is the sophisticated social management that still lives on in the Berber mountain areas, in the piedmonts and within the Moroccan oases “Little

major work, ingenious distribution and a strong collective organisation...” these few words uttered by J. Brunhes truly sum up the agricultural water characteristics of Morocco¹.

Irrigation institutes operated for centuries according to the following principals:

- the disciplinarian resolution of conflict
- participative management in the sense that responsibility is placed in the hands of the irrigating community (the *jmaâ*) with regard to water distribution, upkeep and maintenance of the network
- application, as far as possible, of the rules of equity and justice

How did these principals evolve during the Protectorate? Did they inspire the colonial legislator? Or were new institutions created?

b) Genesis of the dam option during the colonial period

J.J. Pérennès traces the option for reservoir dams and large scale hydraulics back to the turning point of the twenties. He demonstrated the extent to which this question created a cleavage amongst specialists and opposed, above all, public works engineers, who were in favour of large scale equipment, and geographers, who were more aware of the impact of such a choice on the natural and human environment.² J. Brunhes takes the merit for having extended the debate beyond the circle of technicians, into the realms of public debate. The scholar succeeded in delaying in Algeria by two decades, thanks to the relevance and influence of his work, the re-launching of actions in favour of major dams.

At the end of the day, however, it was this “perilous formula” that was adopted in the colonies. R. Arrus demonstrated that the choice of large-scale hydraulics was made not only under the pressure exerted by engineers, but also under that exerted by the metropolitan public works companies and financial and banking groups that backed them up. For this “lobby”, the worksites opened up in the colonies represented an enormous market for the sales of materials as well as a place in which to experiment new techniques³.

In Morocco, the option for large scale hydraulics was also encouraged by other factors:

- The appearance of a cereal surplus on the metropolitan market and the quest for more profitable crops;
- the nomination of the Resident General Steeg who was in favour of dams and whose long term disciple was the engineer, Martin ;
- Several missions to California – amongst which the Martin mission- undertaken to draw inspiration from the American model.

All of these factors played in the adoption of citrus fruit farming and market gardening - the first crops to draw the most benefit from the water provided by the projected dams.

¹ Jean Brunhes, *L'irrigation dans la Péninsule ibérique et dans l'Afrique du Nord*, éd. Naud, Paris, 1902.

² J.J. Perennés, *L'eau et les hommes au Maghreb*, éd. Karthala, Paris, 1993, p. 127.

³ R. Arrus, *L'eau en Algérie*, cité par J.J. Perennés, op. cit. p. 154.

The “Californian myth” was at its summits in Morocco during the thirties. Despite the spectacular nature of the dam option, the structures built during the colonial period remained fairly modest:

Table 2.

Sectors	Potential surface areas to irrigate	Surface areas dominated	Surface areas equipped	Actual surface areas irrigated
Sidi Slimane	30000	28000	22500	13000
Beni Amir	36000	28000	27400	19000
Beni Moussa	86000	30000	16000	5000
Doukkala	148000	30000	4700	1100
Haouz	127000	-----	-----	-----
Basse Moulouya	70000	16000	8000	-----
Total	497000	132000	78600	38100
%	100	26,5	15,8	7,6

This table shows just how little of the land was irrigated. The land that was dominated by the main structures (dams and main canals) was only partially equipped (60%) and only 50% of equipped land was actually irrigated thus leaving dry zones within irrigation areas.

1.1.3. Half a century of agricultural evolution in Morocco under the sign of “one million hectares to irrigate”

a) *From 1956 to 1966: A decade of debate.*

From the colonial period, Morocco inherited a commitment to reservoir dams, the orientation of the production system towards export crops (citrus fruit, market garden produce) along with the increasing implication of engineers in technological decisions.

The question of modern irrigation will once again be taken up immediately following independence (in 1958) within the framework of the specialised commission called the “Hydraulics group ” that participated in the preparation of the five year plan 1960 - 1964 ; This type of “brain trust ” was mainly composed of engineers, but also included a few contributors from social and human sciences. This think tank gave rise to the rich experience of the National Office for Irrigation (ONI) (1960-1966) that must be recalled in order to understand the choices and options adopted in hydro-agricultural planning.⁴

Created in September 1960, the ONI was responsible for administrating the 5 areas inherited from the Protectorate (amongst which the Haouz). This marked the beginning of an intense period of research, projects and actions. The investigation programme touched upon different domains: the regions’ water potentials, industrial crops, farming methods, structural reform, etc.

⁴ M. El Faïz et A. Seddiki, *Essai sur le capitalisme agraire périphérique : cas de l'irrigation au Maroc*, thèse de 3^{ème} cycle, Grenoble, 1979.

b) From 1966 to 2000: the dam option triumphs

Large Scale Hydraulics in Morocco appears to be the work of engineers, essentially marked by technocratic orientations and choices. This is by no means an exceptional situation. It reproduces a pattern that is to be found at work in other countries in which the dam option was adopted in the development of irrigation.

The examination of public investment through development plans shows the importance of irrigation and its weight in agricultural development.

Table 3.

Development plan	Total investment (1)	Agricultural investment (2)	Irrigation (3)	2/1	3/2
1960-1964	259 (a)	78	42	30%	54%
1965-1967	2461(b)	851,6	486,26	34,6%	58%
1968-1972	4910,8(c)	2295,5	1417	46,7%	61,7%
1973-1977	11800 (d)	3000	1586	26%	52,8%
1978-1980	9700 (e)	3000	2700	31%	75%
1981-1985	34623 (f)	11650	8200	33,6%	70,3%

a- value in billions of francs

b,c,d,e,f- value in millions of dirham

From 1960 to 1985, the share of irrigation in programmed investments swung between 54 and 70%. The changes over the beginning of the twenty-first century, when examined, show that there was no deviation from former choices and that the State intended to pursue its efforts in the same direction.

Table 4. Structure of the investment budget of the Ministry of Agriculture, 1999–2004. (Finance Act in percentage)

Budgetary section	1999-2000	2001	2002	2003	2004
Large Scale Hydraulics	39	43	46	52	41
Small and medium hydraulics	14	10	9	9	10
Rain agriculture zone (Bour)	18	14	12	8	10
Total budget in millions of dirham	2016	2114	2585	1943	1749

Source: Akesbi, Najib, Yearly report, Morocco, 2005, CIHEAM, Paris.

It may thus be said that the priority given to investments in large scale irrigation has remained a consistent policy on behalf of the State and one of its major choices. Most of the budget reserved for large scale hydraulics exceeds 40% on average. Thanks to the concentration of funds in the hydro-agricultural sector, Morocco has achieved its project of one million irrigated hectares:

Table 5. Potential and fulfilment in hydro-agricultural management in gross ha (sustainable irrigation)

ORMVA	Surface area developed in hectares			GAP
	Potential	Equipped	%	
Large Scale Hydraulics :	880.160	671.700	76	208.460
Moulouya	77.280	77.280	100	0
Gharb	222.500	106.350	48	116.150
Doukkala	133.600	104.600	78	29.000
Haouz	189.920	142.620	75	47.300
Tadla	117.840	109.000	92	8.840
Tafilalet	27.900	27.900	100	0
Ouarzazate	37650	37.650	100	0
Souss-Massa	39.900	39.900	100	0
Loukkos	33.570	26.400	78	7.170
Small and medium hydraulics	484.090	332.300	68	151700
Total	1.364.250	1.004.000	73	360250

The irrigation potential is spread between:

- Large scale hydraulics sectors that concern the large irrigated areas, supplied by water resources that are regulated by the major mobilisation structures and that are the object of integrated hydro-agricultural management run by the Regional Offices for Agricultural Enhancement.
- Small and medium hydraulics sectors that involve all of the small or medium size irrigation sectors, spread throughout the national territory, generally supplied by non-regulated water resources and managed by irrigator associations.

In Morocco, large structures were built to transfer water between basins in order to balance out the distribution of water between those with a surplus and those with a deficit. 13 transfer projects were thus undertaken for a total flow of 303 m³/s over a distance of 1,045 km. They allow the transfer of an annual volume of 2,992 million m³ of water, 1,797 million m³ of which is between large catchment areas and 1,295 million m³ between sub-watersheds.

All of these projects were achieved thanks to State funding and multi-format aid; the latter progressed from 2. 2% of agricultural GDP (1974) to 6.3% in 1984. Over ten years of progression, the total amount of combined funding has reached 5 billion dirham.

The extension of the water infrastructure and the efforts made since independence has enabled irrigation to become the driving force behind the national agricultural economy.

Although it only accounts for around 10 % of useful agricultural land, the contribution of irrigated land amounts to an average of 45% of agricultural added value and its participation in agricultural produce for export amounts to 75 %. This contribution to added value can reach 75% in wet years. The share of irrigated land in national GDP is between 7 and 10 % according to the water conditions of the given year.

Table 6. Contribution of irrigated agriculture to agricultural production (Situation in 2003)
Source: DRPE

Production	Irrigated land/useful agricultural land (%)	Irrigated production/national production (%)
Sugar beetroot	75	80
Sugar cane	100	100
Cotton	100	100
Cereals	7	15
Pulses	18	26
Market Gardening	74	82
Forage	67	75
Citrus fruits	100	100
Others	21	35
Arboriculture	-	75
Milk	-	26
Red meat	-	-

Dams have certainly reduced the effects of flooding and drought, allowing irrigated farming to satisfy part of the country's needs in terms of sugar and milk and to ensure the development of the agricultural export sector.

However, these positive effects, often pointed out by dam option partisans, must be examined in terms of impacts and costs of the "one million irrigated hectares" project. The major question that is raised is as follows: have we done sufficient work, as J. Brunhes has been inviting us to do for the past century, on the "fundamental link between the technical structure and socio-economic organisation"?

1.2. THE CONTRASTING RESULTS OF IRRIGATION IN MOROCCO: THREAT TO THE SOCIO- INSTITUTIONAL AND ECOLOGICAL FOUNDATIONS OF THE DAM PYRAMID

Before assessing the results of the dam option, we may note that the large effort to mobilise water resources has largely undermined the country's potential, both in terms of surface waters and of underground waters.

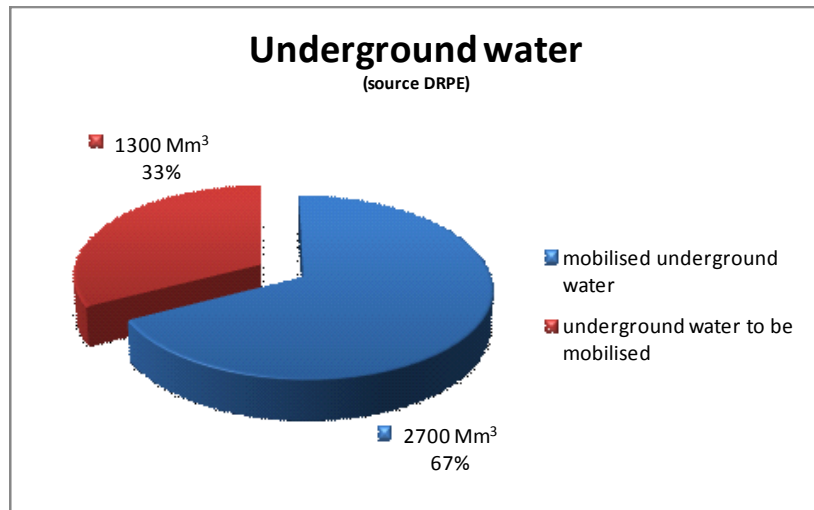


Figure 3. Rate of mobilisation of underground waters (Mm³)

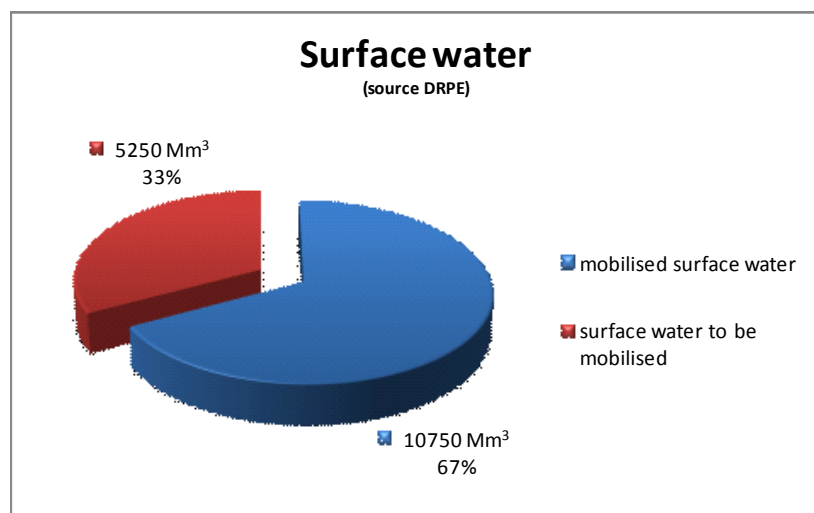


Figure 4. Rate of mobilisation of surface waters (Mm³)

Globally speaking, mobilised water resources represent 67% of available water resources. The rate of use varies from 67% for surface waters to 67.5% for underground waters. The over-tapping of underground water resources is already endangering the economic and social development of certain

regions (Souss Massa, Saïss, Temara, Haouz and the South Atlas basins) and can lead to a serious ecological situation due to growing desertification.

Despite these visible effects, forecasts outline a continuation of past trends and the commitment of the State to the creation of other water mobilising structures. The water basin guideline plans announce the construction of some 30 large dams and a significant transfer of water by 2030.

