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Hamdy A. (ed.), Tüzün M. (ed.), Lamaddalena N. (ed.), Todorovic M. (ed.), Bogliotti C. (ed.).
Participatory water saving management and water cultural heritage

Bari : CIHEAM
Options Méditerranéennes : Série B. Etudes et Recherches; n. 48

2004
pages 209-217

PARTICIPATORY IRRIGATION MANAGEMENT IN MOROCCO

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SUMMARY – Morocco's agricultural sector employs 40 percent of its 30 million people and consumes 85 percent of its water. Rapid population growth, pollution, and drought have intensified pressure on the country's scarce water resources. In this context, efficient and effective operation and maintenance (O&M) of irrigation facilities is a key to water saving and achieving sustainability in irrigated agriculture. This paper presents the Moroccan experiences with users' participation and highlights the recent achievements of the ORMVA's, since 1995, in the process of transfer of irrigation systems. The objectives of the participatory approach are to insure better water management and sustainability of irrigation equipments and systems and, therefore, to reduce water cost and to convince the farmers to pay their shares and to guaranty actual partnership between the ORMVA's and farmers. At present, the movement of participation of beneficiaries in irrigation management is in full swing. In next coming five years, it is expected to bring at least 30% command area under water user association management. It is expected that the transfer of management to beneficiaries will result in sustainable, efficient and economic water use. From the experiences gained during the last years it appears that the execution of the ORMVAs plan of action requires new practices in the area of promotion, creation, and technical support for WUAs in order to get the associations realistically defined and progressively managed by the members themselves. Also, it is recommended to implement effectively a training plan aimed at diverse categories of actors concerned with participative irrigation management, and, also, aimed at a team of trainers. The trainings must take place by objectives and in a real situation, must be active with the trainees ending up with practical skills, concrete decisions, and accomplishments.

Key words: irrigation management, irrigation performances, Water User Associations (WUAs), Participatory Irrigation Management (PIM), Morocco.

INTRODUCTION

Since the 1960s, Morocco has largely contributed to the mobilization of its hydraulic capacities in order to face the demographic increase and sustain its social and economic development. Nonetheless, and in addition to the continuation of the efforts directed to mobilization, and the control of demand, the limited hydraulic potential requires Morocco to resort to unconventional resources (wastewaters and brackish waters).

Morocco's agricultural sector employs 40 percent of its 30 million people and consumes 85 percent of its water. Rapid population growth, pollution, and drought have intensified pressure on the country's scarce water resources.

Irrigation water conservation implies the adoption of measures to modify water demands and maximize efficiency in water use. A comprehensive program of irrigation improvements is being implemented to create conditions which will achieve optimum use of water in irrigation sector. It includes three interrelated major activities: (i) improvements in hydraulic performance, (ii) increases in agricultural productivity, and (iii) participatory management improvement (Kerfati, 2001).

On farm water losses are estimated at 50% of water losses of this magnitude induces economic losses on agriculture production, increases water charges to farmers and leads to waterlogging and build up of soil salinity and ground water pollution that are seriously threatening the sustainability of irrigated agriculture. Moreover, wasting large quantities of water is now accelerating the imbalance between water supply and demand in Morocco.

In this framework, a National Irrigation Program for the 1990s (PIN 1993-2000) had been developed and implemented. One of the major concerns were the improvement of the on-farm water management through the reinforcement of irrigation management extension services and on-farm investments to introduce water saving irrigation technologies. In this context, the development of Water Users Associations that are able to effectively participate in the management of their irrigation system was also very important. It is hoped that these Water Users Associations will serve as a communication link and forum for disseminating information and assistance on improved water use, agricultural practices and technologies.

PRESENT CONTEXT AND SITUATION: WATER RESOURCES IN MOROCCO

Climate Context

Located at the extreme North-West of the African continent, Morocco is affected by the Mediterranean climate that varies following the geography of the country, and which is usually accompanied with more and more repetitive periods of drought leading to serious socio-economic problems.

Indeed, the Moroccan climate varies from sub-humid in the north, semi-arid to arid in the center, to Saharan in the South. The rainfall rate is irregular in time and space. The average annual rainfalls reaches more than 1000 mm in mountainous areas of the north and Tangiers basin and West Mediterranean Coast) and less than 300 mm in the Moulouya, Tensift, and Souss-Massa basins, south-atlas areas and the Saharan area (Fig. 1).

