THE INTRODUCTION OF PERFORMANCE ORIENTED MANAGEMENT IN THE TRIFFA SCHEME IN MOROCCO.

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1. INTRODUCTION

This paper describes the IHE experiences in introducing performance oriented management in the Triffa scheme of the Moulouya Basin in Morocco during the period 1993 - 1997. These activities are carried out in the framework of the IIMI-IHE-ILRI collaborative Research Programme on Irrigation Performance (RPIP)

IHE carried out their part of the research programme in collaboration with the "Office Regional de Mise en Valeur Agricole de la Moulouya" or ORMVAM, the managing agency of the irrigation schemes in the Moulouya Basin. The objectives of this research programme are:

- to identify, for the selected scheme, those factors which are of main importance for adequate and sustained performance of the operating agency.
- to assist ORMVAM to introduce and field-test performance oriented irrigation management based on the hypotheses developed in stage I and to monitor and document the effects with the emphasis of the field research on water delivery.

The programme is based on the propositions and hypotheses developed under an earlier programme: Performance Assessment Diagnosis (Murray-Rust and Snellen 1993).

2. FRAMEWORK FOR INTRODUCTION OF PERFORMANCE ORIENTED MANAGEMENT

2.1 Performance and Service Provision

The performance of an organisation (effectiveness of its activities) is a measure both of the degree of fulfillment of the output objectives (customer satisfaction) and the management of available resources in accomplishing this (efficiency). Along these lines Murray-Rust and Snellen (1993) propose two complementary criteria to measure the overall performance of the irrigation main system management:

- the degree to which the services offered by the main system respond to farmers' needs, within the limitations imposed by national policies and objectives.
- the efficiency with which the irrigation and drainage system uses resources in providing these services.

To identify the degree to which the services offered respond to farmers needs a consultative management approach is required where the users can express their needs and desires that will be reflected in the services offered. Assessment of performance thus requires a clear insight in the service relationships between the irrigation authority and the water users.

Also clear insight is required between the irrigation authority and other agencies involved to define the imposed limitations and constraints like for example ministries supervising the authorities activities and river basin authorities responsible for bulk water supply. These insights can be obtained by defining clear service agreements which contain the services delivered, the

level of service, the payment for service, the procedures for monitoring and control of fulfillment of obligations, for conflict resolution and for changing the agreements.

This definition implies that irrigation authorities work in multiple levels of service provision with different service relations and service agreements. These agreements will be the basis for assessment of the performance of the managing agency.

2.2 The Service Agreement

The service agreement describes the services to be delivered by the agency for the benefit of the user, the requirements and obligations of the users to enjoy these services and the procedures to be followed. These agreements can be formal and informal.

To establish performance oriented organizations all parties involved must be committed to the development accountable service oriented organizations. The government should create the enabling environment by adapting the necessary legislation, allowing organizational and institutional changes and a greater degree of autonomy of the managing agencies involved. The agencies should be willing to change their attitude and behaviour towards the farmers and the government. The farmers should change their attitude as well by accepting the fact that behaviour according the rules is in the long run for everybody the best solution. All the individuals within the agencies and the farmers require incentives to motivate them to behave in a direction towards the common goals. Introduction of service agreements including accountability mechanisms can be used as a catalyst in the process to improve the perfromance and sustainability of irrigated agriculture .

Components of a service agreement

In general service agreements consist of two components: transactions
Farmers have different senses of their right to water. Three factors which should be part of the service agreement, could strenghthen the farmers' position (Chambers, 1988):

- well publicised and understood operational plans to deliver certain amounts of water at certain places at certain times,
- physical means for them to monitor what they are receiving,
- a system of communication and decision making which brings the farmers or their representatives together regularly to discuss allocations, plans and problems.

Box 1
SERVICE AGREEMENTS

Transactions

1. Services provided and level of service provision
2. Payment arrangements for these services

Accountability Mechanism

3. Procedures to check whether obligations are met
4. consequences for not fulfilling the agreement
5. Authority that will be adressed in case of conflict
6. Procedures that will be used for updating and improving the agreement.

Service Agreements therefore consist of two main ingredients (van Hofwegen,1996): the

transactions involved dealing with the level of service in water delivery (how much, when, where and how) and the payments from the clients (how much, when, where and how) and the accountability mechanism to ensure that the obligations are met.

2.3 Level of Service

The level of service can be defined as a set of operational standards set by the irrigation agency in consultation with irrigators, other affected parties and the government to manage an irrigation and/or drainage scheme (van Hofwegen and Malano, 1997).

The cost associated with the provision of a level of service and the price that has to be paid for it are key elements to be discussed with the system users during the consultations. The willingness and capability of farmers to pay for the services depends on the profitability of their enterprises and the reliability of services. With a higher level of service the farmers reduce their risks and are willing to invest in higher value crops. A firm link must be established between the provision of a certain level of service and the concurrent service cost. The agreed level of service comprises water delivery and cost recovery policies which are accepted and adopted by suppliers, distributors and users, and which extract the most flexible and reliable performance available from the water delivery system to meet the agronomic goals.

In formulating an agreed level of service a differentiation has to be made between agreements for existing schemes and for new schemes. With existing schemes the level of service is constrained by the facilities present. In new schemes the facilities can be directly adjusted and adapted to the agreed level of service.

Level of Service Determining Factors

Irrigation and drainage organisations operate under a physical, legislative and socio-economic setting that defines the environment in which the level of service specifications must be developed. For irrigation agencies, the formulation of level of service specifications is a process of 'customisation' of the irrigation supply parameters duration, flow rate and frequency. There are several factors that condition the customisation process becoming a set of boundary conditions to the final service specifications. These include water requirements (crops, soils, climate), water availability, irrigation policies, water rights and competing water uses.

Level of Service Specifications

The delivery of irrigation and drainage services is based on a set of specifications that will govern the operation and maintenance. These specifications serve two purposes: (a) to provide a set of rules against which the operational performance of the system can be measured, and (b) provide a set of rules that govern the delivery of service. The first set of specifications constitute clear, quantifyable and measurable operational parameters that permit the comparison of the actual operation against the management targets. The second set of rules refer in general to the conditions under which the services are provided. A typical set of operational specifications includes the following:

- rate, duration and frequency of supply;
- height of supply;
- supply monitoring;
- security of supply;
- water quality of supply.

The main conditions that apply to service delivery are:

- cost of supply;
- points of supply;
- water ordering system;
- supply restrictions;
- allocation priority;
- service provision during the year.

These specifications and conditions are part of the Service Agreement between the service providers and their clients. Other aspects which are to be covered in these agreements are the payment arrangements (amount, mode, conditions) and the accountability mechanism (van Hofwegen, 1996).

Quality Criteria for Water Delivery Service

The quality or level of service is related to the form of water delivery and can be characterised by a combination of parameters. These are the adequacy, flexibility, reliability, equity and equality. Furthermore, service quality can also be characterised by the convenience of water delivery and the quality of the water delivered.

Classification of Level of Service for Irrigation

System operation concepts can be distinguished on two levels: according the degree of involvement of users in water delivery and according the degree of flexibility of the operational parameters rate, duration and frequency of delivery. Three concepts can be recognized regarding the users involvement: (i) *on-demand* where users decide by themselves on the time, rate and duration of supplies, (ii) *on request* where the users request time, rate and/or duration of supply but the agency ultimately decides and, (iii) *imposed* where the agency decides on the delivery without consulting the farmers. These main types can be subdivided according the flexibility of delivery expressed in the operational parameters.

The classification for levels of service is based on the degree of flexibility in water delivery and the degree of user consultation involved. Flexibility is used as a measure for level of service in water delivery though other qualities as adequacy and reliability can be utilized as basis for classification too. A classification on two levels is proposed (van Hofwegen and Malano, 1997). On the main level the three main classes are distinguished which reflect the degree of user involvement and the sub-levels are based on the degrees of freedom for the management parameters rate, duration, and frequency. These are constant, predetermined (unmodifiable) or variable (modifiable) in any combination and in different time scales (irrigation period, season, years etc).

2.4 Service and performance oriented irrigation management

Performance of an irrigation system reflects the qualities of the organisations and individuals responsible for the management of the system. This is greatly influenced by the management environment (institutional and legal frameworks) and the hydraulic infrastructure. A good manager will ensure that the appropriate management strategies adopted are compattible with both the physical and the management qualities.