Technical works have a rosy future and their defenders seem to be interested in only one goal: mobilising the remaining 40% of available water resources. This set idea is reminiscent of the presumed exclamation of Napoleon before the Nile and that of his will: not to “let a single drop reach the sea”! We can see to just what extent this dream has resisted time and social criticism and continues to nurture the imagination of reservoir dam builders throughout the world. This explains the necessity of assessing the results of hydro-agricultural management using what Michel Marié calls “the pedagogy of cross perspectives”⁵.

Environmental and social aspects have, indeed, been somewhat left to one side in the reflection of Moroccan managers. And it is no chance that these aspects today draw great attention and are amongst the major factors that are blocking the ambitious one million irrigated hectares programme.

1.2.1. The almost insoluble question of silting

Water erosion affects most of the catchment areas in which dams are located.

Losses in storage volume are progressing at a considerable rate: almost 5% of storage capacity is lost yearly, i.e. around 65 million m³, or the equivalent in volume as that retained by a large dam. Out of an overall storage capacity of 14500 Mm³, over 1000 Mm³ have been lost due to silting.

Silting is, to some extent, that little grain of sand forgotten by the structural engineers that is currently threatening to unhinge the costly and complex machinery of Large Scale Hydraulics (GH).

1.2.2. The difficult junction between technical and social aspects

It may be noted that, from the outset, the most important missing element in management frameworks was the fellahs social community. No surveys were conducted in order to hear their opinion or to call upon their participation. The technical vision prevailed in all of the reports issued by the consulted engineering offices. The teams of consultants were, moreover, dominated by the engineering or pure scientific profiles that they represent. It is understandable that in such a programme, human and social sciences were totally absent. Technical rationality, that of “the drawing board” as Paul Pascon calls it, cannot afford to be obstructed by the multitude of rural logics.⁶

Technocratic choices that favour the idea of a model rather than that of studying how things stand in the field, did not take into account the parallelogram of social forces and irrigation stakeholders, thinking that intensified farming could be managed without a true reform of land structures.

⁵ M. Marié, « Aménager ou ménager le territoire », in *Annales des Ponts et Chaussées*, n° 77, 1996, pp. 67-68.

⁶ P. Pascon, *Etudes rurales*, édition SMER, Rabat, 1980.

In Morocco, however, the structural constraints of farming land are renowned: 70% of farms have a surface area below 5ha separated into 6 plots ; 45% of farms are subject to joint ownership; and 24 % of Usable Agricultural Land is composed of jmaa (collective), guich (military) and habous (religious communities) land and Makhzen (state owned) property.

These structural problems are also apparent in irrigated land, in which the process of real estate concentration is strong:

Only 2% of farmers own 27% of irrigated land with farms exceeding 20 hectares, whereas 84% of farmers own 38% of land with farms of under 5hectares.

Within this framework, we must remember that funding essentially benefited farms of over 50 hectares. Large farms benefited from 90% of the funds in the coastal area and 55% in the country's hinterland areas.

The abandonment of the promised land reform following independence was an aggravating factor for social and real estate inequalities. Irrigation, far from reducing the differences, contributed above all to making the rich farmers even richer.

Did the spectacular project of the Large Scale Hydraulics (GH) change the daily life of small farmers and contribute to improving their standard of living?

The fall back in terms of income, heightened by the managers' calculations, seems to have been less obvious in this area. The capitalistic mind set was once again extremely selective and benefited, above all, larger farms, leading to the exclusion of small producers. Can things be otherwise?

“The history of operations targeting the intensification of agricultural production such as that of the green revolution, explains J. J. Pérennès, shows that the effects are discriminatory; generally, those who have the most gain the most”⁷. The poorer one is, the less profit one can make from existing equipment. It has also been established that when a support programme for underprivileged categories is lacking, projects above all benefit those that have viable farms, sufficient capital, larger market shares and easier access to funding.

Thus, faced with the position of large scale hydraulics defenders, it is always edifying to recall the ecological and social limits. We can also mention the internal contradictions of the dam policy and the difficulty that it encounters in satisfying intensification goals and in covering water needs, goals that are amongst its major arguments.

Dams, due to their ability to mobilise ever larger water resources have indeed, since their conception in the nineteenth century, never ceased to capture mankind's imagination with the impression of abundance and profusion. The comparison of results in terms of needs and annual supply of irrigational water in Morocco, show that most areas cannot cover their needs and live with the constraints of rationing and shortage. In all of the irrigated areas, the level of needs coverage is 60% on average. If we take the 1989-1994 period as a reference, the mean yearly volume delivered to the head of irrigation sectors was 2.6 billion m³ i.e. 5.600 m³/ha equipped. This average hides a great

⁷ J. J. Pérennès, op. cit.

disparity between areas with a surplus (137% for Loukkos) and those with a glaring deficit (26% for Tafilalet).

Chronic deficit creates a general climate of dissatisfaction and of shortage, made even more unbearable by the fact that the cost of the structures is outrageous. The term “de-intensification” has even been mentioned, linked to the restricted water supplies within irrigated areas.

An additional phenomenon is characteristic of these areas: this is the gap between controlled land, equipped land and that which is actually irrigated. The loss of earnings amounts to 140000 hectares on average.

Also to be noted is the concentration of investments in the Large Scale Hydraulics (GH) sector, to the detriment of small and medium hydraulics, along with the valorisation of export crops to the detriment of subsistence crops.

The crisis of the Large Scale Hydraulics (GH) model is clearly apparent when we compare results and performance with regard to intensification and agricultural valorisation.

From surveys lead on a national scale, it appears that the Small and Medium Hydraulics areas have a greater intensity of land occupation (121%) that largely exceeds the perimeters of Large Scale Hydraulics (GH) (98%). Although they only have limited means, these areas achieve satisfactory performances and yields. The farmers’ experience and the harnessing of small scale irrigation explain these achievements and valorise local know-how and the legacies of irrigating traditions.

1.3. FROM THE SUPREMACY OF THE “GH” TO THE EXPERIENCE OF THE PARTICIPATIVE MANAGEMENT OF IRRIGATION

The financial crisis that marked the beginning of the eighties led to the adoption of the SAP (Structural Adjustment Programme) in 1983. A national commission was responsible for examining the possible means by which to re-balance the budgets of different public institutions, amongst which the ORMVA (Regional Offices of Agricultural Valorisation). Status reforms, including privatisation, were envisaged. The ORMVA’s status as a public institution was preserved, but they were given responsibility for covering the running and maintenance costs of irrigational structures with the water rates paid by the farmers. In addition, liberalisation measures were taken within the framework State “disengagement”: the ORMVA relinquished mandatory crop rotation and provision of services.

Within this general context of public subsidy cuts, corrective measures were applied to irrigation programmes and implemented with the support of international organisations and, in particular, the World Bank:

- PAGI I (programme for improved large scale irrigation) was launched in 1986 with the goal of making the most of water resources (effectiveness and efficiency), to encourage the development of farming, to improve the management of the ORMVAs and to transfer certain responsibilities to the farmers.
- PAGI II which succeeded PAGI I in 1993, focused on improving network care and maintenance, on enhancing income and on the financial autonomy of the ORMVAs.

- Launched alongside the PAGI, the PMH (small and medium hydraulics) was much less demanding in terms of investment and created the opportunity to reduce the gap between the large irrigated zones and the “bour” (non-irrigated) zones, but in which there were PMH sectors (more than 2000) most of which were below 100 ha in surface area.

The principles of GPI (Participative Management of Irrigation) were introduced during this programme as bank loan conditions obliged irrigators to participate in the conception of the network, in the management and in the maintenance of structures within the framework of associations, the AUEA (Association of agricultural water users) created for this purpose see law no. 02-84, dahir of the 21st December 1990).

The underlying principles of the participative management of irrigation were sanctioned by the national colloquium held November 1995, being fully in line with the frameworks outlined by the PAGI and by the PNI (National Irrigation Programme). Their aim was to achieve the transfer of the ORMVA water service management prerogatives to farmers, who were called upon to create an AUEA. This transfer was to:

- contribute to improving water services and the sustainability of structures thanks to the participation of the AUEAs in network management
- consequently reduce the cost of water
- contribute to the greater financial autonomy of the ORMVAs
- create the conditions for an efficient and fruitful partnership between the ORMVAs and the AUEAs, as well as with other operators, particularly in other sectors such as land planning and agricultural development.

In the nineties, there was also regained interest in rural development. A rural development strategy was defined in 1993, completed by the “strategy 2020” established in 1999.

It is within this framework that the Project for integrated rural development, centred on small and medium hydraulics (DRI-PMH), was set up: Launched in 2001 and funded by the World Bank, its goal is to improve the income and living standards of rural communities organised around PMH activities. It was set up in collaboration with the beneficiaries themselves, and resulted in the increase of current or new farming activities centred on the rehabilitation of small and medium hydraulics irrigational equipment alongside the creation of complementary socio-economic activities such as rural tracks, drinking water conveyance, schools, dispensaries and rural electrification.

The aim of the programme, which is spread out over a 13-year period, in three phases, is to renovate and 46,000 ha of PMH in 15 provinces within the framework of an integrated and participative approach that involves the organising the beneficiaries.

The initial phase of this programme was led over the 2001- 2006 period and resulted in the creation of an area of 9,450 ha of PMH in the Azilal, Khénifra and Haouz provinces and in the creation of the associated socio-economic infrastructures. The cost of this initial phase amounted to 458 million DH of which 228 million DH for the PMH project and 145 million DH for the basic infrastructures.

1.4. EVOLUTION OF THE LEGISLATIVE AND INSTITUTIONAL FRAMEWORK FOR WATER AND IRRIGATION

1.4.1. The water sector in Morocco: an institutional complexity

The water sector in Morocco is characterised by the existence of a multitude of contributors, which does not facilitate the decision making process and partly explains the legislative and institutional blockages.

At the top of the water resource administration and management hierarchy is the **High Council for Water and Climate (CSEC)**. The purpose of this council, whose mission was extended to the climate in 1998, is to define the general directions of the national water policy and to unite the different water operators and users in the adoption of common strategic choices with regard to the planning, mobilisation, allocation and protection of water resources. It was created to reinforce and consolidate national consultation within the field of water. Its body is composed of representatives of the administration, water users, elected representatives and also the representatives of professional organisations that are involved in developing water resources.

At the government level, the direction of national water policy has, since independence, been incumbent upon the Ministry for Public Works and/or Equipment. The structure that is directly responsible for the planning, development and management of water evolved first from a division into a department and then into a **General Directorate for Hydraulics**. In 2002, a **State Secretary in charge of Water** was created; this department was attached to the Ministry of Territorial Planning, Water and Environment with the aim of giving greater weight to the environment and territorial planning within national water policies.

Other ministerial Departments intervene in the field of water, in particular the **Ministry of Agriculture**, the Ministry of Industry, the Ministry of the Interior (in charge of sanitation, water, forests and energy). These ministries act have a sector-based approach to water.

Other ministerial departments have a more transversal approach to water; these are the ministries in charge of health, the environment, the economy and finances.

Several sectors of activity involving water are entrusted to public establishments: The **Water Basin Agencies (ABH)** are responsible for water management in catchment areas ; the National Drinking Water Office (ONEP) for the production of drinking water; the National Electricity Office (ONE) is in charge of the country's electricity policy, nine **Regional Offices for Agricultural Enhancement (ORMVA)** whose mission is to develop, manage and enhance the irrigated areas within their jurisdiction.

Basin agencies were created as from 1999. These basin agencies now form an adequate framework within which to achieve the progressive transfer of water costs to users, in partnership with the administration, local authorities and water users in view of the joint and participative management of water at the scale of the catchment area (*hydrological unit*). The Oum Er Rabia Basin Agency was actually opened in July 1999, followed in 2002 by the Sebou, Tensift, Bouregreg, Moulouya, Loukkos and Souss-Massa Agencies. Two basins are run by the Ministry of Territorial Planning, Water and Environment; these are the South Atlas and Sahara basins.

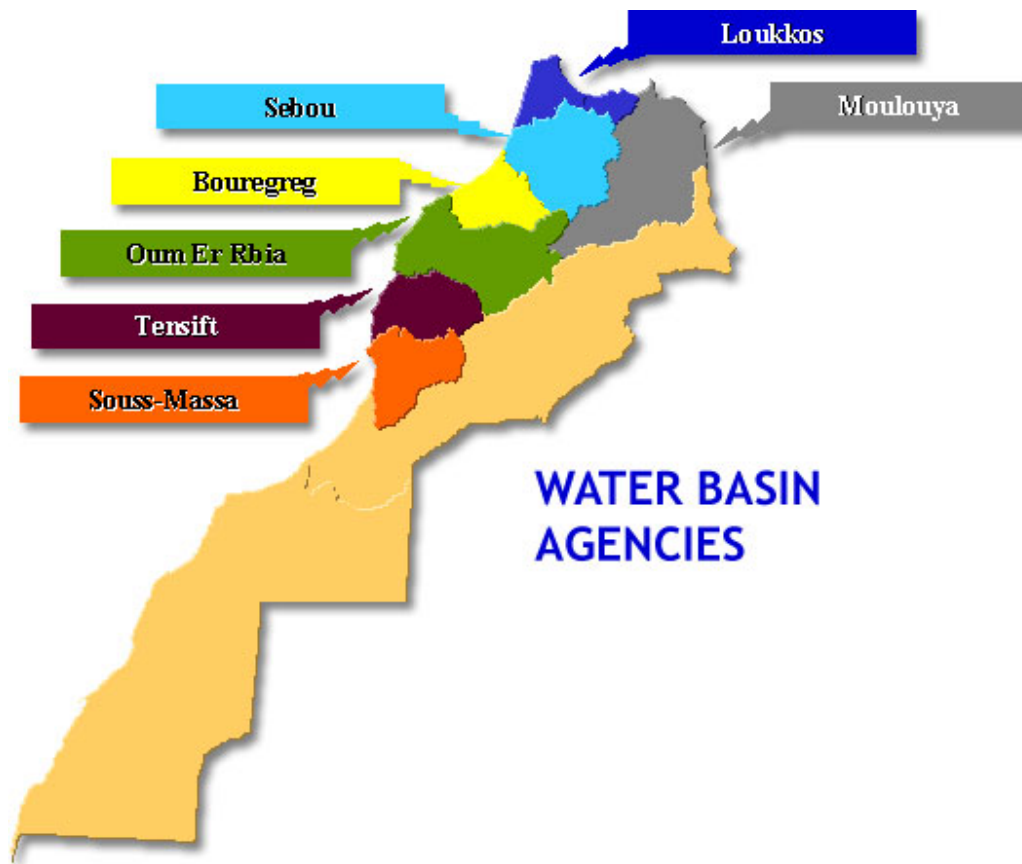


Figure 5. Water basin agencies

The creations of the high council of water and climate and the basin agencies should, in principle, reduce the impact of institutional complexity and encourage consultation between administrations and public establishments riddled with conflict in terms of missions and objectives.