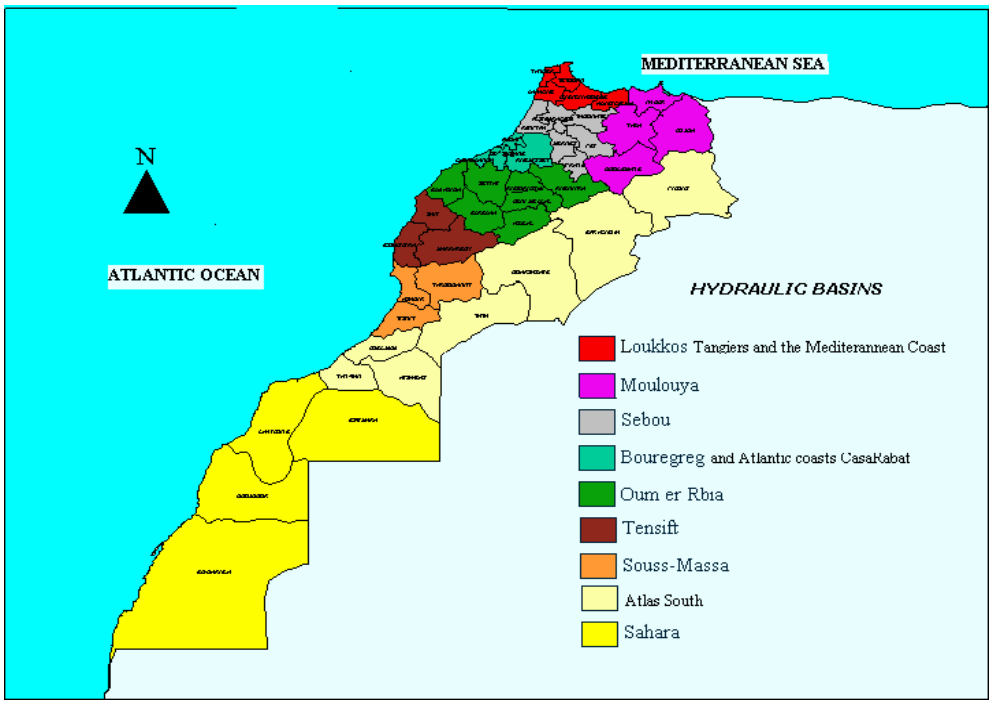

Fig. 1. Geographic distribution of hydraulic basins in Morocco

The yearly rainfalls during dry years may reach very weak levels down to 60 or 75% of the normal average (Table 1). Also, the droughts periods that have been affected Morocco, in the early 1980s and 1990, have shown that the Moroccan economy depends on rainfall and the distribution of rain during the year. The Gross Domestic Product (GDP) relies strongly on the Agricultural product which is itself dependent on the rainfall level. The surface of the affected areas reaches about 85% of the land, i.e. about 71 million hectares.

Table 1. Distribution of rainfall by basins (Source: DGH, 1999)

Basin	Number of rainy days	Inter-annual average rainfall		Dry five-years rainfall		Dry ten-years rainfall		Dry hundred-years rainfall	
		mm	% of global	mm	% of global	mm	% of global	mm	% of global
Loukkos, Tangers	73	680	9	510	10.5	450	10	320	12
Moulouya	31	245	9	135	7.8	120	8	90	9.5
Sebou	59	750	20	540	21.5	475	22	340	25.5
Bou Regreg	56	500	7	370	7	335	8	255	9.5
Oum Er Rbia	57	515	12	380	13	330	14	245	16
Tensift	36	330	8	240	9	200	9	110	7.5
Souss-Massa	54	240	6	170	6	140	6	80	5.5
Atlas South	30	170	19	100	16	75	15	30	9.5
Sahara	21	50	10	30	9	22	8	9	5

Water Resources

The annual rainfalls reach at present an average of 150 billion m^3. 29 billion m^3 are considered effective rains dispersed in run-off waters (20 billion m^3) and in filtered waters feeding the ground waters (9 billion m^3).

The hydraulic potential that can be mobilized in Morocco is estimated at 20 billion m^3 per year.16 billion m^3 is constituted of surface waters and 4 billion m^3 of underground waters.