Performance oriented management is related to the achievement of set objectives and targets, disregard the way these are established. The services provided can be dictated by the management agency usually based on government policies or by the clients. In the first case we can speak of a declared level of service to be provided at a declared level of cost. This means that the need for responding to the needs of the clients is of second order. The clients adjust their agricultural practices to the services provided. This is usually the case in situations where the cost to provide the services are mainly covered by contributions from governments and where the contributions from the clients are only partially covering the cost.

Service oriented management is the provision of an agreed level of service at an agreed level of cost. The agreed level of service is most relevant for authorities that are financially autonomous. Their income depends on the payments made by their clients for the provision of services. In service oriented management the needs of the clients are therefore of primary importance. The service provider adjusts its management practices to the needs of the customers which are dictated by the outcome of the consultation process. Here the level of service is balanced against the cost associated with the delivery of that particular level of service in a process of consultation. The objectives and targets for delivery of services and the accountability mechanism are formulated in a service agreement.

2.5 The Process of Introduction of Performance Oriented Management

The introduction of performance oriented management is a gradual process which involves changing relationships and attidudes. In this paragraph a sequence of steps (see box 2) in this process is described.

STEP 1: Obtain comittment to introduce and apply POM

Introduction of performance oriented management requires a full comittment from the managing agency. Such commitment is not usually obtained by internal drive but requires to be triggered by external forces. These external pressures to change into a performance direction mostly come from governments, financiers and donors or clients. Especially when there is a direct relation between service provision and payment for services the pressure on the agency to perform increases with the level of payment.

STEP 2 Define National Policies and Objectives

Irrigation development, especially in large schemes, is usually the responsibility of the government as part of an overall development plan with specific objectives. The role of the government is to provide the enabling environment for irrigation development and management which allows the irrigation agencies to deliver the irrigation services in a sustainable, efficient and effective manner beneficial to the users in particular and society in general. This enabling environment includes the legal and institutional frameworks, accountability mechanisms and procedures, regulations and criteria for service provision and price setting.

Box 2.
STEPS IN THE PROCESS OF INTRODUCTION OF PERFORMANCE ORIENTED IRRIGATION MANAGEMENT (POIM).

1. *Obtain comittment to POIM*
2. *Define national policies and objectives*
3. *Define service relations and associated levels of service*
4. *Inventory of water resources and hydraulic infrastructure*
5. *Develop performance assessment system:*
   - *analyse process to deliver services*
   - *analyse resource use*
   - *identify performance indicators*
   - *determine density and intensity of observations*
   - *prepare procedures for observations and processing*
   - *establish observation network:*
6. *Training staff, preparation tools.*
7. *Analysis and corrective actions.*

With the given set of development objectives the irrigation agencies develop a physical and management infrastructure to deliver water at the interface with the users. The agency prepares and implements strategies to define and provide these services within the environment created by the government. Policy choices made at this planning level concern water rights, cropping arrangements, water delivery arrangements, ordering procedures, cost recovery, and responsibilities for system management. These choices are not made in isolation but there will be an interaction between the various levels on their choices and decisions making. Consultative approaches are necessary to develop sustainable solutions especially if users have to contribute to the cost of infrastructure development and management.

STEP 3 Define Service Relationships and Associated Levels of Service

Multiple Service Relationships

The authority managing the irrigation and drainage system is providing services to the waterusers connected to the system. The agency is the service provider and the waterusers are the clients. However, the irrigation authority does not work in isolation but has working relationships with other agencies. These can be government agencies like ministries as supervisory bodies or planning agencies, river basin authorities as bulk water supplier, etc. Especially in the latter case the irrigation authority can be a client of the river basin authority. The management of the irrigation system is very much influenced by policies of these agencies. Service relations and service agreements between these agencies have to be developed similar to those between the agency and the farmers. Small and Svendsen (1990) identified in this context three different

purposes of perfomance assessment: accountability and evaluation of management processes and interventions. The main focus in performance oriented management is accountability and effeciency of processes. The supervising agency must be informed on whether the provision of services and its price setting is in agreement with current regulations. The farmers need to be ensured that the agreed services are delivered and the authority needs to know whether the services are delivered and resources are used effectively and efficiently. This means that different sets of performance indicators need to be developed and applied specific for the service relations.

Multiple services

The development, management and operation of the irrigation and drainage infrastructure is defined for the provision of a specified level of service. This level of service must preferably be agreed upon between the users, agency and government and be provided at minimum cost. Agencies can provide single or combined services like irrigation, drainage, flood control, water quality control etc. The services provided need to be made explicit and service levels have to be established for each of the services.

STEP 4. Inventory of water resources and hydraulic infrastructure

Water Resources

The availability of water resources and the reliability of supply is an important feature in the performance of any irrigation scheme. Storage facilities for surface water or availability of good quality groundwater can increase the flexibility of water deliveries and thus the level of service. The impact of high variability of water availability on the performance of schemes, especially in water scarce areas, is very important. Therefore, in any performance analysis the actual water situation needs to be taken into consideration through assignment of specific process performance indicators.

The availability of water resources also has to be related to the expected amount of water required. The nature of irrigation development is ofetn determined by the policy decision to have for example productive or protective irrigation. These aspects have to be taken into consideration when performance assessments are made. These considerations should be translated into impact performance parameters like productivity per hectare or productivity per m3 water supplied.

Hydraulic Infrastructure

The hydraulic infrastructure in existing schemes determines, next to the management capabilities, the potential level of service. Constraints are built in through limited canal capacities, flow control systems, and opeartion and maintenance procedures. Evaluation of performance therefore needs to consider the type and condition of the hydraulic infrastructure.

STEP 5 Develop Performance Assessment System

Analyse process to deliver services and use of resources

The process of service delivery focusses on allocation and distribution of water. This means that the process of allocation and the process of implementation of the allocation have to be specified. The allocation of water is based on water rights or rights to use water. Rules have been established that form the based of the distribution of water over the system between the

individual farmers. For performance oriented management it is necessary that these rules are clear and the decision making on allocations is transparent. Service agreements are most suitable tools to obtain transparency . These allocations are the intended values of water to be delivered at the different levels in the system.

The actual distribution and delivery of water is a matter of day to day operations. Not only the accuracy of the distribution itself but also the level of precision in the allocation process determine how well the actual deliveries approach the intended values. The time span of planning appears to be an important factor. Even during the distribution the intended deliveries or allocations can be changed due to changed requirements (e.g. due to rainfall, additional last minit requests etc). The more flexible the delivery system, the more difficult it will become to deermine the intended values at a reasonable time before delivery!

Identify performance indicators

Svendsen (1993) defined three types of performance indicators: output indicators, impact indicators and process indicators. In the provision of services the agency is interested in the quality of theirs output (water delivery) and the efficient use of their resources (water, land, finance and human resources). Governments and financiang agencies are more intersted in the impact of the provision of irrigation services like crop production, creation of labour etc. Based on the services and the service relations and on above analysis the appropriate performance indicators can be identified. For the managing agency some indicators can be output indicators where for others these will be impact indicators or process indicators. For each service relation a specific set of indicators has to be developed based on objectives and targets formulated in the service relationship.

Prepare procedures for observations and processing

Data have to be collected and processed to quantify the perfromance indicators and should be presented in a format suitable for decision making, accountability or evaluation on effectiveness of interventions. These activities should be compattible with the routine activities of the agency staff and should initially follow the existing routine procedures.

Transparency of service delivery but especially the cost of service provision requires often radical changes in the financial administration of the agency. Where in most agencies finances are managed on a supply basis, covering the expenses as much as possible, in performance oriented and service oriented systems the financial administration must be based on a demand basis. This means that the real cost of specific activities have to be identified and allocated to that activity. this not only demands changes within the agency but also adjustments in the administration of the supervisory agencies.

The volume of data to be collected and processed can become too large to be handled manually. Computerised processing can be of much help. It is however necessary that the software developed follows the system specific features.

Introduction of a performance oriented approach also requires a finetuning of data streams in type, format, timing etc. This demands a review of site specific operations and relations between service provider and client. Application of standard reporting procedures must therefore be done

with care. Small differences in operational procedures may have a very important reason.

Establish observation network:
The installation and operation of observation sites and the time and energy necessary for processing are an additional cost that should be covered directly from the contribution of user fees or from subsidies. In the development process of service agreements the cost for monitoring of the fulfillment of the obligations can be included directly. However, many of the indicators are not of the direct interest of the users or even of the managing agency. If these indicators have to be quantified, special arrangements need to be made in for example reporting obligations, financial support etc. If not, there will be no incentive whatsoever to start up the data collection and processing for these indicators.