1.4.2. Large Scale Hydraulics faced with the inertia of legal authorities

The greatest reform, directly linked to the launching of dam policies and the creation of regional offices for agricultural enhancement, was the promulgation of the code of agricultural investment. Instituted in 1969, this code clarified the framework of ORMVA action and the regulatory mechanisms behind State/farmer relations; in particular with regard to water pricing which is, in fact, just one of the components of the global institutional framework for the development of irrigation.

Preoccupied by the incentives for the valorisation of newly irrigated land and by water pricing to recover part of the hydro-agricultural investments, the State neglected at length the organisational and human aspects of irrigation.

It was not before 1990 that the 02-84 law relative to Agricultural Water Users Associations (AUEA) was promulgated. This law, along with the decree of 1992 adopted for its application, defines the

partnership between the State and the AUEA in terms of the development and management of irrigation systems.

But the legislative structure inherited from colonisation was only truly reformed in 1995, following the promulgation of law no. 10-95 on water. The latter forms the legislative framework by which to ensure the rational and efficient development of water resources.

In addition to confirming the role of the High Council of Water and Climate with regard to consultation and the guiding of national water policies, the law insists upon decentralised management through the creation of basin agencies, the institutionalisation of the medium and long term management of water resources, the implementation of the principle of water resource uniqueness, the development of protective measures for this resource, the institutionalisation of national and regional solidarity, the opening out to the private sector and the development of consultation with regard to water management at local and regional levels.

1.5. CONCLUSION

Since independence, the history of irrigation in Morocco has been mixed with that of the “one million irrigated hectares” project; an ambitious project due to the scale of mobilised water resources and the funding granted by the national authorities for its development. The main problem of this project does not stem from the technical structure as such, but from the attitude that the latter is sufficient and that legal and institutional structural reforms can be postponed indefinitely. On top of these fundamental considerations come the different environmental impacts.

The chronic gap between the areas controlled by the dams and the areas that are actually irrigated can be mainly explained by the delay accumulated within the field of legal and institutional reform. Even where innovation has occurred, it appears to have come late in the day and is accompanied by difficulties in terms of application and implementation in the field. We may also wonder if the budget reserved for PMH (10%) can actually boost such a large sector and enable it to play an effective role in the development of irrigation in Morocco. Are the recommendations made by the World Bank, concerning the disengagement of the State (reduction of public budgets and funds, application of real costs for irrigation water, etc.) able to encourage the much proclaimed GPI? Can we expect irrigating communities to take the initiative in a vital field, from which the State deliberately excluded them, making way for financial backers, engineering offices, engineers, technicians and popularity brokers? Is it possible, following half a century of amnesia, to convince irrigators to involve themselves in an implacable technical approach, that of Large Scale Hydraulics, where everything was planned at the outset, from the mobilisation of the drop of water to its valorisation?

To attempt to answer these questions which are at the very heart of the ISIIM Project and the problem of irrigation management in Morocco, we chose to study two areas:

The first, the Haouz of Marrakech, is renowned for its age-old tradition in irrigation. The interest of this area resides in the fact that we can study three types of irrigation systems characterised by their own techniques and legal and institutional structures belonging to different periods: pre-colonial, colonial and the phase of independence. The interest of this area resides its technical and institutional complexity and the fact that it is possible to study innovation in irrigation with a scientific and practical scope.

The second area is that of the valley of Aït Bougmaz which is a mountain ecosystem and stands out due to the coexistence of two modes of irrigation and water management:

- The local system, that shows a large capacity for adaptation and assimilation, in line with the great flexibility of water supplies (from floods that destroy irrigated zones to the total drying up of springs), and that is observed within the scope of its diversity in terms of water distribution rules, the multiple adaptations to these rules and the institutional capacity of collective action;
- Also, the new institutional and technical system introduced a few years back by the DRI – PMH project, with a specific approach that seeks hydraulic performance, to improve the management of traditional irrigation systems, but without touching upon the customary rules relative to water rights and the distribution of water between the seguias along the Wadi or at the level of each seguia.

2. THE EXAMPLE OF HAOUZ OF MARRAKECH: BETWEEN THE TECHNICAL APPROACH OF LARGE SCALE HYDRAULICS AND LOCAL WATER CULTURES

2.1. THE HAOUZ OF MARRAKECH: AN ORMVAH JURISDICTION

The jurisdiction of the National Office for the Agricultural Enhancement of the Haouz (ORMVAH), stretches over a total surface area of almost 7, 000 km². there are 470,000 ha of farming land, i.e. two thirds of this surface area, of which about 310,000 ha can be irrigated in two major zones, central Haouz in the south west, and Tessaout (upstream and downstream) in the North East.

2.1.1. Geographical characteristics

The boundaries of this area are formed to the North by the Tensift wadi, then further east by the piedmont plain of the High-Atlas, to the East by the El Abid wadi and to the West by the N'fis wadi beyond which it extends for ten or so kilometres. By road, the distance between the boundaries of the area, from the extreme West to its North-Eastern extremity, is around 180 km.

2.1.2. Climate characteristics

The Mediterranean climate of the Haouz, hot, dry and continental-like, is classified at the limits of semi-arid and arid. It is characterised by low and variable rainfall, a high mean temperature, wide daily and monthly variations, low hygrometry and very strong evaporation.

As a conclusion, we may note that the climate conditions of Haouz are extremely severe, making it difficult to have sustainable crops without irrigation and without optimal management of the water resource.

2.1.3. The population

The total population located within the jurisdiction of the ORMVAH amounts to 3 002,000 (Assessment dating back to the year 2000). The rural population amounts to 1 884,000 i.e. 63 % of the total population. It groups together 136, 000 rural households and 74,000 farms.

2.1.4. Water resources

The water resources mobilised for irrigation are essentially composed of:

- the surface waters of the Tensift wadi catchment area (N'fis, Rhirhaïa, Issil, Ourika, Mellah, Zat, R'dat and secondary wadis) representing a mean yearly supply of around 700 Mm³, of which 85 Mm³ are regulated by the Lalla Takerkoust dam, built in 1990 ;
- the surface waters of the Tessaout catchment area (Lakhdar and Tessaout and secondary wadis) representing a mean yearly supply of around 800 Mm³, regulated at 610 Mm³ by the Sidi Driss and Moulay Youssef dams;
- waters from the catchment area of the El Abid wadi, regulated by the Bin El Ouidane dam and of which 235 Mm³/an are allocated to the downstream Tessaout;

- underground waters, essentially located in Central Haouz (in particular in the N'fis and upstream from the Ourika and Zat wadi fans) and in the upstream Tessaout, representing available volumes respectively estimated at 175 and 65 Mm³.

One can still distinguish the areas of traditional irrigation that have not yet undergone modern development, and those areas that have been developed.

a) Traditional irrigation

Haouz is a region that has a very longstanding tradition of irrigated agriculture, using both surface waters and underground waters; the severe climate has, indeed, been responsible for the intimate interweaving of agricultural development and progress in irrigation. Three main traditional systems stand side by side: seguias, khattaras and wells.

Seguias

The mobilisation and distribution of surface waters: The seguia system was present in three quarters of irrigated land before the development of large scale hydraulics. Down stream from a simple intake in the wadi bank, an earth canal composed of a pipe main that varies in length and a downstream distribution part, control a variable surface area ranging from several dozen to several thousand hectares.

Along the downstream part of the seguia, the water is distributed through a network of mesrefs (branches of the seguia) according to the water turn organisation characteristic of the water unit formed by the seguia area.

Seguias were initially present in the upstream areas of the wadis, where they flow into the plains (foums). This system was then extended to the plains on the wadi fans. We can therefore differentiate the seguias according to their position along the wadi, and therefore their supply priority: We generally find, except for a few notable exceptions (the case of the Tamezguelft seguia in the left bank of the N'Fis), from upstream to downstream, sustainable or almost sustainable seguias, then seasonally supplied seguias and, lastly, seguias used only in times of high water.

Currently, the amount of land controlled by working seguias is around 210,000 ha, spread over the entire jurisdiction of the Office.

Khattaras

La khettara is a ground water drain, with a slope that is gentler than that of the natural terrain and than that of the ground water. This is a true civil engineering structure, including: an upstream underground part, that above all drains, and then transports to its downstream section and an open air reservoir basin (withdrawal is permanent whereas usage is intermittent, hence the necessity of compensation so as not to exhaust the ground water without reason). The system is then composed of a network of distribution channels.

Before the development of modern irrigation, khattaras supplied around 20% of irrigated land. In 1974, around 500 khattaras were still operating, supplying a total flow of about 5 m³/s. The lowering

ground water combined with the high construction and maintenance costs (the drain part above all) of the khattaras lead to a clear drop in their numbers, only about one hundred of them are left.

Wells and bore-holes

There were an undeniably restricted number of these individual irrigation systems (occasionally collective) throughout the Haouz, in comparison with other systems. We have no data indicating their current number, or the flow supplied and surface area that they irrigate.

b) Hydro-agricultural development

The first major structures

These were developed during colonisation, in the second quarter of the twentieth century. These were essentially:

- Intake structures on the Ourika and Riraya wadis;
- The Lalla Takarkoust dam on the N'fis (a second dam on the N'Fis is currently being built, the *Ouirgane dam*).

The main developments of large scale hydraulics

These were built following independence and are composed of three large geographical units, from West to East and from South to North:

- Central Haouz 70, 000 ha
- Upstream Tessaout 52, 000 ha
- Downstream Tessaout 44, 000 ha
- Central Haouz receives water from the N'fis wadi, regulated by the Lalla Takarkoust dam, and water from the Lakhdar wadi, regulated by the Hassan 1st dam and transported by the ring canal (118 km long) as far as the N'fis perimeter. The annual gross volume allotted to this zone is around 340 Mm³.
- Upstream Tessaout benefits from 250 Mm³ yearly from the Tessaout wadi, regulated by the Moulay Youssef dam.
- Downstream Tessaout is mainly supplied by (235 Mm³) transfer, via the T.2 canal (90 km long), with water from the El Abid wadi regulated at Bin-el-Ouidane, and to the extent of around 40 Mm³/year for water originating from the Tessaout and Lakhdar wadis.