However, the climatic order affecting the hydrologic order has directly altered the unequal distribution of surface waters between the basins. In fact, as shown in Figure 2, the north basins (Loukkos, Tangiers and the Mediterranean coast, and Sebou) use more than half of the hydraulic potential of the Kingdom, while their surface does not exceed 1/10 of the country with 1/3 of the Moroccan population. In addition to this irregularity in the space distribution comes the seasonal irregularity.

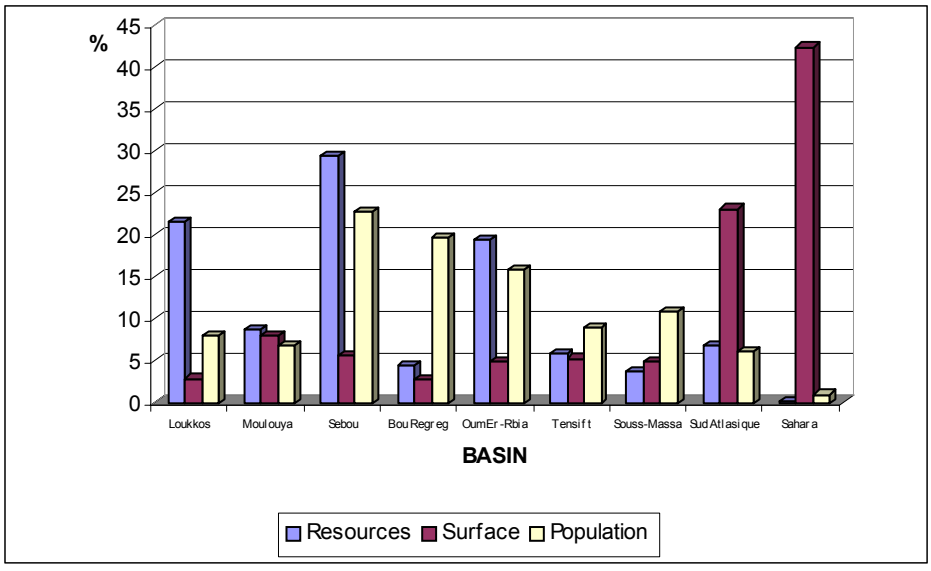

Fig. 2. Geographic distribution of surface waters resources

Equally, the underground waters constitute an important part of the national hydraulic pool. They are divided into 32 deep aquifer and more than 48 shallow aquifers. Similarly to surface waters, the geographic division of underground water resources is also unequal. More than 50% are spread in

central regions and the north of the country (Table 2). These aquifers play an important role in agricultural development and water supply for populations especially during droughts.

Table 2. Geographic distribution of underground waters resources (Source: DGH, 1999)

Basin	Resources in waters that can be mobilized (%)
Loukkos, Tangiers and Mediterranean coasts	5.65
Moulouya	19.47
Sebou	11.33
Bou Regreg	3.15
Oum Er-Rbia	8.15
Tensift	11.45
Souss-Massa	6.00
Aquiferous systems of the High and the Middle Atlas	3.75
Atlas South	15.30
Sahara	0.40
Diffused flow	15.35

Water Resources Issues in Morocco

In Morocco, the volume of water available per inhabitant per year, an indicator of a country's wealth or shortness in terms of water, reaches actually about 1000m^3/inhabitant/year. This rate is commonly considered as the critical threshold before the move to scarcity. At present, this rate varies between 180m^3/inhabitant/year for the areas known to be poor in terms of water resources (Souss-Massa, Atlas South, Sahar) and 1850m^3/inhabitant/year for areas of the basin of Loukkos, Tangiers and Mediterranean Coast, known to be relatively rich.

It is probably that the water resources per inhabitant can reach around 600m^3/inhab/year towards 2010. At this date, about 14 million inhabitant, i.e. almost 35% of the total population of the Kingdom will not dispose of more than 500m^3/inhabitant/year.