STEP 6 Training staff

Introduction of performance oriented management requires a change in procedures and might involve new technologies to be applied. Introduction of new operating and reporting procedures and communication lines will initially create confusion if no proper information and training programme is organised prior to the introduction.Moreover it involves a change in relations between clients and service provider. This needs from both sides a process of change in attitudes. Training programmes and staff support services are an important element in the whole process of introduction of POIM.

Training is required not only for the whole organisation (managers, office staff, operators) but also for the users. The farmers need to be informed about the change in attitude, their new responsibilities, obligations and rights. Especially in areas where service orientation and reliability of services was doubtfull, huge efforts are needed to convince the users of the advantages of the service oriented system.

3. INTRODUCTION OF PERFORMANCE ORIENTED MANAGEMENT IN ORMVA DE LA MOULOUYA

3.1 ORMVA de la Moulouya

The Regional Agricultural Development Office of Moulouya (ORMVAM: Office Régional de Mise en Valeur Agricole de la Moulouya) is established by Royal Decree in 1966 as a public establishment with financial autonomy. It is placed under the supervision of the Ministry of Agriculture.

The area of jurisdiction of ORMVAM is located in the Provinces of Berkane and Nador in the North-East of Morocco (figure 1). The climate in the area is semi-arid mediterranean with a low and irregular average annual rainfall of 300 mm. Rainfall is concentrated in the period between November and April. The average annual temperatures vary between 17.6 °C. and 20.5 °C. The average annual evaporation is about 1500 mm.

The total area of 335,000 ha consists of 110,000 hectares cultivable land and 224,000 ha of forests, built-up area and incultivable land. Of the cultivable land, 71,000 hectares is irrigated of which 50,890 ha (71.7%) by gravity, 14,300 ha (20%) by sprinkler and 210 ha (0.3%) by micro irrigation. The remaining 5,600 ha is located in small scale irrigation schemes. The four plains which form the irrigation area are the Triffa Plain on the right bank of the Moulouya and the Zebra, Bouareg and Garet Plains on the left bank of the Moulouya.

Institutional Framework

ORMVA de la Moulouya is established by Royal Decree (dahir 22 October 1966) as an autonomous body under the technical supervision of the Ministry of Agriculture (MAMVA) and the financial supervision of the Ministry of Finance.

In accordance with this decree, ORMVAM is administered by a board of governors (*Conseil d'Administration*) chaired by the Minister of Agriculture and composed of:

- the Governors of the Provinces Berkane and Nador
- all the directors of the central directorates of MAMVA;
- representatives of the departments of other Ministries involved with ORMVAMs activities (Ministry of Finance and Public Works);
- representatives of the national organizations of farmers (*Chambre d'Agriculture*).

The board meets on an annual basis to evaluate and review the programmes and the future activities of the ORMVAM, and to fix its budget and level of subsidy.

There are two Provincial Technical Committees (*Comité technique provincial)* at local level. They are chaired by respectively the Governors of the Province Berkane and Nador. They are composed of local representatives of all the Ministry Departments concerned and of farmers representatives (*Chambre d'Agriculture*). The committee meets once a month or whenever it is necessary (especially in drought periods), to examine the issues and problems faced locally by the ORMVAM. The decisions are made in full consensus. No voting system is applied.

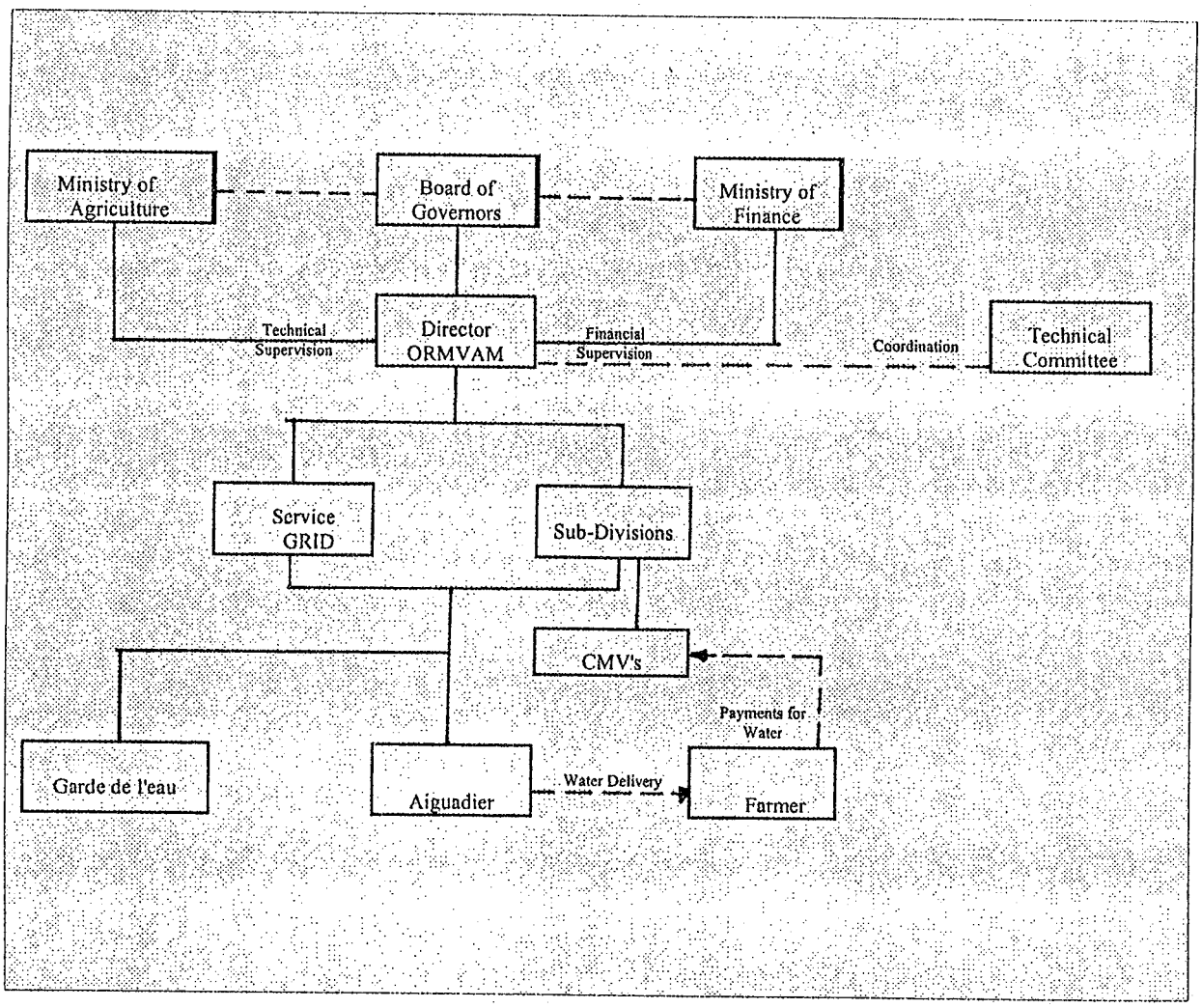


Figure Institutional Framework

ORMVAM consists of nine services. The most important service within the scope of the activities of the RPIP is SGRID (*Service de Gestion des Réseaux d'Irrigation et de Drainage* or Service for the management of the irrigation and drainage network). This service is responsible for all activities related to the planning of water deliveries, water use, maintenance of the canals and structures, and billing. The activities are carried out by five sections: Operation (*Bureau d' exploitation des réseaux)*, Irrigation and Drainage techniques (*Bureau des techniques d'irrigation et de drainage*), Tarification and Cost recovery (*Bureau des redevances et du recouvrement*), Maintenance (*Bureau de maintenance des réseaux*) and Pumping Stations *(Bureau des stations de Pompage).*

At field level, the ORMVAM operates through "*Centres de Mise en Valeur Agricole*" (CMVs). These CMVs are the basic units for crop and livestock development activities. ORMVAM has

established five sub-divisions which supervise the activities of the CMVs operating within their territorial boundaries and co-ordinate the activities of the various departments in the field. They are the subdivisions: Boughriba, Madagh, Zaio, BouAreg and Garet. Two are located in the Triffa scheme (Boughriba and Madagh). A Subdivision has a high degree of authority. Sector S22 falls under the jurisdiction of CMV 103, sub-division Madagh.