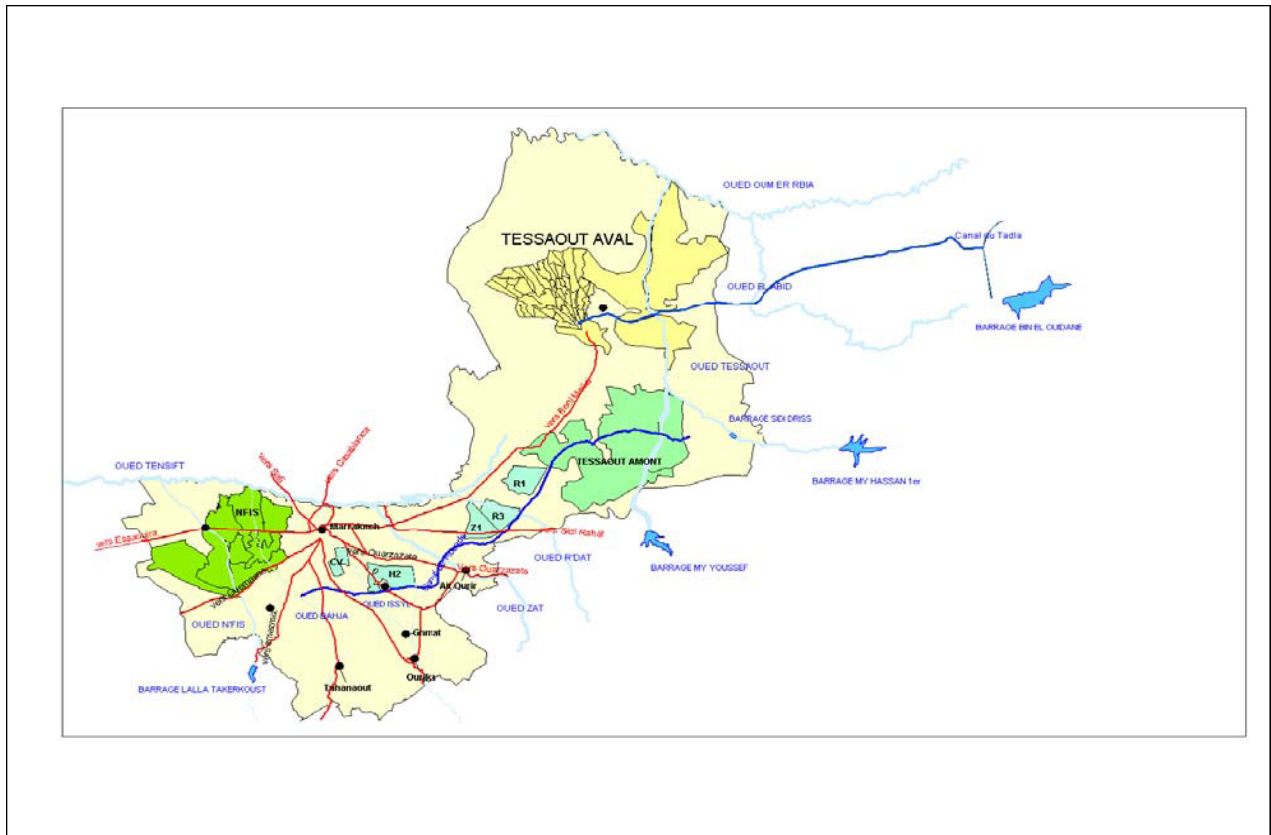


Figure 6. The irrigated areas of Haouz. (Source: GIS of the Haouz ORMVA)

c) Use of ground water

The traditional techniques of the khetaras and wells have gradually been replaced by the pumping of ground water. To begin with, pumping was collective and developed with State funding within the framework of small and medium hydraulics (PMH). 19 sectors thus irrigated a total surface area of around 5,000 ha, pumping a total flow of 2.4 m³/s from the ground water. Most of the pumping units are private. There are thought to be about 10,000 of them located in particular in the N'Fis.

d) Land structure, farmer organisations and land occupation

Status of irrigated land

All the types of legal land statuses that exist in Morocco are to be found within the jurisdiction of the ORMVAH.

- Private property (Melk): 38% of total land. In central sectors, this proportion reaches 75% whereas it is 58% in Tessaout-upstream, 30% in N'Fis and less than 10% in Tessaout-downstream.

- State- owned land: 13% of the total, essentially located in N'Fis (84% of total state-owned land) and in central sectors (10% of total), part of which is allotted (land reform cooperatives).
- Common land: 39% of land mostly located in upstream Tessaout and in downstream Tessaout.
- Guich (tribal) land: 8% of land, mainly located N'Fis and in central sectors
- Habous (tribal) land: 2%, listed in central sectors and upstream Tessaout.

Size of farms

Out of a sample of 85,000 ha around 19,700 farms were identified, there were 15,400 farms from 0 to 5 ha, representing 29,000 ha, i.e. 34% of the land and 78% of the total number of farms.

There are 3,300 average sized farms from 5 to 20 ha, i.e. 17% in number, representing 4,000 ha, i.e. 28% of the land.

Lastly, there are about 1,000 farms of over 20 ha, therefore representing 5% of the number of farms and covering a surface area measuring 31,000 ha (37% of land).

Farmers' organisation

Law no.2/84 of the 21st December 1990 sets down both the goals and the constitutional and operational details of the Agricultural Water Users' Association (AUEA) which, in Haouz, represents the most frequent type of organisation adopted by the farmers. Before this law was promulgated, there were various types of association:

- Customary or "de facto" associations, created upon the users' initiative in traditional sectors;
- Privileged Agricultural Union Associations (ASAP created within the framework of the 1924 Dahir);
- Irrigator associations, de facto associations created in the area of upstream Tessaout upon the creation of the modern systems (1968).

As soon as law no. 2/84 was promulgated, ORMVAH proceeded with the conversion of the existing associations into AUEAs, and with the creation of new AUEAs, in the modern sectors and in the PMH sectors. There were also the land reform cooperatives, above all present in the upstream Tessaout sector.

Land occupation

The irrigated crops grown in the sectors included in this study are, in order of size:

- cereals: 38, 400 ha, i.e. 46 %,
- Fruit arboriculture : 21, 600 ha, i.e. 26% of land principally comprising olive trees,
- forage: 5, 000 ha, i.e. 6%,
- Market gardening: 2, 600 ha, i.e. 3%,
- Industrial crops: 3, 300 ha, i.e. 4% of land.

2.2. THE WATER MANAGEMENT INSTITUTIONS IN THE HAOUZ

2.2.1. The ORMVAH: a formal institution

This is the central organ for agricultural and water supervision and management and of which the headquarters is in Marrakech, accompanied at a local level by the Valorisation Centres (CMV) and the network management centres (the CGR, housed by the CMV). Irrigators depend on a particular CMV according to their sector.

Within the Office, water management comes under the responsibility of the Irrigation Network Management Department (SGRID). This is the ORMVAH department that is responsible for the running and maintenance of the water intake, transport and distribution structures and equipment, of the drainage and sanitation structures and, generally speaking, of all of the known infrastructures belonging to the development (tracks, buildings, etc.), as well as for the invoicing of water delivered. In order to fulfil its mission, the SGRID was subdivided into different departments which all have a hand in water management and play complementary roles:

- The Department for network operation (BER) divided into 4 sections:
 - The irrigation Programming and monitoring section, responsible for:
 - Establishing the provisional irrigation programmes
 - Monitoring the application of irrigation programmes
 - Collecting daily data concerning the meteorological and hydrological conditions in the wadis and dams – dam operations results (restitution + supply)
 - Dealing with the petitions from different users
 - The inventory of water rights (procedure of recognition and expropriation of water rights)
 - The gauging of non-regulated wadis and the application of the regulation concerning the distribution of wadi supplies between the seguias
 - The AUEA supervision section, whose missions consist in :
 - Defining action programmes
 - Setting up the AUEA management structures
 - Monitoring and coordinating AUEA activities
 - Establishing results for the AUEA participative policies
 - Monitoring AUEA operations
 - Applying AUEA regulations
 - Developing training programmes for AUEA members
 - The pumping section, responsible for :
 - Dealing with the requests for and the granting of pumping authorisations
 - In-the-field surveys and the creation of administrative files
 - Publishing pumping authorisations in the Official Bulletin
 - Participating in commissions of inquiry

- The invoicing department, responsible for:
 - Collecting and verifying consumption readings
 - Entering data onto the computer
 - Issuing charges
 - Issuing receipts for irrigation water charges
- The unit for collection of charges, responsible for:
 - establishing and monitoring collection schedules and reminders
 - Liaising with collection officers who are revenue managers established in each CMV and placed under the hierarchical authority of the Chief Accountant.
- The office for Network Maintenance (BTER) is also divided into 4 sections. Their scope of action in water management consists in:
 - Planning and programming maintenance operations
 - Budgeting and accounting for maintenance operations
 - Monitoring and controlling maintenance work
 - Studies for network improvement
 - -Providing subdivisions and the CGTC (Centre for the management and remote control of Haouz Central), with the logistic means for maintenance operations on the switchboard (supply of materials, fuel, vehicles and equipment)
 - The processing of the paperwork necessary to carry out maintenance work (calls for tender, works contracts, technical files, maintenance cost assessment reports, activity reports etc.)
- The Office for irrigation techniques: in charge of the extension of irrigation techniques, the experimentation of new hydro-agricultural techniques.
- Centre for the Management and Remote Control of Haouz Central (CGTC): this centre is responsible for managing the main adductors of Haouz Central (Ring Canal and N'Fi Canal) and filter and energy dissipater structures at the head of pressurised networks.

In addition to the offices, on-site delocalisation has been established in order to be closer to the user and therefore to provide a better service. There are three of these subdivisions: the Upstream Tessaout subdivision, that of Downstream Tessaout and that of Haouz Central to which N'fis is also attached. The latter are each composed of three sections in the same way as the SGRID:

- The network operation section;
- Running and maintenance section;
- AUEA supervision section.

Each of these sections is delocalised at the level of the Network Management Centres created at the level of the Valorisation Centres.

The Network Management Centre (CGR): Its position in the ORMVAH organisation chart awards it with a very important role in irrigation management and user relations. Its tasks range from its

participation in water turn scheduling to the collection of irrigation charges; its personnel must therefore:

- Ensure that individual allocations are respected;
- Establish individual invoicing according to consumptions ;
- Proceed with the opening and closing of hydrants, taking care not to exceed the pipe capacity and that the times are in compliance with the water inspection agents' working hours;
- Operate and maintain the hydrants.
- Transmit, to the head office in Marrakech the schedules for water supply to the main pipe.

2.2.2. The Jmaa: a customary institution

The Jmaa (traditional institution that informally represents the members of a tribe or a village) exists at two levels, that of the douar and that of the tribe. It plays a very important role in water management. It extends to the traditional network (control, management and distribution between irrigators or groups of irrigators) as well as to the modern network (start of month scheduling and maintenance downstream of the hydrant, notifying anomalies and solving conflicts between irrigators. The Jmaa ensures these functions with the help of the Amazal, the Kessam or the Ferraq, the Moujaris and the Aiguadiers (hydrant representatives)

Management of the traditional network:

- Controlling distribution to the mother seguia: Users appoint an "amazal" within each group of irrigators for a given seguia. This person is responsible for controlling irrigation in his seguia with the help of the "Mojaris" also appointed by the users. They must check that the passage of the water turn between mesrefs runs smoothly. They must work together to set the cleaning days for the mother seguia. The latter is looked after by the users themselves. All irrigators must participate either directly or indirectly by having themselves replaced by another person that they pay to maintain the mother seguia.
- Distribution of water in the mesrefs (branches of the seguia): irrigators belonging to the same mesref appoint a mesref representative who is responsible for ensuring that irrigation runs smoothly in the mesref that he is responsible for. He also negotiates exchanges and loans of water turns between irrigators. This representative is called a Ferraq or Kasam.

With regard to the cleaning work on the canal, the decision to clean is made by the mesref representatives. All irrigators begin the cleaning of the seguia at its most upstream point. Users that have their plots further downstream on the seguia therefore have the most work to do.

2.2.3. Agricultural Water Users Association (AUEA): A new water management institution

To turn GPI into a reality, Morocco adopted law 02-84 relevant to the creation of AUEA that are defined as the legal framework of the participation of agricultural water users in the management, running and maintenance of irrigated sectors. According to this law, "the AUEA is both the instrument and the means by which users can achieve the goal of progressively taking over the management of water and networks". The aim is to help them to conceive their own organisational framework in compliance with the defined legal framework, with the support supervisory administration to achieve the general goal of conducting all development work linked to the use of agricultural water.

The AUEA field of application: The AUEA can only be set up in sectors where the state proceeds or has proceeded with the development of equipment in view of using water for agricultural purposes. This supposes that this type of association cannot be set up in sectors where the State does not intervene (such is the case for the traditional networks of the seguias).

Setting up an AUEA: The AUEA is set up either at the initiative of the Administration, or at the request of two thirds of the owners or farmers whose funds are involved in development work. Once formed, a legal status is allocated to the AUEA along with legal capacity as provisioned in the Dahir of the 15th November 1958 for associations recognised to be of public benefit.

Administration and management: the AUEA is administered by a council elected by its members on the “one member=one vote” principal. A president is elected amongst the council members; he is invested with the authority required to accomplish the missions of the association according to the decisions made by the general assembly and essentially by the council. A 7th member, representing the administration, participates in all of the AUEA council meetings and has voting powers.

Financial resources and privileges: Members pay a mandatory contribution. In addition to the member’s participation in the association’s expenses, this contribution includes the taxes and charges that the association is mandated to collect from its members, in the name of the State,. The AUEA are totally exempt from taxes and fees of any type. They can be authorised by the Administration to proceed with expropriation for reasons of public benefit and will be granted with the necessary rights to accomplish their missions.

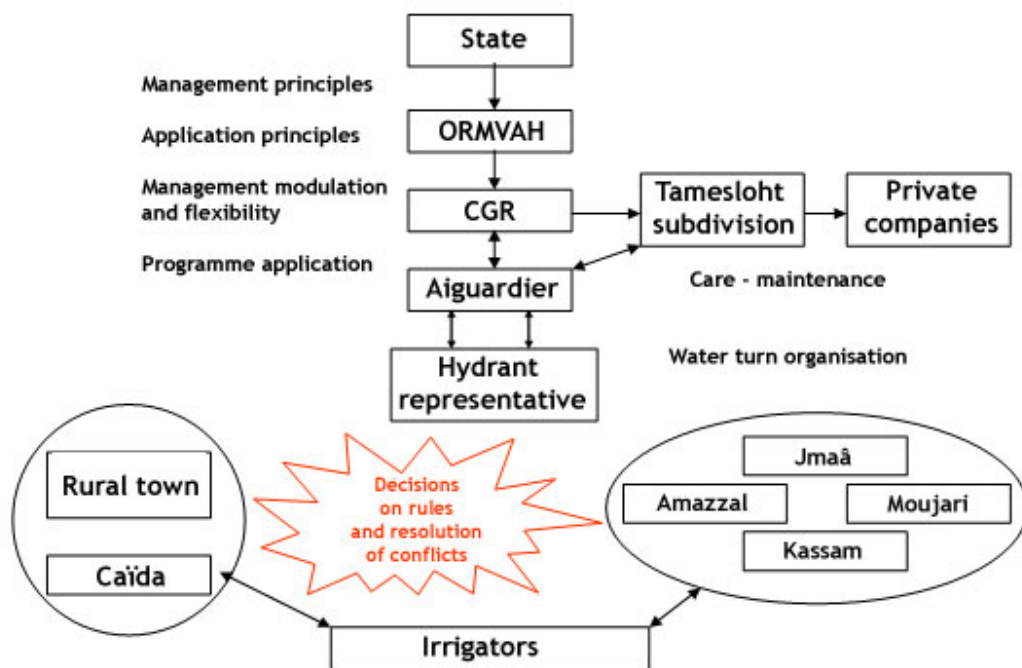


Figure 7. Flowchart of irrigation water management (N'Fis - Haouz de Marrakech sector)

2.3. THE N'FIS SECTOR: CASE STUDY

2.3.1. Insufficient water resources

The N'fis sector is located to the west of Haouz of Marrakech. Two wadis cross this sector: the N'fis wadi and the Bahja wadi (extension of the Riraya wadi) whose waters are collected by the Tensift wadi. On the first, a regulating dam has been operating since 1935 whereas no regulation has been developed on the second.