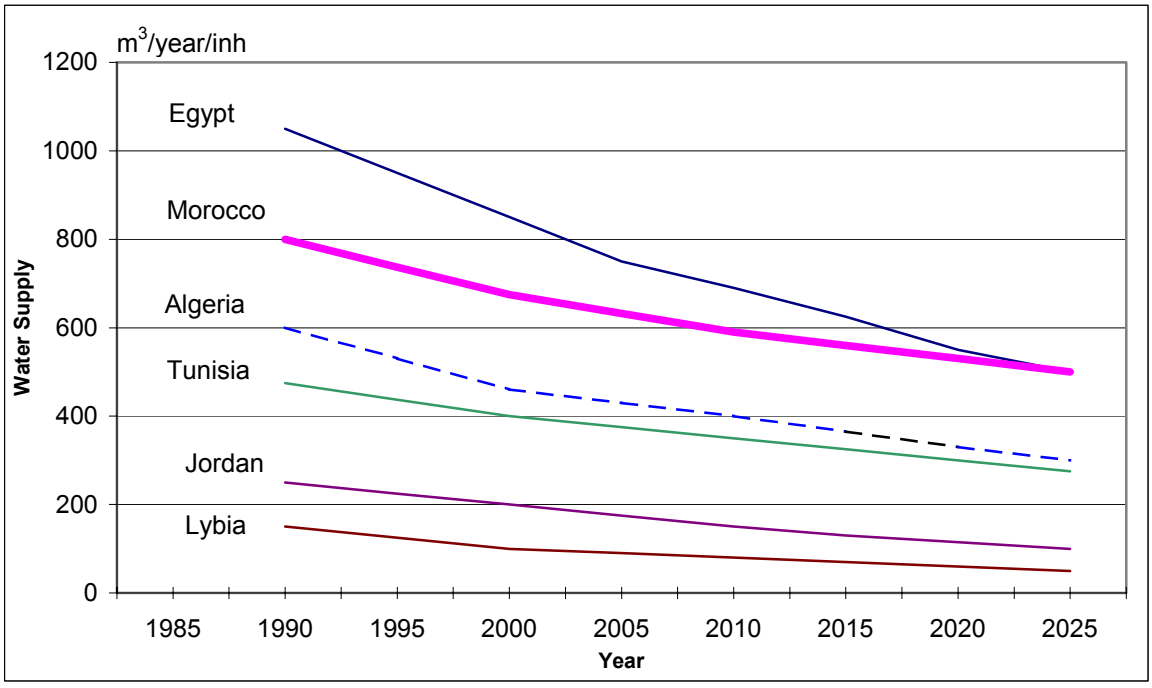

Fig. 3. Evolution of supply of available waters per inhabitant and per year in comparison with some countries of the Mediterranean (Source: AGR/DDGI, 1999)

The chronic water scarcity is thus becoming a permanent situation that can no longer be ignored to draw the strategies and policies concerning the management of water resources in Morocco (Table 3).

Table 3. Water Resources Availability, 2020 forecast (Source: AGR/DDGI, 1999)

Basin	Population (millions of inhabitants	Water resources availability (m^3/inhab/year)			
		Average year	4 years over 5	Dry year after 10 years	Dry year after 100 years
Loukkos, Tangiers and coasts	3.645	1353	745	563	418
Moulouya	2.448	1065	795	696	541
Sebou	7.918	996	605	509	395
Bou Regreg	9.076	109	49	39	29
Oum Er-Rbia	6.171	1232	973	910	835
Tensift	3.131	546	324	280	240
Souss-Massa	3.250	362	207	180	156
Atlas South	2.606	735	414	347	279
Sahara	0.625	168	-	-	-

On the other hand, the hydraulic assessments prepared within the framework of the planning studies, carried out at the level of all the hydrologic basins, have proved that many of these basins are showing a shortfall. In addition, the quality of these resources has undergone a considerable degradation during the last decades due to the different sources of pollution (domestic, industrial, agricultural wastewaters etc.)

On the basis of the climatic and geographic context, the resort to non-conventional waters, namely treated wastewaters, constitutes an alternative, especially in basins suffering from droughts. The treated wastewaters are said to constitute a national development factor through extending irrigated areas, exploiting arid lands, improving public health, controlling environment pollution and managing the quality of water resources at the level of hydrographic basins.

CURRENT NATIONAL STRATEGIES IN AGRICULTURAL DEVELOPMENT

Evolution of the state role in the development of agriculture sector

The evolution of the role of State in agriculture sector since 1960s can be summarized as follows. The period before 1960 is a time where big extension programs were conducted. The actions corresponded mainly to the promotion of tillage, fertilizers techniques and seed production. During this period the State was involved in the regulation of the market through the prices setting and the execution of the development actions. In 1969, the agricultural Code of investment (CIA) was established and since that time it has become the legal text that statues the organization and development of the sector. From 1969 to 1993, many land and water management and sectoral (milk, meet, sugar, cereals, oil, citrus, horticultural crops) plans were lunched and implemented. During this period, the market regulations remained but the role of the State shifted from the execution to the participation in the development programs. The State disengagement process, which started in 1980s, has become just the participation and referee in the development programs.