3.2 National Irrigation Policies of Morocco

In Morocco there are approximately 7.7 million ha of arable land of which 1.2 million ha are potentially irrigable. Modern irrigation and agricultural development in the country has taken place almost exclusively in the broad plains and plateaus that border the northern Atlantic and Mediterranean coasts. Most of Morocco's good land and water resources are located in this zone -- as are almost all of its urban centres, two-thirds of its agricultural population, and virtually all of its commercial agriculture. Irrigated agriculture has a high priority in Morocco, to meet the needs of its rapidly growing population and to expand exports both of commodities and processed agricultural products. Irrigation accounts for 88 per cent of the water use compared to 8 per cent for domestic use and 4 per cent for industry (Ait Kadi 1988). Irrigated agriculture contributes about 45 per cent of the agricultural value added and produces 65 per cent of the agricultural exports.

The objectives of the agricultural policy of Morocco are in line with their development policies. They are:

- improvement of selfsufficiency by a better cover of the primary food requirements like wheat,sugar, oils, dairy products and meat;
- improvement of the trade balance by development of export of agricultural products, especially fruits and vegetables;
- improvement of the living conditions of the rural population by increase of revenues, generation of rural employment and reduction of the social gap;
- exploitation of agricultural products for development of agro-industry.

These objectives were to be achieved through irrigation development to be carried out by nine decentralised ORMVAs each servicing one delimited command zone. Their main mission is:

- development of infrastructure in their area of jurisdiction;
- management of the irrigation and drainage networks;
- intensification of productivity by training of farmers and strengthening of professional organizations.

The ORMVAs should ultimately be financially fully autonomous. For this purpose the Government of Morocco has introduced a special programme PAGI-2 (see 3.3).

The analysis of the performance of the ORMVAM should therefore include impact indicators relating to production of export crops industrial crops, financial autonomy etc.

3.3 Committment from ORMVAM to Performance Oriented Management

ORMVAM is committed to the introduction of performance oriented management through external pressure from the Government. The Ministry of Agriculture initiated a national programme to improve efficiency of operations and management capacity of all ORMVAs in the framework of rationalization of public administration. The objectives of this programme are to increase efficiency and effectiveness of management of water resources and to improve the level of services provided to water users.

To enhance system performance important interventions are proposed within the framework of the PAGI-2 programme financed by the Worldbank. The interventions are of technical, administrative and management nature and comprise a rehabilitation and modernization of the flow control system in the main canal (ADI-Gersar ,1995), a change in administration and management procedures related to a shift from public administration to private corporate management of the ORMVAM (Price Waterhouse,1995), and a change in operation and maintenance procedures (BCEOM-Maghreb Projets, 1996).

The relationship between ORMVAM and the Government had to become more flexible and transparent to facilitate the process of increased autonomy. For this purpose an agreement has been prepared between the Government and ORMVAM on mutual rights, obligations and responsibilities. Basic to the agreement is the financing of above mentioned interventions by the Government against an increased autonomy of an effective and efficient ORMVAM. This agreement includes a set of performance parameters for monitoring the fulfillment of the agreement. The agreement is signed in 1996.

3.4 ORMVAM Service Relations and Services

Service Relations

As explained in the institutional framework, ORMVAM is supervised by two ministeries. Moreover a provincial technical committee is involved in the planning of water use. Moreover, ORMVAM receives water from the Moh.V reservoir which is managed by the Ministry of Public Works. Agreements between MoPW and ORMVAM are made through the provincial coordination committees on availability of water for agriculture to be managed by ORMVAM. These agreements are made in consultation with other interest groups. There is at present no payment involved for the delivery of water to ORMVAM.

Multiple services

The ORMVAs are responsible for the design, construction, operation and maintenance of the irrigation networks. ORMVA technicians supervise farming operations for industrial crops and assist in the establishment and monitoring of agricultural co-operatives. ORMVA integrates all the productive services required by farmers under one management structure. They distribute inputs, provide extension and mechanization services to farmers, supervise short-term credit and provide genetic improvement and health control services for livestock.

In addition, ORMVAs are responsible for providing assistance to rainfed farmers and those dependent on traditional irrigation located within their area of jurisdiction. They also provide technical assistance to local communities in the design and construction of village infrastructure such as housing projects, electricity and water supply, sewage and road systems.

In this paper only the irrigation component of ORMVAm responsibilities are discussed.

Service Relation ORMVAM-farmers

There is no real contract concerning water delivery between the ORMVAM and the farmers. Farmers can make use of the irrigation services only if:

(i) they are official state-registered landowner, tenant or representative in case of co-ownership within the command area of the scheme.

(ii) they purchase land in accordance with the official regulations (code des investissements agricoles).

At this moment they obtain a statement ("*Déposition*") allowing the farmer ("*dépositeur*") to benefit from the irrigation services by taking part in the irrigation cycles ("*Tour d'eau*"). This document constitutes an agreement which also obliges the farmer to pay the water charges for a duration of three years. ORMVAM only recognises for irrigation affairs one single mediator with a mandate by the co-owners, in case of subdivision of an ownership less than 3 hectares. This procedure gives more responsibilities to the farmers and limits the number of mediators dealing with the system operators.

The service relation between the farmers and the ORMVAM is direct through the field officers (*aiguadiers* - water masters). The allocation and delivery of water is done with the consent of the farmers. The service specifications are delivery of a fixed discharge (main d'eau of 20l/s or 30 l/s) for an agreed duration at an agreed time at a designated turnout. In case of gravity irrigation the height of supply is above reuired field level. The supply can be monitored through observing the opening of a certain number of baffles that indicate that deliver a constant discharge. The ORMVAM is obliged to provide the agreed supply. In case of unforseen circumstances disturbing the delivery, the farmers can claim the volume at another time in the same irrigation cycle or they get priority during the next cycle. As the water quality has always been of good standard, no specifications on this are mentioned.

After delivery the farmers sign for the volume received for billing purposes. If the delivery is not in accordance with the allocation, farmers can claim the remaining volume through the *aiguadiers* or even the Office (see 5.3). Beside delivery of water, the service delivered by ORMVAM for the users is the protection of water rights against abuses of other users (water theft etc.) and protection of the irrigation system against damage by external factors.

3.4 Water Resources and Hydrauiic Infrastructure

Water Resources

Surface water comes mainly from the Moulouya River with an average annual runoff of 800 Mm3. The discharges are regulated by the Mohammed V reservoir (completed in 1967) with an initial capacity of 730 Mm3, presently reduced to a live storage capacity of 400 Mm3 (SGRID, 1996) due to an annual sedimentation of 10Mm3. The Mechraa Homadi Barrage is operational since 1957 with an initial life capacity of 40 Mm3. The sedimentation during the years before the Mohammed V reservoir was completed resulted in a remaining live storage capacity of only 8Mm3.

At Moulay Ali, downstream of the Mechraa Homadi Barrage, a new pumping station is constructed for supplementary supply from return flows and outflow from rocky aquifers between the barrage and the pumping station. It has a capacity of 4 m^3/s and allows theoretically an average annual volume of 100 MCM to be pumped 95 meters up from the Moulouya River into the Triffa Main Canal. This pumping station is operational since April 1995.

Groundwater is developed in all systems except the Zebra plain where no phreatic water is available. The salinity of the groundwater differs from system to system. The Triffa plain is blessed with groundwater of good quality(salinity 0.8 - 2 g/l, SGRID) and sufficient quantity estimated at an annual renewable supply of 70Mm3 (BCEOM-Maghreb Projet, 1995). It is used in times of scarcity and for supplementary irrigation.

The Irrigation Network

The diversity of the irrigation network can best be illustrated by the following classification (BCEOM-Maghreb Projet, 1995):

A: Delivery from Barrage to tertiary level (prise) by gravity:		
A1: gravity distribution up to farmlevel (66%):	Triffa Gravity System	27.511ha
	Bou Areg	10.138ha
	Zebra	5.660ha
A2: pressurised on farm level (1.5%)	Triffa+B.Areg Gravity System	1.107ha
B: Delivery from Barrage to tertiary level lifted by pumping:		
B1: distribution by gravity (11.5%)	Triffa Pumping Scheme	7.482ha
B2: pressurised conveyance-sprinkler (21%)	Garet	13.500ha

The main canals are trapezoidal, concrete lined canals. Water level control is done by fixed or movable regulators. Secondary and tertiary canals are elevated semi-circular prefabricated concreat conduits. Their regulation is done by fixed weirs in combination with baffle distributors as outlets.