Water organisation in the N'fis is characterised by the diversity, the complexity and the deep historical background of social organisation. Different types of development can coexist within the same territory, and a single plot may be supplied by different networks.

This sector is also characterised by the rarity of water resources. This rarity is first of all apparent in the low levels of rainfall recorded in this region, in the irregularity of rainfall and their poor distribution in time, but also in the clear drop, over the past few years, of water supplies from the dams that feed the N' Fis.

The N'Fis wadi, regulated by the Lalla Takerkoust dam, makes it possible to mobilise an average of 158 Mm³ (1961-1976 average). Downstream there is an after bay dam in which turbine water is stored and used for farming. The Lalla Takerkoust dam was built in 1979 following problems of silting and can now regulate 85 Mm³.

The N'Fis water framework is completed with the main canal, to which several seguias are connected, along with the wadi water intakes: the main canal seguias were not sufficient to ensure the irrigation of all of the crops within the sector, the complement was therefore provided by flood water. In addition to this, the ring Canal was built in 1985 – a structure measuring 118 km in length with a flow of 20m³/s that transfers water from the Lakhdar wadi to the Tensift basin.

It is important to note that these waters have a high sediment discharge (especially that of the ring Canal) that causes the dysfunction of the pressurised irrigation network by blocking the hydrants and counters. Underground water resources are also used, in addition to these surface waters, thanks to bore-holes and wells.

2.3.2. The network of traditional seguias

Before the Lalla Takerkoust dam was built, the basic water system was that of the traditional distribution of the N'fis wadi water supply. The water was diverted from the wadi by Ougougs (dams that were generally built from earth and branches) through pipes dug into the arable earth (seguias) that are used to transport water from the wadi to the farmable land below.

Canals that are dug down a little less deeply (mesrefs) collect the seguia water and transport it to the plots of land where it is distributed through micro-pipes (sprinklers). The layout of this type of network is linked to land topography. The seguia and mesref beds require a considerable minimum slope (3 for 1000 on average).

When the Lalla Takerkoust dam was built in 1935 the rules of irrigation management were totally upturned within the N'Fis sector. Dam water was transported via a large upstream by-pass. Along

the entire length of these canals or pipes, a relatively low flow was provided to a few seguias as a right of way (Imarina, Agadir Chems, Bou Lahmoul...).

This constant mortgage (guaranteed continuous flow) transited essentially through the N'fis-Tassoultant canal (Tamesloht and Marrakech town) and through the Targa seguia (Assoufid, Saada, Askejour and Targa). (The constant mortgage amounted to 1,130 l/s). Up to 4,500l/s, the flow that exceeded the constant mortgage was enough to satisfy the first rank seguias. For a released flow above 4,500l/s, the headrace canal also pours the available water into another group of seguias, the flood (or second rank) seguias.

2.3.3. Pressure system distribution network

Fundamentally, there are two types of irrigation network in Haouz, the open channel networks and the pressure system. The latter are located in the N'fis. They operate by down stream regulation, i.e. the downstream section imposes the hydraulic operating conditions, upstream is obliged to comply. In the present case, this “upstream” operating mode does not mean that water is supplied at demand, since a water turn is established and the opening and closing of hydrants is under strict control.

However, this type of system, that requires no other regulating than the restriction of flow at the hydrants, does offer a certain amount of flexibility (precision of flow distributed, respect of irrigation programme, rapid change in rate of flow), that only depends upon the ability of the upstream supply system to adapt to the variations in flow at the top of the network. This is why the reservoirs were built (Basins 513 and 520) at the top of the N'fis network, but their volume, 15 and 20,000 m³ respectively, do not allow a great degree of latitude.

The right bank of the N'Fis : The upstream part of the right bank sector of the N'fis is fed by the Lalla Takerkoust dam and by the after bay dam located downstream (pipe P2). The downstream part is fed by the ring canal (pipes P3 and P4).

The left bank of the N'Fis: here lies an irrigation network of traditional seguias, dominating a surface area of around 25,000 ha, part of which has been modernised (sector N4) and is supplied by the (P1) pipe.

In fact, the N'Fis is in a region where irrigation is secular. The current situation, both with regard to farming practices, irrigation networks and social organisation, is extremely complex, as the new forms have never totally erased the old ones but have reached a compromise with them, mixing tradition and modernity.

2.3.4. The Seguias within the study

a) The Jeblia seguia

As throughout all of the N'Fis, water organisation in the sector of the Jeblia seguia (right bank seguia) is characterised by the diversity, complexity and deep historical background of social organisation. Within this area, there are two co-existing types of water structures (the network of traditional seguias and the modern pressure system network) along with several managing institutions (the ORMVAH, the AUEA, and the Jmaa). The wide variety of systems and stakeholders incurs differences in strategic interest that make it difficult to install the participative management of irrigation.

The Jeblia seguia (which literally means “which comes from the mountains”) is a seguia that draws its source from the N’Fis wadi and currently irrigates a surface area of around 3,023 ha located between the Sarro seguia and the Souihla seguia. Before the pressure system was developed, it figured amongst the so-called second rank seguias, i.e. its water supply came after that of the first rank constant mortgage seguias.

In addition to the direct supply from the wadi, the Jeblia seguia is, along its entire length, fed by the flood seguias built on the N’Fis wadi:

- Tizemt Seguia
- Elhendek Seguia
- Targag Seguia
- Timoukelt Seguia

These seguias have intakes on the N’Fis wadi and also form the branches of the Jeblia in the transport of resurgence water. Before the pressure system was developed, these flood seguias, then called second rank seguias, benefited from water released from the dam once the first rank seguias had been supplied, thus allowing a surface area of around 4,950 ha to be irrigated. Water from a resurgence located on N’Fis wadi also supplied the Jeblia seguia.

Currently, because the traditional seguias are no longer supplied due to the new pressure system, the Jeblia seguia is now only supplied by the water from this resurgence whose flow often reaches 60l/s. Because the seguia is no longer supplied by regulated dam water, the surface area controlled by the seguia in question has been reduced to around 3,023 ha. On rare occasions, when the Lalla Takerkoust dam has reached its maximum capacity, water is released into the N’Fis wadi thus feeding the flood seguias that carry the water to the Jeblia seguia.

b) The Tamzguelft seguia

The sector controlled by the Tamzguelft seguia is classified by P. Pascon as one of the largest in Haouz. Its surface area exceeds 12,000 ha and is essentially part of the rural towns of Agafai, Ait Immour and Sidi Opine, the Oudaya circle, a province of Marrakech. The mother seguia (17 mesrefs) extends over 30 km, from its intake on the left bank of the Nfis wadi, to one km upstream of the Frouguia road bridge that links Marrakech to Imintanout, and the starting point of the final mesref (Lakhchicha), about 2 Km south of the Marrakech-Essaouira main road. From a historical point of view, most of the land and water belonged to the State. The populations living in the Tamzgulft sector belong to the Mjat, Tekna, Hmar and Ait Immour communities.

On the Tamzgulft, three modes of irrigation water distribution can be described according to the origin of the irrigation water:

- Regulated water from the dam: This is the case when water is released from the dam at the request of the users transmitted by the AUEA in due respect of the global annual allocation granted to the seguia; the flow released at the top of the seguia amounts to 946 l/s. In this case, water is distributed from Downstream to upstream, mesref by mesref, according to acquired rights. From the control reach, the water is sent to the end of the sector of the

mother seguia, and the intake structures of the different mesrefs are gradually opened from the furthest downstream up until the most upstream intake which is the last to be supplied;

- Flood waters: This occurs when, following a rainfall event, there is a rise in water levels in the mountains and the water is recuperated in the ougougor taken from Tamzgulft seguia on the N'Fis wadi. The flow transported can vary greatly according to the extent of the rise but does not exceed 4 m³/s which corresponds to the maximum capacity of the seguia. However, water distribution is carried out from Upstream to downstream, all-over plot by plot, so that the mesrefs and plots supplied in this way receive water to their fill with no restrictions in terms of quantity. The downstream mesrefs only receive water if the flood flow is large enough to exceed the capacity of the upstream mesrefs, or when the latter mesrefs no longer require irrigation;
- Dam water with flood water: This is occurs when there is a flood at the same time as water is released from the dam and the flood water is collected by the intake in the wadi. At that point, the applied rule consists in applying to flood water the same water turn that is customarily used for regulated water with a Downstream to upstream distribution. In this way, the mesrefs located downstream can benefit from both flood water and dam water according to their allocated rights; the seguia's flow is thus increased by combining both resources.

Another specificity that further complicates water distribution modes involves the inflow of flood water from the Chaâbas that cross the Jdida seguia sector and supply the Tamzguelft seguia. This seguia is indeed fed by the flood waters of two talwegs (chaabas) that cross the seguia at the 9 and 16 kilometric points. These are respectively the Ouirmane and the Goulmine chaabas. At the mouth of the last in the piedmont, a small hill dam, with a 3 Mm³ reservoir, was built some twenty years ago in order to replenish the groundwater. In high water periods, the seguia is separated into three sections which are managed independently; the first lies upstream and uses the flood water from the N'fis wadi , the second lies in the middle and uses water from the Ouirmane Chaaba, and the last one, located downstream, uses the water from the Goulmine Chaaba.

3. IRRIGATION MANAGEMENT IN THE VALLEY OF AÏT BOOGIES: FACING THE INSTITUTIONAL MODELS OF THE PLAIN

The secular irrigation of the Aït Bouguemmez valley has been modelled over the centuries by local communities; its technical and institutional foundations have prevailed until the present day as they are highly effective. The introduction of the DRI-PMH project and the GPI approach (participative management of irrigation), of a new institutional tool, the AUEA (agricultural water users association) and of new hydro-agricultural structures to improve hydraulic performance and water management will obviously require readjustments both of a technical and of an institutional nature within the field of irrigation water management. As this introduction is still very recent and as building work has only just begun, it is difficult to conceive any plausible change scenarios.

However, the current situation does provide the ISIIMM project with the opportunity of gaining a detailed description of the physical and social environment, of the territorial basis of the population groupings, of water distribution practices, with regard to both distribution rules and their application. It also allows us to observe the articulations between the current system and the changes incurred by the DRI – PMH project that is now being set up, to analyse and identify how to extend our knowledge along with the essential questions to which a solution must be found.

3.1. OVERVIEW OF THE AÏT BOUGUEMMEZ VALLEY

The valley is part of the Azilal province. It corresponds to the rural town of Tabant, and is part of the Tabant “caïdat” and the Azilal circle. There were some 13,000 inhabitants in 2003, 1,700 households spread over 22 douars. It is a steep valley of the central High-Atlas, enclosed by high mountain chains of over 360m in altitude. It stretches over 30 km between 2,200 and 1,800 m in altitude. It forms part of the upper catchment area of the Lakhdar wadi that flows into the Tessaout wadi, a tributary of the Oum Er Rbia.

The bottom of the valley is fairly wide as compared to other high mountain valleys and 1,600 ha of its land is irrigated by 57 seguias, supplied by 19 springs and resurgences of alluvial or karstic origin, along with rain water and snow melt drained by the mountain thalwegs.



Map 1. Central High Atlas
Source: according to a study by André Fougerolles

The main crops grown are cereals (60% of the SAU (surface area farmed)), also grown in bour zones, forage (9%), of STH (constantly cultivated areas: 4%), and potatoes (26%), cash crops that were introduced and have been sold for over 60 years. Traditional arboriculture includes walnut trees, along with apple trees that have been increasing rapidly over the past ten years or so. The valley, with its mountain pastures and forests is also an area in which extensive breeding still prevails (cows, sheep, goats), but that is undergoing the beginnings of intensification with the growing numbers of cross-bred cows.