Since 1993, a new strategy of the development of the agriculture was elaborated. Many laws were promulgated. Among them are the Law on water (Law 10:95) and the Law on the creation and development of rainfed perimeters (Law 33:94).

New Law on water (Law 10:95)

Taking into consideration that water has become not just limiting factor of agricultural production but also a limited resource and that the approaches adopted in the past in the domains of water management and allocation were not successful, a new law on water was promulgated in 1995 (OB 1995). This law introduces innovations and an integrated strategy in water management takes into account both the conservation and the improvement of the efficient use of this natural resource. In fact, this law is based on the principle of "pollutant-payer", meaning that who pollutes or spends too much water has to pay a higher price. The law came also to solve the problem of the fragmentation of the responsibilities of many partners involved in water resources management (six ministries and certain public institutions) and to modernize the administration of the resource. In fact, new authorities acting in cooperation were created at national, regional and local levels. These are:

1) high water and climate council that is in change of formulating general orientations of the national policy in the domains of water, the study of all aspects concerning plans of the development of water resources and the legislation of water;
2) hydraulic basins agencies which are managed by an administration council composed of all partners involved in water management and that are in charge of the organization and execution of water management programs at the basin level; and
3) commissions of water at the prefecture and province levels. The objectives are to insure the participation of local collectivities and to promote the decentralization of water management.

Creation of associations of water users and review of water price in large scale irrigation

In the agriculture sector, the strategy of large scale irrigation was initiated in 1960s. This strategy was consolidated with important legal and institutional measures such as the Agricultural Code of Investment and reinforced, since early 80s by the management of small and medium scale irrigation. The experience of Morocco, in dams construction and the modernization of irrigation systems, has been successful in terms of the economical development of the country. However, in order to keep the ORMVA's (regional extension authorities in high scale irrigation perimeters) financially autonomous, it was decided since 1970s that water users have to pay for the expenses related to exploitation, maintenance of irrigation equipment and to amortization of this equipment. Unfortunately, these dues were not paid and the development oh high scale irrigation has remained dependent on public funds. In fact, more than 2/3 of the total agricultural investments go to the development of irrigation and 50%of the expenses mentioned above have been paid by the State. To solve this problem, it has been decided that water users be fully involved and participate in irrigation management. In fact, associations of agricultural water users (AUEA) have been created in the ORMVA's (AGR/DDGI, 1999). The objectives are to insure better water management and sustainability of irrigation equipments and systems and therefore to reduce water cost and to convince the farmers to pay their shares and to guaranty actual partnership between the ORMVA's and farmers. To encourage farmers to stop wasting too much water and increase water use efficiency, the price (EURO/m^3) of water were increased. In fact, they have been, in general, equal or lower than 0.02 EURO/m^3 and became now higher for most ORMVA's. Nevertheless, they are different from one basin to another and varied in 2002-2003 from 0.020 to 0.062. Variation in the price within the ORMVA's is due to the energy (pumping and irrigation systems) required to provide farms with water. The only ORMVA's where the price remained constant and low (0.02 EURO/m^3) were those of Tadla, Ouarzazate and Tafilalet.

Morocco has long history of farmer's participation in irrigation. The need for farmer's participation was also recognized in Morocco for efficient utilization of water. The WUAs are working satisfactory in various regions of Morocco. The main purposes of establishing WUAs are:

- to reduce losses from distribution network,
- to maximize irrigation efficiency, equitable distribution of water, farmers' involvement in decision-making.

The water savings observed through efficient use of water in irrigation project under participatory irrigation management have been quantified to possible extend. However, there is possibility of larger amount of water saving by community due to water saving awareness program.

At present, the movement of participation of beneficiaries in irrigation management is in full swing. In next coming five years, it is expected to bring at least 30% command area under water user association management. It is expected that the transfer of management to beneficiaries will result into sustainable, efficient and economic water use.