Table 4.1 The Irrigation Network (BCEOM-Maghreb Projet, 1995)

	length (km)	capacity max/min (m3/s)	regulators number	type
Main Canals				
Right Bank				
Triffa Main Canal	83.300	18/	26	mixed
Triffa Branch A	15.330	3.0/0.9	9	usc-Duckbill
Triffa Branch B	8.985		11	usc-Duckbill/
Triffa etage 1	15.935	4.0/1.0	6	dsc-Avis
Triffa etage 2	1.870	1.1	0	dsc -pump
Triffa etage 3	4.686	0.55/0.25	2	dsc-Avis
Left Bank				
Zebra	28.575	17/17	6	usc- 5 Amil +1 duckbill
Zebra-Zaio	13.519	4.5/0.8	13	usc- 4 Amil +8duckbill+1 mod
Garet	37.088	6.0/2.16	8	dsc - avis
Boü Areg D	21.740	4.5/0.8		usc-fixed sills
Bou Areg G	9.110	5.5/		usc-fixed sills
Distribution Canals				
Gravity	1416 km	Semi-circular elevated flumes as secondary and tertiary canals		
Sprinkler	320 km			
Drainage canals	364 km	main drains		
	650 km	secondary drains		
Inspection Roads	1115 km			

The Triffa Scheme

The Triffa scheme (36 060 ha) is situated on the Right Bank of the Moulouya. Water is diverted from the right intake (design capacity 18 m^3/s) of the Mechra Homadi barrage in the Moulouya. This intake is managed by the Public Works Department. It consists of a float water level regulator in combination with a battery of baffles. Regulation of intake discharges is done in steps of 500 l/s (capacity smallest gate). From the intake, water crosses the Beni-Snassen ridge via a tunnel of some 12 km length. This tunnel is also within the jurisdiction of the department of Public Works. The authority of ORMVAM starts at the outlet of the tunnel. The right main canal also provides 500 l/s water for sanition and drinking water supply for Berkane.

The upstream part of the main canal has head until the chute at km 18. From there the canal continues with a mild gradient without any drops. Higher areas are served by eight pumping stations. Though designed for 18 m3/s, problems occur if the discharge exceeds 14.5 m3/s. Operation is done in the freeboard and on some locations overtopping will occur. One of the reasons given is the improper functioning of the water level regulators: a mixture of duckbill weirs and automatic upstream, downstream and mixed control gates. The secondary and tertiary canals are elevated semi-circular concrete canals.

Flow Control System

Water levels in the main canal are regulated by a mixture of control structures: AMIL Upstream Control gates, duckbill weirs, Mixed control Neyrpic gates and AVIO Downstream Control Gates.

The regulation of the waterlevel is rather complicated due to the different interventions in the system by different offices during the lifetime of the system. This is regarded as one of the main obstacles for efficient water delivery. For that reason a study is being undertaken by ADI-GERSAR on the regulation of the main canal.

The turnouts to the secondary canals in the main canal are Baffle Distributors type L or C which are supposed to deliver water at a constant rate (± 5%). The turnouts to the sub-secondary and tertiary canals are baffles of type X or XX with the water level regulated by duckbill weirs. The turnouts to (groups of) farmers are modules of type X. Water distribution between the farmers is done by on-off gates in distribution boxes (if available).

There are no measurement devices. Neither scales with minimum and maximum water levels are available. For water distribution, the accuracy of the baffle distributors is for the time being, considered to be sufficient. A calibration campaign is carried out to check the accuracy of these turnouts (*prises).*

Irrigation Methods

The most important irrigation methods used are the traditional "Robta" and "Planche" systems. Most farmers prefer the Robta system: a traditional system where small basins (2m x 3m) with 3 - 5 ridges are made and crops (vegetables and sugarbeets) are planted on the sides of these basins. This system requires permanent attention of the irrigator and his labourers. Moreover, the density of crops is less compared with the furrow systems. A possible reason for the farmers to be hesitant to change to furrows is the cost for the required landleveling. The equipment with skilled operators is however available.

The "Planche" system differs from the Robta in the size of the basin (3m x 8m) and the absence of ridges. The system is mainly used for fodder crops and wheat.

Furrow irrigation is propagated by the CMVs as this method is under present conditions considered the most efficient one in terms of land use (28% higher intensity than Robta), water use and manpower. However farmers are not using the system because of difficulties to manage the furrow discharges, the obligation to use communal irrigation equipment and the insufficient landlevelling

The orchards are irrigated in small basins around each tree. In some places, farmers started with micro or drip irrigation for their tree-crops. The present scarcity of water increases farmers' interest for this technique. In the BG2-3 area, use is made of moveable sprinkler installations.

Table 4.2 Irrigation methods in Triffa (1993)

Gravity	35 032 ha
Sprinkler	828 ha
Micro	200 ha
Total	36 060 ha

3.5 Performance Assessment System

Process to deliver services and use of resources

The basic principle of water distribution in the Triffa scheme is that each landtitle owner (*TF: titre foncier*) will receive a predetermined volume of water per irrigation cycle (Tour d'eau) usually in one but sometimes in two or more gifts. This volume depends on the crop and the time of year. Water is released through an ORMVAM managed turnout (*prise*) to a number of farmers. The farmers take the flow in turn; they take all the water released at a time and for a duration as agreed with the *aiguadier*.

Depending on the water availability and requirement, the management of ORMVAM decides on the implementation of a *tour d'eau* (irrigation cycle), its duration and the unit flow rates for the various crops to be applied. The starting dates of these *tour d'eau* are based on the need for irrigation so they are not fixed.

There is no arranged cropping pattern. Farmers are free to select their crop. Twice a year an inventory (*recensement*) is made of the actual cropping plans per farmer. These are registered and will serve as a basis for future water allocation. The only regulatory mechanism in the cropping pattern is the priority for irrigation of crops in case of water scarcity. Tree crops have the first priority as they represent longterm investments of the farmers. Second in line are the industrial crops which serve as an input for the agro industry, followed by fodder crops for cattle and dairy. Last on the list are cereals and vegetables as they can be purchased on the international market.

ORMVAM developed a list of unit water requirements per crop in cubic meter per month which is converted in duration of delivery (in hours) of the irrigation flow or *main d'eau* (20 l/s or 30 l/s). Reduction of delivery during scarcity periods is done by cutting vegetables from irrigation followed by industrial crops, fodder for cattle and tree crops, by reducing the frequency of delivery and by reducing the unit irrigation rates (*doses*).

For every cycle the *aiguadier* prepares for his area of jurisdiction the FTE form (*FTE = feuille de tour d'eau*) which indicates the start and end of delivery to each farmer (figure 5.2). Then he combines the releases to the various turnouts in such a way that the discharge in the parent canal will become more or less constant. To the accumulation of all water masters' requirements, a certain discharge is added to provide for losses which cover the actual losses. It is therefore

different for each secondary canal. The total results in the discharge to be released at the head of the secondary canal. This discharge varies in time.

The requests are forwarded to the *garde des eaux* (supervisor main canal section - responsible for a certain number of turnouts on the main canal) and the CMV. Before the reorganization the CMV used to requests the Head Office for delivery at the secondary head level. At present the CMVs forward their request to the Sub-divisions which inform SGRID. The operation bureau of SGRID processes the requests of the Sub-divisions and a schedule for release from the barrage is made. This schedule takes into account filling time, emptying time, response time and an amount for losses ranging from 25 - 40% for the whole system. Since 1995 the maximum allocated loss is reduced to 30%. The amounts and times used are all based on experience.

Monthly, after the deliveries, the farmers have to sign a note of acceptance of their share of water. (*Feuille de Controle*). Based on this note, the payments will be determined by the tarification bureau of SGRID. In case of non-delivery to a certain farmer, this farmer gets priority for the next delivery. If non delivery is due to disturbed flows because of damage or maintenance works the farmer will get a receipt or "*Bon de Récuperation*" on which his additional right is officially stated. Additional requests from farmers can only be granted in case of sufficient availability of water. Farmers will then obtain a "*Bon Complémentaire*". Since 1995, the system of additional deliveries has been changed. After the Tour d'eau a small tour *(petit tour)* is added especially for crops which need more frequent irrigation and to allow for additional gifts (if approved).

PROCEDURES FOR THE PREPARATION, IMPLEMENTATION AND EVALUATION OF THE TOUR D'EAU:

(i) Check status of "*Dépositeurs*".
(ii) Inventory by CMV of actual cropping areas and a statement of planned cropping per landtitle or official agreement (*recensement* - twice a year)
(iii) Use of the crop irrigation requirements as determined by SGRID to fix allocations *(doses)* per crop per hectare per *tour d'eau*.
(iv) Determination of the duration of irrigation per landtitle by *Aiguadier* (par tour d'eau) following the fixed rates per crop and per hectare,
(v) Preparation of the distribution plan (FTE) per sector by *aiguadier* and *chef-aiguadier*.
(vi) Calculation of the discharges to be released at the head of the secondary canals by *garde des eaux*,
(vii) Preparation of the operation schedules for the pumping stations,
(viii) Distribution of the operation schedules for secondary canals and pumping stations,
(ix) Preparation of the schedule for releases at the reservoir by SGRID.
(x) Distribution of irrigation notes to the farmers by *aiguadiers*. These notes contain the date and hour of opening and closure of the turnout at their fields, the duration and discharge of delivery.
(xi) Start of the irrigation cycle by opening of the secondary and tertiary offtakes by *garde des eaux* and *aiguadiers*.
(xii) Monthly preparation of the consumption receipts (*FC = Feuille de Contrôle*) per landtitle, sector, CMV and Scheme by SGRID.
(xiii) Verification and signing of FC by farmers.
(xiv) Calculation of system efficiency by SGRID.