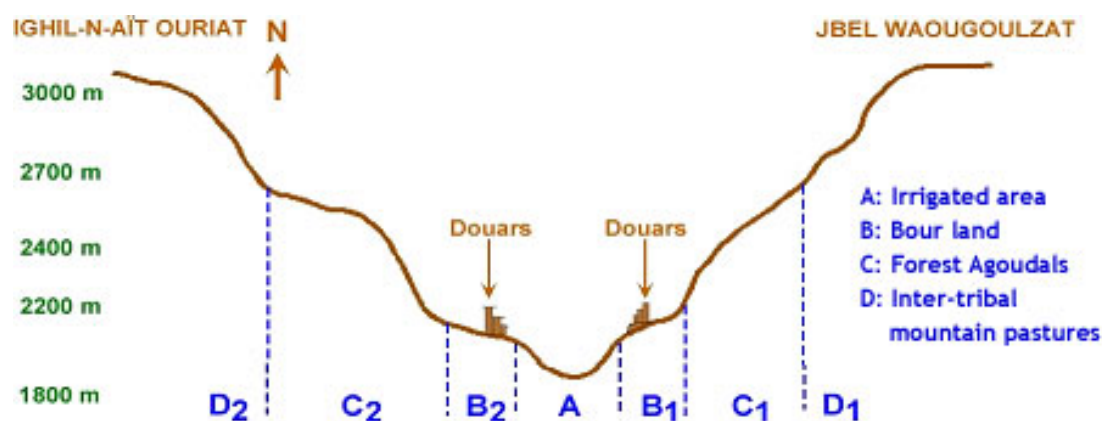


Figure 8. Ecological levels used by the Ait Bouguemez population

Over the past fifteen years or so the valley has become increasingly popular with tourists, following training set up within the scope of the PHAC (Central High Atlas Project)⁸ for mountain guides. This new activity has generated extra revenue that has, at least partially, been re-invested in agriculture, breeding and tourist infrastructures (rest houses). It has certainly encouraged greater efforts on behalf of public authorities in improving living conditions and development: electrification, drinking water supply, telephone, tarmac roads, and schools.

3.2. THE INSTITUTIONAL FRAMEWORK OF THE SOCIAL MANAGEMENT OF WATER

The term "institution" does not necessarily mean organisation. It rather tends to mean "a series of rules actually used by a group of individuals to organise repeated activities that have an impact on these individuals, and possibly on others" (ostrogot, 1992). These rules may, or not, be materialised in the form of formal organisations. "An irrigation institution is therefore a set of actual rules for the distribution and use of water, in a given place ". On the basis of this definition, we may consider that a water management institution is in fact any entity, formal or not, that is responsible for defining, implementing and enforcing water management rules. In the valley, therefore, there are two types of water management institutions: the customary institutions historically built by the inhabitants and the modern law institutions progressively introduced by the state.

3.2.1. The local water management authorities

a) *The douar Taqbilt: the douar water authority*

In the Ait Bouguemez valley, the douars do not have a douar leader. Douar affairs are managed by all of the household heads gathered within *Taqbilt*, the only socio-political unit linked to the territory. According to (LECESTRE-ROLLIER, 1992), "the *Taqbilt* applies to any public socio-spatial structure, i.e. eminently political, from the basic community, the douar, to the entire tribe ".

⁸ The PHAC was a project for integrated development above all centred on mountain tourism –and more widely, rural tourism- that emerged and developed in the valley and elsewhere. The valley currently has around thirty rest houses.

b) Roles of the douar Taqbilt:

The *Taqbilt* plays a number of roles: it makes all decisions involving water management, pastures, forests, tracks and mosque property. It solves disputes between farmers and decides upon the penalties to be applied to those who break the collective laws

c) Decision making

The douar *Taqbilt* normally meets every Friday within the framework of the *Jemaâ*. All of the household heads discuss douar affairs and make unanimous group decisions. When a few people remain inflexible with regard to a particular question, the majority decision is imposed to avoid deadlock situations. At first sight, the *Taqbilt* works in such a way as to involve all of its members in the debates and decision making. A few comments from a small number of farmers, however, show that in the *Jemaâ* sessions, two different groups (that do not have the same decision-making authority) stand out: the *Ikbatarn* (who are "important members" or "elders") and the rest of the group. These *Ikbatarn* would appear to be those who truly have the authority to make decisions within the douar *Taqbilt*.

d) Application of the Taqbilt decisions

Once a decision has been made within the *Jemaâ*, it is considered to be collectively accepted. The *Taqbilt* can then appoint people to enforce it. Since the creation of the *caïdat*, *Taqbilt* decisions are written down in a document which is then registered at the *caïdat* as a reference for arbitration in douar affairs.

3.2.2. The other local water management authorities

a) The Naïb-n-Taqbilt: the douar water-bailiff

From *Zaouit Alemzji* to *Ifrane*, the *Naïb* is a person appointed by the *Taqbilt* to look after the management of douar resources for a period of one year. He is paid by all of the douar (on average one abra of barley ≈ 16 Kg and 10 DH per household).

From *Tagboulit* on, the role of the *Naïb* is a voluntary role taken on by the *Amassaye* or the *Amghar-n-lajmaât*. This responsibility is ensured, for a year, by each household in turn according to the same order as the water turns within the douar.

In most of the *Aït Hakim* douars, the *Naïb* no longer fulfils his role, either because he asks to be paid more than usual, or because the *Taqbilt* could not agree upon whom to appoint.

b) The Moqadem-n-Waman, the Mourakib and the Aassas:

The *Moqadem-n-Waman* is appointed by the *Taqbilt* during the period of canal maintenance to help the *Naïb* or to replace him where necessary. During the canal dredging work, this is the person who allocates the sections to be dredged by each farmer. He can also look after the water distribution surveillance and collect fines and contributions.

The Mourakib is also appointed during the dredging period. He helps the *Moqadem-n-Waman* by checking the work carried out by each farmer during the canal maintenance works. In the downstream territories, the *Aassas* are responsible for guarding the *Ongongs* at night to prevent the theft of water.

3.3. MODERN INSTITUTIONS AND WATER MANAGEMENT

3.3.1. The Tabant caïdat

a) Creation and organisation of the caïdat

The first caïds to control the Aït Bouguemez valley were members of the elite who formed an alliance with the protectorate and maintained order in these distant areas. Following independence, the Makhzen progressively replaced these elites with civil servants. This is how Tabant caïdat was created in 1985. A caïd, appointed by the ministry of the Interior, represents different authorities in this area. He is helped by two *Chionkb* (cheikhs of *Aït Méhiya* and cheikh of *Aït Hakim*), who are in turn assisted by ten or so *Moqadem*.

b) Roles of the caïdat in water management: the case of the Ait Hakim

The Aït Hakim resisted using a caïd to solve the douar's problems at length. But the elders vouch for a certain increase in conflicts left unsolved by the *Taqbilt* and that were submitted to the caïd or the *cheïkb* (RIAUX, 2003). The caïd therefore took charge of arbitrating the conflicts that exceeded the village or inter-village scopes by applying the rules set down by the *Taqbilt*. When the conflicts are sent to court, the caïd is responsible for enforcing the ensuing judgments. The caïd also plays a key role in setting up and implementing State projects. Within the framework of the DRI-PMH project, he played a decisive role in each step of the creation of the AUEA.

3.3.2. The rural town (CR) and the *Hakem*

a) Background of its creation

Today's rural towns are the result of a transformation (in 1965) of the administrative towns created under the protectorate to replace the tribe *Taqbilt* (LEVEAU, 1985). A town court (run by a judge: *LHakem*) is attached to each rural town to resolve conflicts that require good knowledge of local traditions (*orf*).

b) Roles of the town in water management

The rural town often funds water structures in the douars. It also resolves certain conflicts linked to water management through the *LHakem*. The town council has often used this funding to change the balance of power between douars by obliging certain douars to hand over part of their rights with regard to certain resources. In the valley, it is less and less frequent that the *LHakem* resolves conflicts linked to water management.

3.4. THE PRINCIPLES AND RULES OF WATER DISTRIBUTION

The Aït Hakim valley has a wide variety of rules and customary principles that govern water distribution:

3.4.1. Water rights and water statuses

a) Definition of water rights

The water right is defined as a "quantity of water" or a "water access time" allotted to a person for the irrigation of his plots of land. When this involves a quantity of water, the amount of water allotted for irrigation is not pre-determined. In the same way, when it involves a "water access time" the duration of irrigation of the plot is not pre-determined. Consequently, for the "bouguemezien" mountain dweller, the possession of water rights means that he has the amount of water or the time necessary to entirely irrigate his plot of land.

b) Water statuses and rightful beneficiaries

In all of the douars of the Aït Hakim valley, "*water is married to the land*", i.e. water only belongs to a man for as long as he owns the land. Moreover, water springs and irrigation infrastructures belong to all the families of the douar. Consequently, any person who owns at least one plot of land within the irrigated sector is a rightful beneficiary (of the canal that irrigates his plot of land). In compensation, this person must contribute to the yearly maintenance works on irrigation structures and is subject to all of the collective rules concerning the sharing of water.

History tells us that at Zaouit and at Ifrane, water was linked to the family. As inter-douar land transactions were increasingly common, these douars once and for all adopted the status of water linked to the land.

c) Water rights and land transactions

In the Aït Hakim valley, the land status is *Melk* (rural owners). Land transactions are therefore frequent. In the past, they were preferential between person of the same douar, firstly, to avoid granting water rights to people who did not belong to the *Taqbilt* and secondly, to avoid providing these people with a social admission to the douar. Currently, transactions between people from different douars are common as land is now considered to be a means of production more than of social admission within a community. A plot of land can be sold with or without a written sales deed. In all cases (presence or absence of sales deed), water rights are made over along with the land sold. The new owner must then ensure the yearly maintenance work of the canal that irrigates his new plot, in the same capacity as the other rightful beneficiaries.

3.4.2. The customary rules of water distribution

Following our presentation of the institutional framework of water management and a few generalities concerning the terms of access to water and land, we are now going to describe the rules of water distribution : first between canals (the inter-douar towers) and then between plots along the canal (intra-douar towers).

a) *Sharing out the water between canals: inter-douar water turns*

Very little historical data exists on the setting up of water turns between douars. It would appear, from what the elders say, that these water turns are the result of agreements that date back a long way (before *Siba*) and that arose between douars following serious conflicts linked to water (case of Ait Ouchi and of Ighirine) or to exchange resources (case of Ighirine and of Ait Ouham). The sharing out of water between the canals differs throughout time (periods of water abundance or shortage) and in space (upstream or downstream of the network). When water is abundant, there is no particular water turn between canals the rules presented here therefore only apply in periods of water shortage

Water turns between Ait Ouham and Ighirine

When water becomes scarce, the four upstream douars decide together how to share out the water between the canals given that it becomes impossible to supply them all at the same time. In periods of water shortage, the quantities of water available are distributed between the two canals that are directly fed by the Ait *Ouham* spring and the first intake on the wadi. The water supply of the four remaining canals is suspended until flow in the wadi is sufficiently high to feed them.

Table 7. Water access times of the four upstream douars

Canals filled with water	Canal water supplies	Irrigation days of each douar
Tin Oussamar	Aghbalou-n-Ait Ouham	Ait Ouham : 4.5 days ; Iglouane : 1.5 day ; Ighirine : 1 day
Tin Oukbou	Aghbalou-n-Ait Ouham	Ait Ouham : 7 days a week
Tin Tassemlit	First ougoug on the assif	Ait Ouham : 3 days ; Iglouane : 2 days ; Ighirine : 2 days
Tmadla	Ighboula-n-Ikiss	Ighirine (Timilit) : 3 days
Targa-n-Aghbalou-n-Ait Aamar	Aghbalou-n-Ait Aamar	Ighirine&a few farmers in Ait Issa Ou Ali (no water turns)

Water turns between Ait Ouchi, Ifrane and Taghoulit

The way in which water is shared out between the three douars of this sector is indeed a reflection of the varied and complex nature of relations that form between the douars along the wadi. Upstream of the sector, the four canals used by *Ifrane* and *Ait Ouchi* are run on a weekly water turn basis that allocates water to each douar for a certain number of days. During their allotted water access time, each douar supplies its canals intake by intake, from upstream to downstream, alternating between the intakes of both banks. Generally speaking, all of the water available in the assif is sent into a single canal. As soon as the rightful beneficiaries of this canal have finished irrigating their plots, all of the water is directed to the next canal. Irrigation continues in this way until the last canal in the douar. The two downstream canals used by *Ifrane* and *Taghoulit* are not subject to any common rule

of water sharing. In Ifrane where the intakes of these two canals are to be found, the farmers only let the water flow through to Taghoulit when they consider that all of their plots have been sufficiently irrigated.

Table 8. The water access time of Ifrane and of Aït Ouchi

Canals	Water supply	Aït Ouchi	Ifrane
<i>Targa-n-Oulzweg</i>	Aghbalou-n-Oulzweg	½ day	6 ½ days
<i>Tin Ouammass</i>	Ougoug to Aït Ouchi	4 days	3 days
<i>Tin Oumalou</i>		5 days	2 days
<i>Imjoujoua</i>		A few farmers	Almost 7 days

The water turns between Aït Oughral, Aït Sellam and Tadrouit

The three Aït Wanougdal douars do not have their own springs to re-supply the wadi. They do not, however, have a water turn with the upstream Aït Hakim douars. As they are accustomed to managing water shortage situations, the three douars have set up the following water turn on the wadi: *2 days for Aït Oughral ; 4 days for Aït Sallam and 3 days for Tadrouit.*

Within each douar, the water is distributed between canals intake by intake but not systematically from upstream to downstream. A draw is carried out to determine the direction of canal supply and plot irrigation.

b) Distribution of the water amongst plots: intra-douar water turns

In the Aït Hakimvalley, water is distributed amongst plots, along a canal, according to four principal methods: distribution on a “first come” basis, distribution intake by intake, distribution by area, distribution amongst families (or lineages). Which distribution method is used depends upon the context and the rightful beneficiaries of each canal who determine the rules and methods depending on the period:

The "first come" or absence of water turn:

The "first come" method is the most common in water distribution on the intra-douar canals. Used by all douars in periods of water abundance, this consists in letting the rightful beneficiaries have total freedom with regard to when they wish to irrigate their plots. The first farmer to arrive in the sector irrigates all his plots and then passes the water on to the next in line, who arrived just after him. Water is thus distributed amongst plots along the entire length of the canal in no particular order and with no restriction of irrigation times as, according to the farmers, the large quantities of water guarantee water access to all of the rightful beneficiaries whenever they come to the irrigated sector.