Case of Tadla region

The Tadla perimeter currently possesses significant hydraulic equipments and infrastructure including three dams, 2600 km of principal, secondary and tertiary canals, 1703 km of drainage canals, and 2600 km of unpaved roads serving farms with total 109,000 hectares of cultivated area (18.6% of the national cultivated area served by large scale irrigation).

In July 1998, seventeen WUAs had been created, encompassing 5,056 producers and farming a total area of 26,142 hectares. Actually, the total number of WUAS is 49, incorporating 22,671 members with a total farm area of 90,641 hectares. The actions of the ORMVA of Tadla are within the perspectives mentioned above, but as with others ORMVAs, it encounters some difficulties in putting it into operation due to somewhat imprecise legal texts governing the WUAs and the lack of a precise official orientation concerning the sharing tasks between ORMVA and the associations. The absence of belief in the value of Associations on the part of the farmers, as well as the task of financial means for an Association to take action, renders paradoxical the fact that the office is gearing itself to modify and put into effect a strategy and an operational plan aimed at activating participative irrigation management in Tadla region.

Also, the Associations are critical of several deficiencies in the irrigation network as well as with their own lack of means to take action in dealing with ORMVA. According to farmers, the technical deficiencies have to do with a diminished flow of water, particularly in the months of April and May, where the need for water is important and urgent. This diminished water delivery is aggravated for certain farmers by water thefts, or by the poor stat of the canal. Thus, even though predisposed and motivated to participate in the management of their irrigation system, the WUAs currently existing cannot fulfills their mission for lack of adequate human , material, and financial means.

From the experiences gained during the last years it appear that the execution of the ORMVA of Tadla plan of action requires new practices in the area of promotion, creation, and technical support for WUAs in order to get the associations realistically defined and progressively managed by the members themselves. For the technical and administrative staff of the office charged with the responsibility for WUAs. These new practices now consist of the following functions:

- An organizing function in order to put into place the conditions favorable to the creation and to the sustainable, proper functioning of WUAs by energizing them through social intervention;
- Training and information for the farmer-members of the Associations in the foundations, missions, and roles of these associations, in their internal rules of procedure, as well as the methods of internal and external communication;
- A general supervisory function, not limited only to maintaining the conformity of Association management to the regulations governing these Associations;
- A function of technical support to the WUAs, which, in the initial years of their existence, is able to substitute for them in certain of their statutory functions that they might not be able to fulfill for the present, due to the lack of human and material means.

These new functions imply the re-engineering of the technical and administrative structure of the office deals with WUAs. This structure currently consists of a single office charged with water user relations which does not have the human and material resources sufficient to properly carry out its strategies mission of Participative Irrigation Management: It would be suitable, then to re-deploy ORMVAT personnel to strengthen this structure. Among other things, this structure should be able to harmonize its actions with those of the Extension Service and Professional Organization office, particularly when it comes to the diversification of centers of interest of WUAs, extending the activities of these associations to agricultural production and marketing of agricultural products of members.

The promotion of Participative Irrigation Management in Tadla also requires the establishment of a training plan found on a precise identification of training of Association members and officers as well as of technical personnel charged with support of the WUAs. It involves training by objective for each

category of beneficiary in the areas judged as priorities by common agreement between the WUA and ORMVAT. The goal of this training is not simply an improvement in everyone's knowledge, but also the emergence and maintenance of a dynamic, a sense of teamwork and solidarity of action between all the actors concerned in order to reinforce and consolidate the Association already created and to prepare favorable conditions for the creation and proper functioning of future Associations.

This promotion of Participative Irrigation Management comes also through the support of the office for WUAs in the matter of administrative organization, the development of working methods and tools, of assigning personnel to assist particularly those active WUAs and the creation of simple legal and technical essential for the training and information of Association members.

The work of Participative Irrigation Management in Tadla should be permanently and rigorously monitored and evaluated by ORMVAT and by the associations. In this there is the need to establish a monitoring and evaluation unit to do not just quantitative indicator monitoring, but also to gather qualitative information, because this type of monitoring evaluation consists an effective learning tool for action while being a means of concerted management of intervention by the office in matters of Participative Irrigation Management. However, the monitoring/evaluation must, as a matter of priority, be done for the purpose of counsel and support to Associations and the agents responsible for promotion and technical services to these Associations.