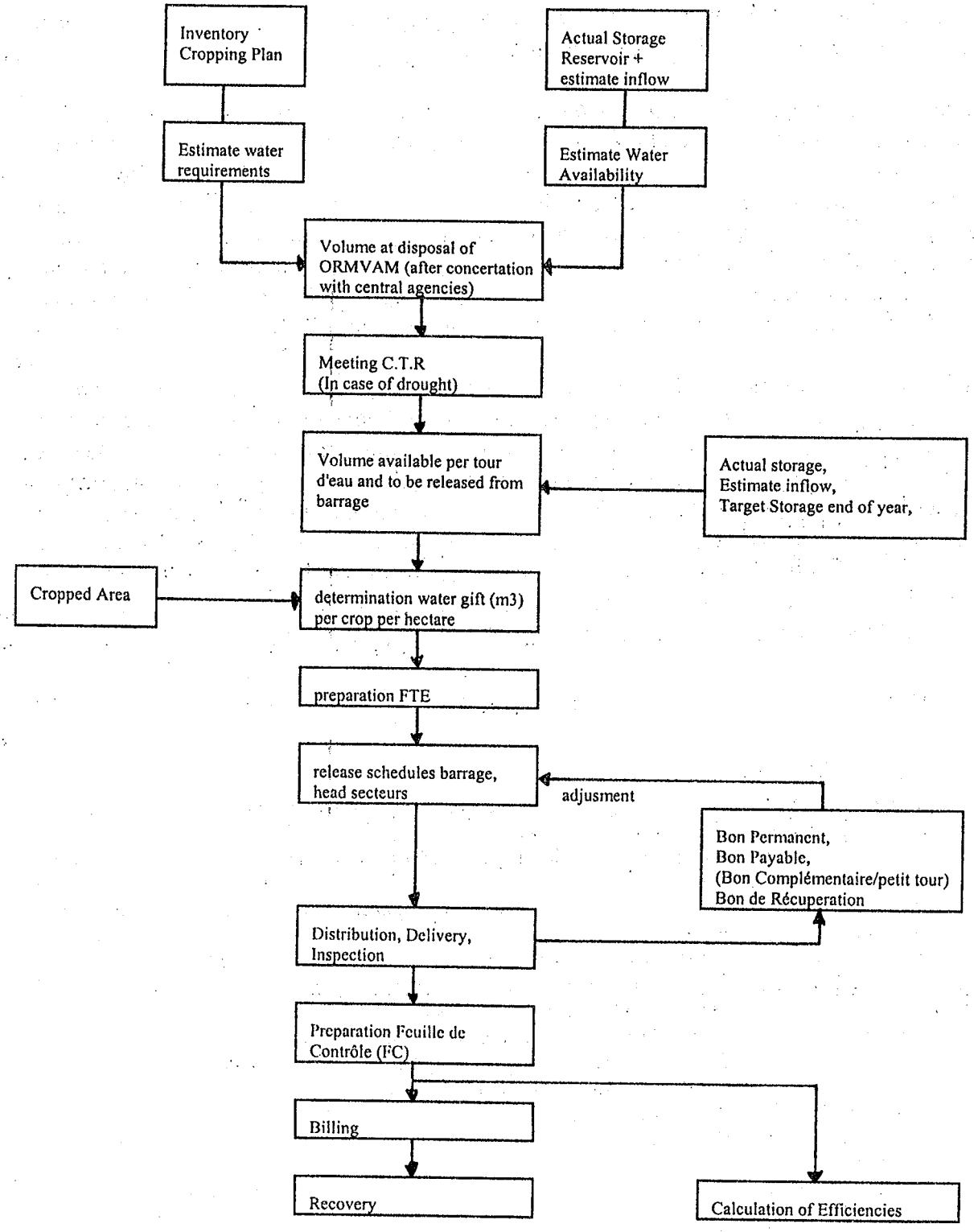


Figure 3 Scheme of Process of Water Allocation, Distribution and Cost Recovery

Identify performance indicators (output-process-impact)

Based on above processes the following indicators are identified as suitable to monitor the performance of ORMVAM related to the water delivery services:

Selection of indicators

Various performance parameters and indicators are being tested on their suitability for performance oriented management. The next sections will describe these parameters. In the discussion on the suitability of these parameters and indicators the following needs to be taken into consideration.

The parameters used must support the management of the organization that collects them. Collection of data involves considerable costs on manpower and infrastructure. If data are to be collected which do not support the objectives and targets of the particular organization, the interest of collecting them will reduce to a minimum. If anyhow these data are to be collected a financial support from those agencies which require these data seems reasonable.

Output Indicators : delivery of services according agreement.

Delivery of Water
- water delivery performance (WDP)
- adequacy

Payment for Services:
- Level of payment
- Collection Efficiency

Process Indicators

Efficient use of resources:
- Water: system efficiency
- Land: irrigated area, cropping intensity
- Labour: agency staff per irrigated hectare
- Finance: cost/ha, cost/m3
- Energy: pumping cost

Effective organisation:
- O&M cost
- Financial Autonomy

Impact Indicators:
- crops: yield, production, productivity (ton/ha, DH/ha)
- Environment: groundwater levels
- Socio-economic: Value of Water

observation network:

Hydraulic Measurements

To quantify the performance parameters many observations have to be made. The question is where and how often as doing additional observations will involve additional investment and operational cost for observation sites, equipment and processing. Therefore, as much as possible use is made of existing data collection mechanisms and observation sites and where found necessary additional observation sites were proposed.

Basic monitoring instruments are the baffle distributors in the turnouts (prises). Here water is delivered to the farmers at an assumed constant rate of 20, 30 or 40 liters per second. The delivery of water is monitored by measuring time and assuming a constant discharge through the Neyrpic Baffle distributors in accordance with manufacturers rating curves. To verify the correctness of this assumption, a survey of actual flows was done for a sample of 30 out of 200 distributors in the S22-S23 sectors. The result was that the average measured flow deviated 3.4% flow the manufacturers specifications. The standard deviation of the difference between measured and specified flows was 9.4%. The maximum deviation was 15% The measurements were carried out with a portable CBR flume. The results are as such that the baffle distributors in the field conditions are sufficiently accurate to justify its use as monitoring tool for delivery of a specified constant discharge.

The time and duration of delivery are monitored through the "*Feuille de Control*" where users sign for the time, duration and rate of supply received.

The amount of water received at the head of the scheme is presntly not measured. The releases from the reservoir are measured at the intake. The transfer point to the ORMVAM is some 12 km. downstream of the intake. Losses between the intake and the transfer point are therefore not identified. Control of these losses is beyond ORMVAM scope as the upstream stretch is under the responsibility of the ministry of Public Works. Construction of an observation site is proposed and approved. Equipment has been provided. However implementation was stopped as the envisaged construction period was longer than three days, the maximum duration the canal can be closed for reasons of water supply to the city of Berkane.

To monitor the effective use of water a monitoring network in the main canal and in secondary system S22 was proposed. An automatic discharge measurement station is installed and operational at the head of the study area S22. Data became available from September 1995 onwards. A second station is built at a distribution point within the secondary unit. Further discharge measurement sites were proposed in the two tail branches A and B of the Triffa Scheme. The designs of measuring weirs have been prepared. Construction is however posponed because of new proposals for major interventions (of-line storage reservoir to reduce response time) at these locations.

Cropped Area and yields

The cropped areas are inventorized twice a year with adjustments for each tour d'eau. The

observations are based on farmer declarations and interviews/inpsections where estimates of areas are made. There is a need for a more accurate inventory of crops and crop areas.

Production of the main crops are measured at the intake points of agro-businesses, cooperatives and sugar factories. Production of vegetables etc. is measured by samples and crop area estimates.

Financial Parameters

All financial parameters are obtained from the regular administration of ORMVAM. To obtain cost of specific activities, a functional administration was introduced.