Intake by intake distribution (*Assemidi's Assemidi*)

Intake by intake distribution is to be found mainly in sector (C) from Ifrane to Taghoulit during periods of relative water abundance. Along the irrigation canals, each plot or group of plots is irrigated by one or several intakes. Intake by intake distribution consists in supplying these intakes with water generally from upstream to downstream for the entire time necessary to irrigate the plots that they control. The rightful beneficiaries thus irrigate in turn along the canal. When there is no more water left and not all plots have been irrigated, the next time water is available in the canal irrigation starts again at the place where it stopped the time before.

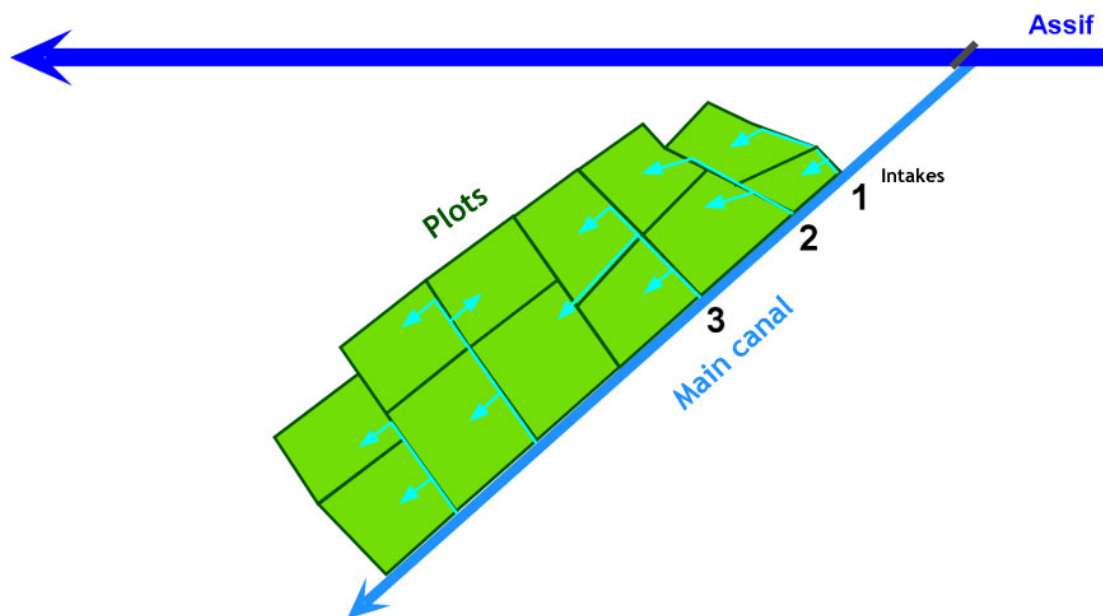


Figure 9. Diagram of intake by intake water distribution

Distribution by area or *Dart*

A *Dart* can be defined as a group of plots, belonging to a more or less large number of families from the same douar or from different douars, to which an irrigation time ranging from 12 to 48 hours (the most common being 24 hours) is allocated.

In periods of water abundance or shortage, along the upstream canals, water is distributed from upstream to downstream, in a set order, amongst the seven *Darts*. Water turns begin on Fridays and end on Thursdays. Prayer times are used as reference points. Within an irrigation area, water is always distributed intake by intake (*Assemidi's Assemidi*). A draw may be organised to determine in which direction irrigation will take place.

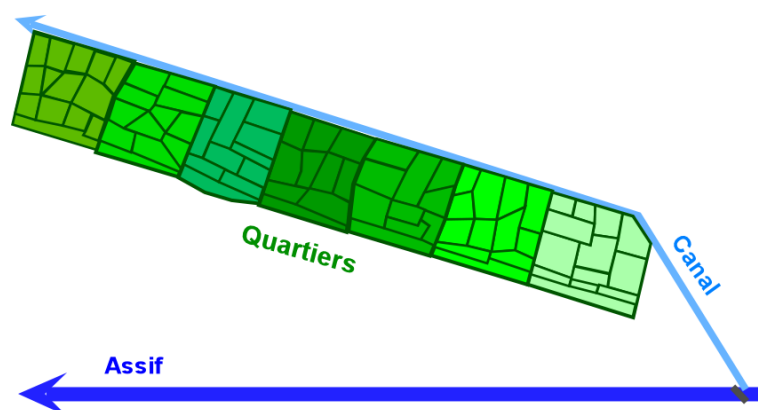


Figure 10. Distribution of water amongst areas

Distribution of water amongst families- *Ighs*

Distribution between *Ighs* is practised in Zaouit Alemzi and in Ifrane. The same principle is applied as that amongst areas except that the water is allocated to families or groups of families for a period of 24 hours. They then proceed with irrigation according to the topographical succession of their plots or according to particular arrangements (e.g. : irrigation of priority crops).

c) Supervision of water distribution

The douar Taqbilt is an assembly of household heads and is the local authority which guarantees the water rights of each farmer and which appoints the people (*Naïb, Amghar-n-lajmaât, Amassaye.*) responsible for making sure that water turns are complied with. This authority also contacts the makhzeniennes authorities when an individual or a group of individuals from the douar refuse to comply with the collective rules for water sharing. It goes without saying that the douar *Taqbilt* is the water authority that regulates and controls water distribution. Water distribution is supervised in two main ways:

- Formal control: carried out by a *Naïb* during periods of when there is pressure on water (periods of drought and second summer crops) and in areas where there is pressure on water (downstream of the network).
- Informal control: that is applied amongst neighbouring farmers. Each person makes sure that his neighbour frees the water as soon as possible and that he does not indulge in over-irrigation (especially in periods of water shortage).

d) Maintenance of irrigation infrastructures

In compensation for the water rights that he owns, each rightful beneficiary must provide yearly maintenance work on irrigation infrastructures. In this way, not only does he deserve the share of water that is allotted to him, but he also demonstrates his belonging to a farming community (MATHIEU et al., 2001). To begin with, we will describe canal maintenance rules as explained by the farmers. Then we will proceed with an analysis in the light of our observations in the field whilst maintenance work was ongoing.

Canal maintenance rules

Canal maintenance work is carried out once a year. It is repeated each time the canals are damaged by bad weather. Each household must provide a person for the maintenance of the canals that irrigate its plots. Those who are absent are fined an amount that corresponds to a day's work (30 to 40 dirham). Upstream of the sector, (from Aït Ouham to Ighirine), the douars that are downstream from the water springs and the canals are the only ones that look after the maintenance of the canals and intakes. This is probably the way in which they assert their canal user rights and is compensation for using the water supplied by the spring of an upstream douar (RIAUX, 2003). From Ifrane to Tadrouit, all the douars that use the canals participate in their maintenance. Work can be done collectively for certain canals and individually for others.

Organisation of the work

The maintenance work began, as planned, towards the end of February and spread over two weeks. By 8 am, each farmer involved in the work of "the day's canal" was sitting in front of his plot, downstream from the canal, waiting for the "work to arrive". A farmer does, indeed, only participate in the work on the section located between his plot that is the furthest downstream and the canal intake. The farmers who own the last plots to be irrigated by the canal therefore give the kick-off signal to start work. As they progress, they are joined by other farmers when the "work arrives" at their plots. Thus, when work on the canal pipe main begins, all of the farmers that have at least one plot irrigated by the canal are present on the worksite

Those taking part in the work arrive at the sector equipped with a small scythe, a spade and a basket. The scythe is used to dig in the canal, the spade and basket to clear away the debris. Because the debris must always be discarded on the terrace above the canal, the work is made considerably harder. Those who do not abide by this rule, are called to order by the farmers that own the plots located at the bottom of the canal "our plots are not dumps, the debris must be put on the terrace above the canal because that's where it comes from" they proclaim noisily.

Supervision of work

During the work, we noted that there were four particular people present on the worksite (three appointed by the *Taqbilt* and one mandated by the *caïdat*) who, due to their important roles, ensure that the work runs smoothly:

- *the Naïb-n-Taqbilt* : responsible for the general supervision of work and for sorting out any small problems that may arise between farmers,
- *the Moqadem-n-Targua* : is always at the head of the line. He measures the distance to be cleaned out by each farmer using a 1.5 metre-long stick that he is rarely without. He frequently consults the *Morakib* before allocating to the farmers the new sections to be cleaned out
- *the works Morakib*: responsible for checking the work done by each farmer. He frequently takes note of those who don't do their work properly and sometimes even asks them to come back to the section that he considers to be poorly cleaned.
- *the Moqadem of the caïdat* : Present on the worksite as from the start of work, he remains until the canal pipe main is reached. It is only at this point that he notes down on a list the names,

provided by the *Naïb*, of those who are absent. This list is then registered at the *caïdat* and will be used as a basis for arbitration if those who are absent refuse to pay their fines.

e) Conflicts linked to water distribution

Conflicts linked to water distribution can be separated into two main categories:

Minor conflicts (intra-douar)

This type of conflict arises in the douars above all in periods of water shortage when the arrangements set up in the former periods of water abundance become increasingly intolerable. Interpersonal disagreements due to delays in freeing up the water or to water cuts during irrigation then become frequent and can rapidly degenerate into conflict. The farmers, however, qualify these disagreements as “small problems in the douar”. It must also be said that these rarely move beyond the village context. To call upon the *caïdat* is considered to be a solution that is not within the scope of internal douar affairs. In most cases, therefore, these problems find a friendly solution thanks to the good action of a *Naïb*, an *Amassaye*, and an *Amghar-l-jmaât*, of an *imam* or of the entire *Taqbilt* brought together. The guilty party generally gets off with an official warning or a fine. The *caïdat* is only called upon if no grounds for agreement have been reached by the parties involved.

Major conflicts (inter-douars)

These conflicts arise in periods of water shortage and occur at two levels:

- Between the two sections: The conflicts that break out between the two sections are mainly due to the absence of water turns on the wadi between upstream (the *Aït Hakim* section: place of water concentration and appropriation) and the downstream douars (the *Aït Wanoughdal* section: place in which there is a constant shortage of irrigation water).
- Between douars within a section: Conflicts can also arise between douars located within the same section as was the case in 1953 between Ighirine and Aït Ouchi (when Ighirine attempted to take over all of the spring waters *Aghbalou-n-Ikiss*) or in 1980 between Aït Ouham and Ighirine (when Aït Ouham cut off the water and Ighirine retorted by forbidding Aït Ouham access to the *Ikiss* forest).

Settling of inter-douar conflicts

Conflicts that arise between douars are often brought before the local authorities (*caïdat*, rural town authorities, and courts). This is often the opportunity for a downstream douar to oblige the upstream neighbour to accept that a water turn is set up on the wadi or to respect the water turn in force.

The study of the social management of water shows that two types of authorities are involved in water management. The modern authorities (*caïdat*, rural town authorities), progressively introduced by the State, are frequently called upon by the communities to resolve conflicts between douars that with regard to the sharing out of water along the wadi. The customary authorities, historically set up by the communities of irrigators, are responsible for setting, implementing and enforcing the rules for water distribution.

The rules determined by these authorities can be homogeneous for all the douars, as is the case for water rights (access time to water) and land transactions (water status linked to land). History shows, however, that in Zaouit Alemzi and in Ifrane, water rights have not always been linked to land. These two douars have now joined the others by adopting water rights linked to land, especially in the case of land transactions.

Rules concerning water distribution amongst douars and farmers do, however, vary greatly depending on whether one is upstream or downstream, depending on the douars and on periods (water abundance or shortage). Water distribution between douars can thus be done without water turns (case in Taghoulit and Ifrane and in Taghoulit and Aït Oughral) or according to water turns (case in other douars of the sector). Within each douar, in periods of water abundance, all of the canals are supplied with water at the same time. In periods of water shortage, however, a water turn is applied between canals, or the supply of certain canals is temporarily suspended.

There are four different methods used for the distribution of water amongst farmers along the canal of each douar: First-come distribution which corresponds to the absence of a water turn, intake-by-intake distribution which consists in successively supplying the intakes located along the canal, the distribution between areas where the water is shared out amongst the groups of plots positioned along the canals and, lastly, distribution between families where water is allocated to a family or a group of families for a period of 24 hours. The type of distribution used is contextual and depends on the group of rightful beneficiaries of each canal.

Considering the multiple management rules, there is no shortage of conflicts, especially when water is scarce and rules can be interpreted in different ways. Conflicts may arise between farmers within a douar or between douars for different reasons. In most cases, they concern water cuts upstream. All of the authorities are called upon to solve these conflicts. Although intra-douar conflicts are solved by the village community, it has become commonplace to call upon the caïdat and the courts with regard to conflicts that oppose douars or groups of douars.

Within the framework of the DRI-PMH project, the AUEA were set up in the Aït Bouguemez valley. These associations were set up with the aim of obtaining a more rational and egalitarian collective management of irrigation water and a financial participation of farmers in the construction and maintenance of the network.

It was decided to cover the networks over appropriate distances (50 km of seguias out of the 121 in the given valley), to improve spring catchments, to build structures to transport floods to the wadi and to build open-air purification collectors in the downstream territories.