Finally, the Tadla Resources Management Project can help the organization and reinforcement of Participative irrigation Management in the Tadla perimeter. This support can come in the areas judged as priorities such as training of the Association officers and technical support agents; information for the Association officers through the development of the legal guides and technical manuals relating to the use, maintenance and repair of equipment and irrigation works currently used by the water users; organization of study tours for WUA officers; and support for the establishment of the monitoring/evaluation unit in ORMVAT.

PRIORITY ACTIONS

The actionable measures indicated below are arranged in descending order of importance (AGR/DDGI, 1999b). This classification takes into account the degree of urgency in the execution of the measures.

A. Give help to the WUAs in the form human and material resources for action, beginning with those Associations who wish to put into effect, with participation of the office, their own annual, or multi-year, programs of work focused on the utilization of irrigation water. A plan to help all of the Association in this irrigation perimeter should be established in advance through the office of DGRID and put into effect according to precise schedule and order of priority in the offer of resources.
B. Reinforce, through ORMVAT resources, the policing of the irrigation water in those locations considered most vulnerable, and encourage such policing everywhere and at all times, be it carried out by the Association themselves, or, if they demand it, by office personnel seconded to the Association, who would receive a risk bonus paid by the Association to which they are attached.
C. Establish a model program plan for service, maintenance and repair of equipment and hydraulic works which can inspire the Association in the drawing up of their own annual or multi-year work plans with the aid of the office technical staff.
D. Create within DGRID a technical-administrative structure, having the rank of a Service, whose mission would be to promote, create and advice the Association and, to this, would maintain functional relations, particularly, with the Extension Service and the professional Organizations office to be able to coordinate its actions in Participative Irrigation Management. While awaiting the creation of this service, it would be appropriate to reinforce, with urgency, the human and material resources of the existing office of Water user relations (adding a professional employee with irrigation system experience, two technicians with good water Management experience who have mastered the techniques of communication and extension, and priority access to ORMVAT transport of the personnel advising the Association). Moreover, the Office of Water User Relations is called upon to change its practices more or less directive, and favor practices that are more conducive to participation (negotiation with the Association of work program, progressive diminution of the role as a substitute for the WUAs in their statutory functions, the systematic execution of time-specific plans to transfer management tasks to the

Associations.)

E. Establish and put into effect a training plan aimed at diverse categories of actors concerned with participative irrigation management (Association Board members, presidents and vice-presidents, treasures and vice-treasures, the 7th Board member, ORMVAT agents assigned to assist WUAs) and also aimed at a team of trainers (2 or3 professionals from the office). The trainings must take place by objectives and in a real situation, must be active with the trainees ending up with practical skills, concrete decisions, and accomplishments.
F. Develop a set of technical and administrative working tools needed to run an Association:
   - Internal operating rules format;
   - Budget format;
   - Financial plan format; and
   - Procedure of calling a meeting, setting an agenda, and making decisions.
G. Produce, through the technical facilities of the Ecole National of Agriculture at Meknes, videos on the techniques of modem irrigation, particularly at the farm level, and make these cassettes available to WUAs upon demand.
H. Bring the Association presidents concerned into the process of the issuance of requests of bids, contractor selection, monitoring and approval for payment of the work performed of service, maintenance and repair of equipment and hydraulic works
I. Study the legal, financial and accountability implications of the possibility to refund 20% of the collected water fees to associations who undertake themselves certain of the work of servicing equipment and maintaining the hydraulic works.
J. Study the legal, financial and accountability implications of the possibility of deposit into common Association funds in the Tadla perimeter, the money paid as fines for infractions of the regulations relative to the use of irrigation water.

Working closely with Tadla's farmers – who draw water from Morocco's oldest large-scale irrigation system the ORMVAT introduced technologies to improve canal efficiency, reduce groundwater pollution caused by the overuse of nitrate fertilizers, and minimize the application of pesticides. Most dramatically, "laser leveling" – using a tractor-drawn earth mover to make fields perfectly flat – resulted in water savings of 20 percent, labor savings of 50 percent, and a 30-percent rise in yield. Two local firms have begun operations that will level 1,200 hectares every year. ORMVAT, the regional water authority, now uses computer modeling to track water availability, ascertain crop needs at different points in the growing cycle, and relay the information back to farmers.

At the policy level, ORMVAT helped decision makers devise water pricing policies that reflect the true value of water and encourage rational use. They also helped farmers form water users' associations, which paved the way for Morocco's decision to decentralize the management of its natural resources.

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