Prepare procedures for observations and processing

In ORMVAM many data were present prior to the introduction of performance parameters. The processing of these data however required much labour if done manually. The volume of data to be collected and processed became too large to be handled manually. Computerised processing was introduced. A software package was developed which aids the SGRID in planning of water allocations, distribution and billing. With the data already used in these processes some performance parameters could be easily calculated. In addition this programme is designed to minimize the extra work by directly automating the now manually done processes on further processing of the feuille de tour d'eau (FTE), feuille de control (FC) and the facturation.

Introduction of computer aided planning for a performance oriented approach also requires a finetuning of data streams in type, format, timing etc. This demands a review of site specific operations and relations between service provider and client. Strict reporting schedules are introduced for preparation of the irrigation cycles. The data required relate to actual cropping, maximum allowable duration of supply, desired duration of supply and the time and place of supply.

Much of the allocation processes is the result of a consultation process between ORMVAM field staff and farmers. Application of standard reporting procedures must therefore be done with care. Small differences in operational procedures may have a very important reason.

5. PERFORMANCE INDICATORS: USE AND UTILITY

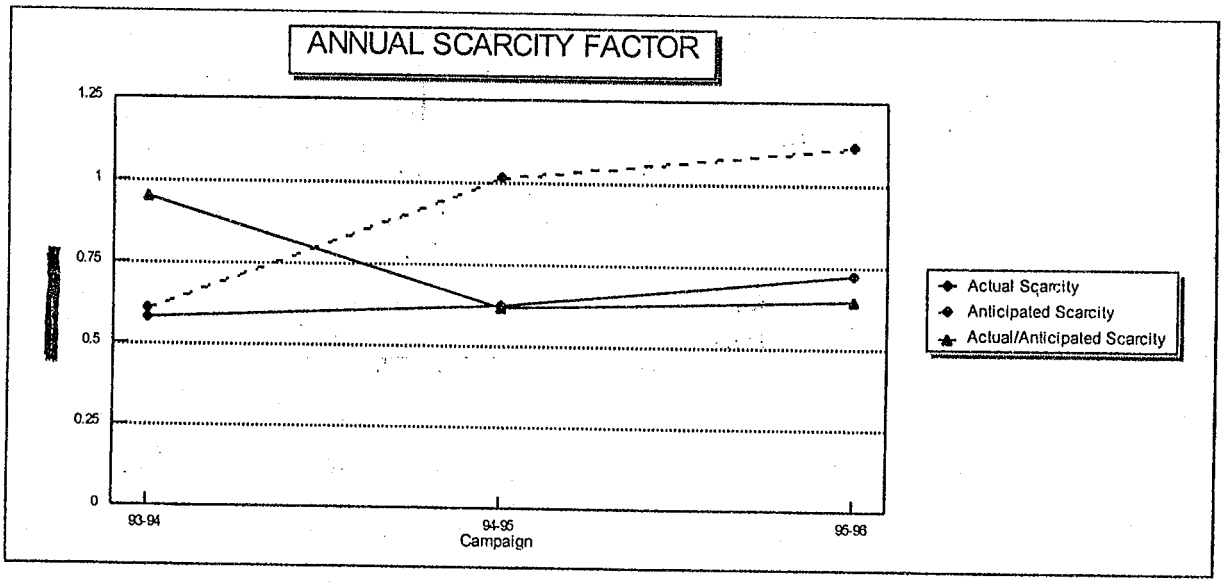
5.1 Conditions

Level of Service

The level of service is defined following the classification given in Chapter 2 (Table 2.1). The delivery of services is based on a request from the users for delivery of a fixed rate for a certain duration. The duration is limited to a maximum based on the kind of crops cultivated. The farmers are hence able to adjust the amount of water to the requirements of the crop. Rigidity is existing in the frequency of the deliveries. A clear distinction must be made between the different irrigation schemes within the Moulouya Basin. The delivery regime in the Triffa scheme is dictated by the capacity of the main canal which is insufficient to alow for a full irrigation of the area with a desired intervals of ten days. A special distribution pattern has developed in the form of main tours directly followed by small tours especially for vegetables. Two sets of tours are hence implemented. The other areas on the Left Bank do not face such constraint. Here strict 10 day intervals or three tours per months are maintained.

The level of service can thus be defined as on request (Class II) with one parameter variable (duration of supply).

Scarcity factor



The scarcity factor is defined as the ratio between the actual volume of water released for agriculture at the barrage and at the pumping station of *Moulay Ali* and the gros volume of water required in the standard year. For a normal campaign SGRID and SPA estimated the net water requirements for the whole system at 476 Mm3 per year. This target volume is further specified for monthly requirements.

The anticipated scarcity level is defined as the ratio between the intended volume for delivery and the gros volume of water required for the standard year. The intended volume to be delivered is determined per campaign in September of each year. It is based on the storage level in the reservoir and a statistical analysis of the inflow for remaining period of the campaign. Since the 1996-97 campaign the volume to be released is a concerted action between the Ministry of Public Works which is responsible for management of the reservoirs, and the Ministry of Agriculture. ORMVAM prepares a proposal based on a cropping plan and storage in the reservoir per 1st of September. The agreed volume will in future be used to determine the intended level of service.

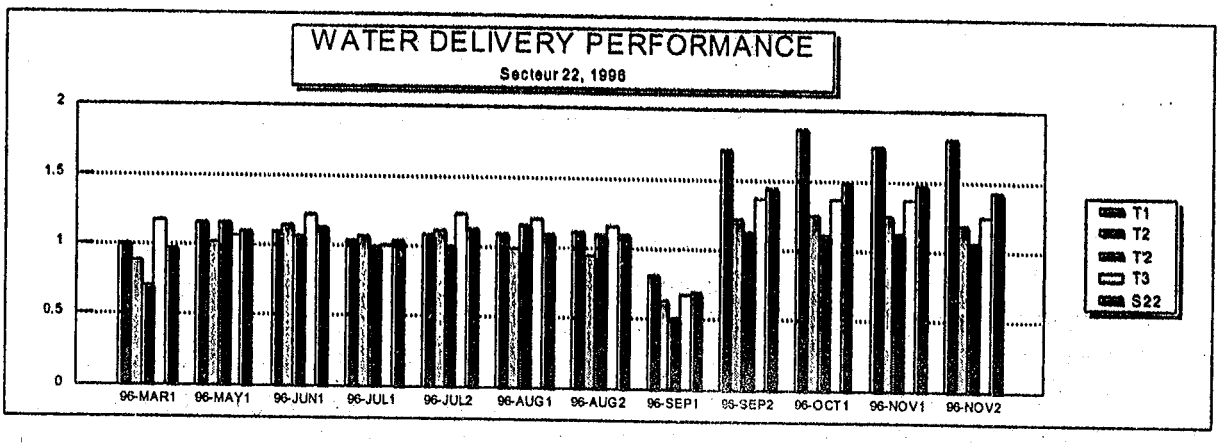
The scarcity factor is gradually increasing due to the regulating volume of the reservoir which is continously decreasing due to sedimentation.

The utility of this indicator is limited. The values of the last year (0.62) means a delivery of water of 62% of the intended delivery. However, this can be either due to shortage of water where no water is available to meet the demand, or due to excess rainfall when irrigation is not necessary. Only in combination with an indicator for water availability or water scarcity can this indicator be of use.