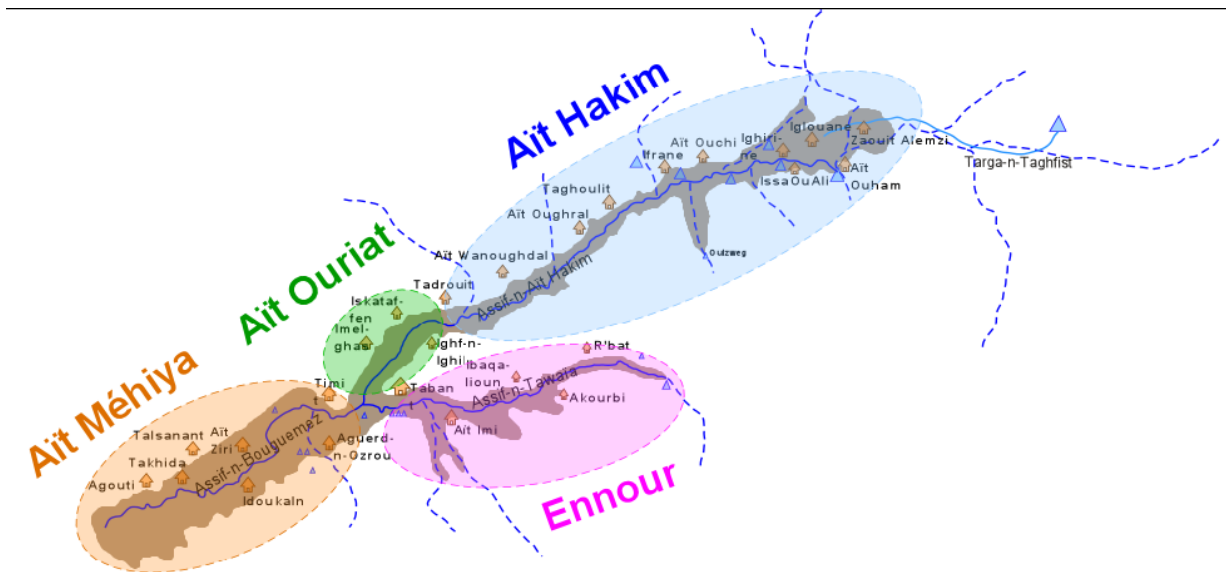


Figure 11.

Thanks to World Bank funds and with the help of the DPA (provincial department of agriculture) and the local authorities, four associations were created: Aït Hakim, Ennour, Aït Ouriat and Aït Méhiya. What results have been yielded by introducing these new irrigation authorities?

To answer this question, we thought it would be of greater interest to consider the answer at the scale of the territories that were involved in the case studies selected by the ISIIMM/Morocco project.

3.5. THE EXPERIENCE OF THE TRANSPLANTING OF THE AUEA WITHIN THE ENVIRONMENT OF THE HAOUZ PLAIN AND THE AÏT BOUGMEZ VALLEY

In Morocco, the disengagement of the State has an impact that is even further accentuated by the fact that farming was, for a very long time, subject to extensive State control. The new context, moreover, required a redistribution of roles between the State, the private sector and the rural organisation involved in this development. With regard to irrigation management, the consequence of State disengagement is dialogue, the responsibility and participation of farmers/water users. As early as 1990, the public authorities adopted the strategy of participative management in irrigation (GPI), in order to develop irrigation. The fact that the State opted for GPI, can be justified due to the change in direction of irrigation policies that moved from a vision of State control in the conception, planning, funding and execution of all hydro-agricultural development operations, the running and maintenance of structures and hydraulic equipment, towards a participative vision with the goal of involving and giving responsibility to the farmers of the irrigated sectors with regard to future hydro-agricultural development and the management of irrigation systems.

In order to create the institutional conditions necessary to implement GPI, in 1990 the State promulgated the law 02-84 relative to the Agricultural Water Users Association (AUEA). This law,

along with the decree of 1992 for its application, determines the conditions of partnership between the State and the AUEAs concerning the development and management of irrigation systems.

According to the statistical data available at the Hydro-agricultural Development Department (DAHA, 2003), there are now 1,633 AUEA in Morocco, uniting 277,985 members and covering 580,986 Ha, of which:

- 408 AUEA in Large Scale Hydraulics uniting 148,784 members and covering 348,368 Ha ;
- 1,225 AUEA in small and medium scale hydraulics, uniting 131,201 members and covering 232,619 Ha.

It is therefore important to consider the specific characteristics of these AUEA, their constraints, objectives, the outlook concerning their self-management and participation in the tasks and functions linked to irrigation system management.

The way in which the AUEA operate is, indeed, a subject of great concern for public authorities. The AUEA must take over the irrigation systems within the framework of the sharing of tasks agreed and negotiated between the administration-AUEA partners. However, it is difficult to set up the AUEAs and to get them to actually start working due to the resistance to change observed in farmers who have, for a considerable amount of time, been accustomed to State assistance.

In order to reinforce these AUEA and to make them operational, the ORMVA requested, in 1995 and in 1999 that action plans be developed for the implementation of GPI (participative management in irrigation). These plans were developed with the help of two national seminars on GPI and were the opportunity to locate, direct, structure, organise and monitor the implementation of the GPI project in the Offices' respective action zones. According to the action plans, the AUEA should be involved in an initial stage (from 3 to 4 years) in programming irrigation, establishing maintenance and rehabilitation programmes and the diffusion of irrigation techniques. In a second stage, and according to the development of the AUEAs' operational and managerial abilities, the latter should, within a negotiated and contractual framework, take over certain running and maintenance tasks.

Following a considerable effort, 1,225 AUEA were formed in Small and Medium Hydraulics (PMH) uniting 131,201 users for a surface area amounting to 232,619 ha and 490 AUEA for Large Scale Hydraulics uniting 187,714 farmers for a surface area of 390,577 ha (DAHA, 2003).

These physical (statistical) results do not, however, reflect the low level of operation and the lack of dynamism displayed by these associations. These associations do, indeed, suffer from poor management and do not meet their assigned targets. Due to these facts, promotional actions and measures to make these associations operational must be undertaken by all stakeholders involved in the development of irrigation.

Within this scope, the Isiimm project aims to participate in a study on how to boost the AUEAs in Large Scale Hydraulics (Haouz sector), and also in the PMH (Ait Bouguemmez sector) sectors.

The interviews conducted with administrative agents (Haouz ORMVA or Azilal DPA ...) and in-the-field surveys (on the two Isiimm project sites), concerning the appraisal of the AUEA, gave rise to the following assessment:

- the extreme deterioration of hydraulic structures and equipment;
- a weak administrative contribution in the supervision of the AUEA;
- a blocking or a lack in the functioning of existing AUEA;
- a lack of knowledge amongst farmers as to the role and attributions of the AUEA;
- a lack of adhesion amongst farmers with regard to the goals of their AUEA;
- mistrust on behalf of farmers as to the consequences of their commitment to the AUEA;
- absence of a plan for the sharing out of tasks between the authorities (ORMVA, DPA...) and the AUEA;
- absence of a structure for the operations monitoring-assessment of the AUEA for their participation in running, care and maintenance tasks.

The factors that explain the non- or poor functioning of the AUEA within the two sectors (Haouz and Ait Bouguemmez) can be deduced from these assessments at each level of analysis:

- The non-commitment and non-participation of users in the collective management of water are determined by:
 - The negative image that the users have of their organisations ;
 - The presence of conflicts between users (distribution, management...);
 - The lack of users' motivation to adhere to the AUEA targets.
- The low level of internal operations of the AUEA is linked to:
 - Problems relative to the creation of the AUEA (AUEA imposed and not proposed, legal bases of constitution ...);
 - A lack of information and training amongst AUEA council members (degree of illiteracy...);
 - Insufficient AUEA funding and means of action.
- The poor coordination between the AUEA and the authorities (ORMVAH) is linked to:
 - the negative image that the farmers, or group of farmers (the Jmaâ), have of the authorities;
 - the fact that the office does not meet user expectations and does not satisfactorily manage the irrigation system;

The Clerks Office of modern irrigating institutions, responsible for managing the infrastructures and making sure that the farmers actually participate, seems to have created more problems than it has solved. Whether in the plains or in the mountains, the diagnostics reveals a lack of adhesion, amongst the users of agricultural water, in the institutional projects implemented by the State.

4. GENERAL CONCLUSION

If we observe the evolution of farming in Morocco over a long period of time, we cannot but note that rural areas have been subject to increasingly rapid change since the beginning of the eighties. This change, mostly due to the grafting of the Large Scale Hydraulics model, has significantly transformed the landscapes of the plains that are now dominated by impressive dams and bled by water transfer structures. Although the dam option in Morocco is a legacy from the period of the French Protectorate, staggering development has been achieved since independence. The number of dams has progressed from 16 to 103 and irrigated surface land from 50,000 to one million hectares. The capacity of water mobilisation has itself progressed from 1.5 billion m³ to 15.8 billion m³. The example of Haouz of Marrakech illustrates, on a regional and local basis, the conquest of dam reservoir technology. Throughout the entire Protectorate, colonisation only constructed a single dam of a fairly modest size within this territory. But since the beginning of the eighties, the structures built have changed the physical and natural characteristics and the landscapes of the entire region.

Faced with these technical feats, frequently inscribed by engineers and politicians, we may note the very slow development of the structures and institutions that are capable of running the infrastructure that was built at such great cost. Within this field, that belong more to social engineering and the engineering of mankind and civilisations, the results have been modest. This is why it is important to learn from the initial experience in the modernisation of irrigation institutions (1914 dahir and 1924 dahir) and to compare this with the changes implemented over the past two decades.

We may note a certain amount of continuity with regard to water legislation between the protectorate and the period of independence in Morocco. The 1924 dahir on the Privileged Agricultural Union Associations (ASAP) was not abrogated until the law 10/1995. Throughout this entire period, the legal rules continued to govern land relationships and irrigation environments. Morocco inherited two major directions from the colonial period that play an important role in restricting the effects of dam policies and that explain the delay in seeking the effective organisation of irrigation institutions.

The first direction concerns the important place held by engineers on the design and implementation of the water policy. If we recall the comment made Jean Brunhes, we may understand the reinforcement of the principals of technocratic option and of the administrative management of water to the detriment of good governance and the participative management of irrigation.

The second direction involves the marginalisation of the traditional groups of irrigators (in particular the Jmaa) and the absence of a project on the creation of union associations that are both powerful and autonomous. The colonial legislator evoked the Spanish model of “comunidades de aguas” an Arabic (or sarrasin) legacy. But the Jacobin spirit made it impossible to consider this model within the framework of autonomous institutions (ref. free union associations) and of the local governance of irrigation.

We are not certain that the Moroccan legislator who developed this new water law had learned all he could from this lesson, offered up to us by history, of the institutional innovations under the protectorate. It would appear to us that there has been no break with the Jacobin mindset or with the desire to continue to marginalise the traditional Jmaa. The failure of the AUEA is partly due to the absence of a global reflection on the institutional and legal innovations of the protectorate, their

benefits and their limits. We must now break with the spirit that presided, for almost one century, over the conception of the colonial water code (Jacobinism, the desire to reduce the role of the Jmaa who were suspected to be seat of resistance) and turn towards a new methodological approach based on the principals of participative democracy and the conception of institutions that are representative, competent capable of autonomy and of making decisions.

The major lesson drawn from the Marrakech /Valencia exchange does indeed demonstrate how the existence of autonomous, structured and powerful irrigator associations can help to solve the economic, legal and administrative problem raised by the water issue. However, we may rightfully wonder if it is possible to reinforce the capacity of associations without extensive reforms of land structures and a shift in State/Farmer relations? The future of irrigation in Morocco will depend upon the answer to this question and on a radically new perception of the countryside. For centuries the latter has been considered to be a place of conservatism and ignorance that can be economically and politically exploited. The future challenge will consist in turning irrigators into true players in irrigation and in working towards implementing hydro-agricultural technical progress in the service of improving the living conditions of the majority and of developing sustainable and integrated farming.

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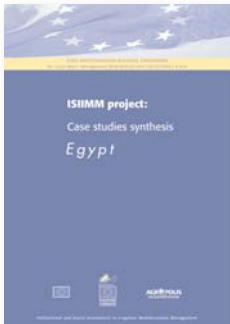
Morocco



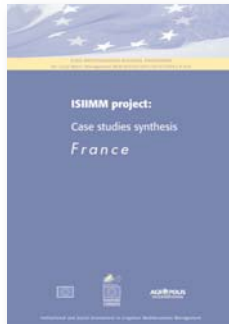
Spain



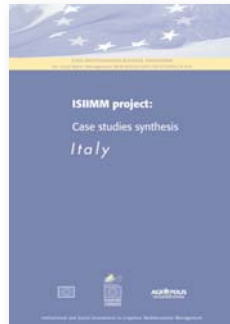
ISIIMM Project documents



Case studies synthesis
Egypt
 (English)



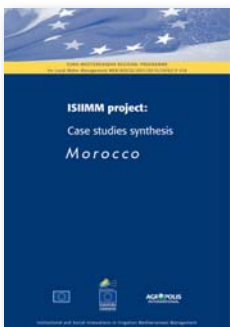
Case studies synthesis
France
 (English, French)



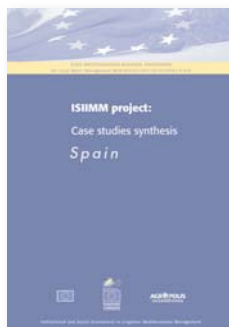
Case studies synthesis
Italy
 (English, Italian)



Case studies synthesis
Lebanon
 (English)



Case studies synthesis
Morocco
 (English, French)



Case studies synthesis
Spain
 (English)



General synthesis
 (English, French)



Institutional report
 (English)

Partners



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