5.2 Ouput Indicators

Water Delivery Performance

Water delivery perfromance is defined as the ratio between the actual and intended volume delivered. With use of the RPIP software package the water delivery perfromance can be monitored upto the offtake level. In the graph the WDP is presented for the sector S22 and its four subsectors T1,T2,T'2 and T3. It can be seen that after september 1996 the deviation in WDP



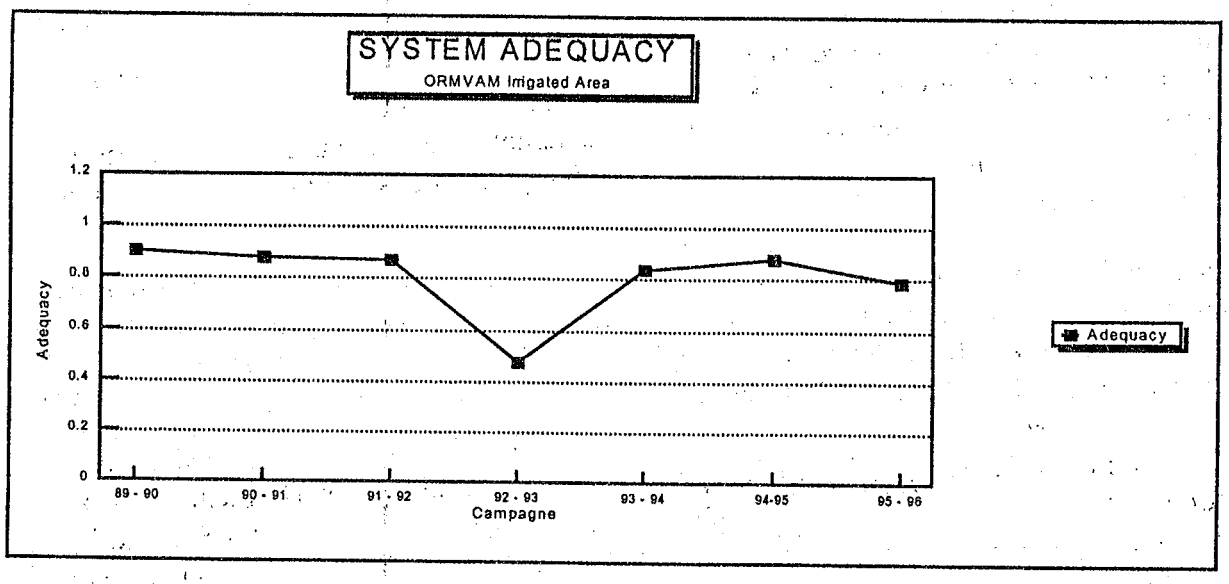
is considerable. This is due to the fact that the data entered as intended value are based on the planned values before the *tour d'eau* starts. This means that the corrections and additions during the *tour d'eau* are not included. However, they are included in the actual deliveries. This deviation now shows that a flexible operation during the irrigation cycles makes monitoring more difficult.

Adequacy

The adequacy is defined as the degree to which the volume to be delivered at the prises to meet crop evapotranspiration is actually delivered.

$$Adequacy = \frac{Actual\ Delivered\ Volume\ (volume\ billed)}{Estimated\ Irrigation\ Requirement\ x\ Cropped\ Area}$$

The gross field irrigation requirements in average years for the different crops available are given in a table based on the Blaney Criddle formula. These deliveries once fulfilled are regarded as adequate. Rainfall is however, not taken into account in this table. The timely and spatial distribution of the rainfall makes it very difficult to establish the effectiveness of rainfall. In the performance sheet, the adequacy is expressed including zero and fifty percent of the annual rainfall as effective rainfall. Further study on effective rainfall is necessary because the occurance of rainfall is taken into account in the decision whether or not to start, reduce or stop a *Tour d'Eau*.



In case of rainfall the farmers can decide not to receive their allocated share of water. The *aiguadiers* are informed and they will reschedule the *tour d'eau*. If many farmers decide not to irrigate, the *aiguadier* in coordination with his superiors can decide to reduce or stop the delivery. The same procedure progresses until the level of the barrage. However, there are no exact figures on when this will happen. The decisions are made based on experience related to irrigation of already wet soils and possible damage to the crop if irrigation is stopped.

At present freeboard at some locations in the canal is 0.15 - 0.20 m if discharge is around 14.0 - 14.5 m3/s. As there are problems with water level regulation, ORMVAM can decide during heavy rainfall, to reduce discharges in the main canal for canal safety. The *tour d'eau* must be rescheduled in such case. Farmers scheduled to irrigate will be alloted a new time period in the *tour d'eau*.

The Cropped Areas are presented in the agreed cropping plan inventory (*recensement*). The *recensement* should be translated into a required volume per campaign per secteur or CMV. This can now be done in the software developed. Adequacy rates are obtained on prise, tertiary, secondary and system level. The actual delivered volumes are identical to the volumes billed.

This adequacy parameter can be determined for different levels: all systems, the complete Triffa system, and on secondary, tertiary and farm level. In PPS-WDP 3a the annual system adequacy level is given based on the estimated water requirements (m3/year), the actual cropped areas (*recencement*) and the actual deliveries (volume billed). Based on these experiences the software is developed which combines the planning process with the monitoring process.. Results are presented in the graph below.

In the determination of these values for adequacy the following assumptions are made:

- effective rainfall is zero as better information on effectivenness of rainfall is presently not available.
- contribution of groundwater not included because no monitoring system is available to observe groundwater abstractions.
- the unit irrigation rates are constant per *tour d'eau.*

Reliability

For the *Tour d'eau* of July 1995 all gate settings (time of opening and closure) were recorded in three sectors: S10, S22, Ain Chebbak. These were compared with the intended opening and closure times as recorded on the FTE and FC. The investigations in the above mentioned sectors indicate that in S22 timeliness is excellent (=1) at the prise level and at farm level. Gate settings are changed exactly in time. To use an indicator to confirm the gate settings is therefore not very effective. A better method is to indicate the not timely delivery. This can be done via the "*Bon de récuperation*", or special random reliability surveys done by the field inspectors.

To enable exact gate setting changes, a detailed release schedule is made for each turnout at the main canal. The discharges are presented in time units of one hour. In figure 6.1 the planned release and the actual release are compared. It indicates that, to fill the system, releases start one hour before the first delivery is made.

5.3 Process Indicators

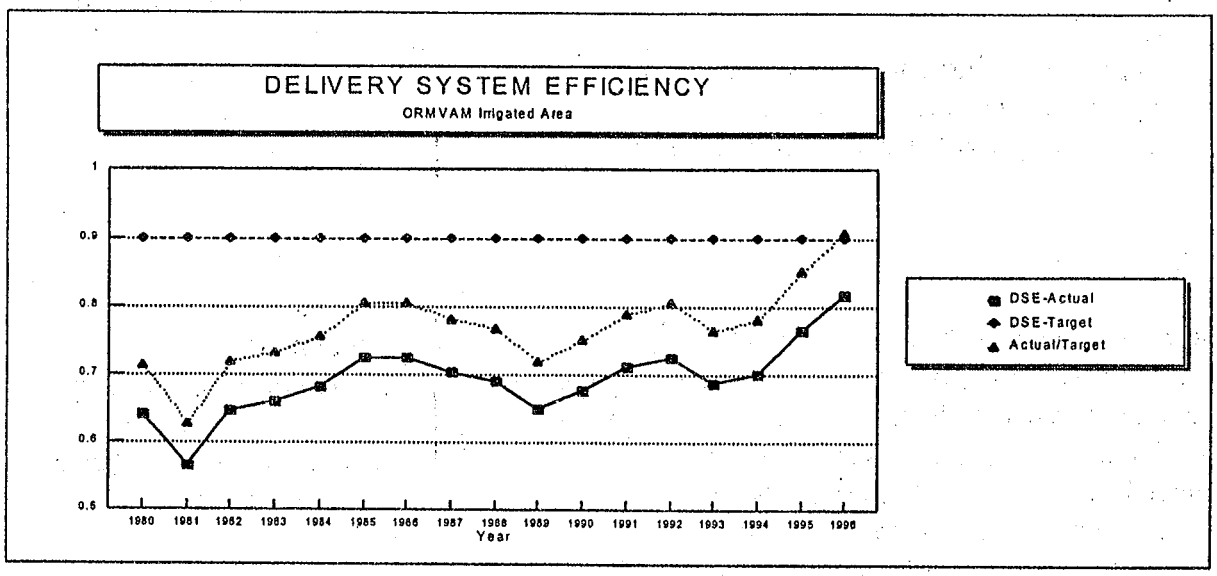
Overall Project Efficiency

The demands for planning of the releases from the barrage are based on the crop water requirements using Blaney-Criddle formula. The availability of water determines how much of the demand can be provided. Because of the relative scarcity of water the demands can usually not be fulfilled. An overall project efficiency as defined by Bos e.a. 1993 of over 100% will often occur. This performance indicator is therefore of no value for the Triffa Scheme.

At present discharge entering the system can not be properly measured due to the nature of the intake which is not managed by ORMVAM. The since 1993 proposed measuring weir can only be installed when the canal is put dry. This was not yet possible.

For the time being, the used indicator of system efficiency is the ratio between the Volume of water billed (= the volume of water received by the users at the turnout) and the Volume of water released at the reservoir for irrigation (for right- and leftbank annualy an extra volume is released for non-agricultural purposes of 31.5MCM) . This is an indication of the efficiency of the main, secondary and tertiary canals under management of the ORMVAM based on the releases published by Public Works.

The volume billed is not the precise volume of water delivered to the users. For research stations and some other purposes water is delivered but not billed. This means that the total water



delivered is a fraction more than the billed volume. The amount is around 1 - 2 percent. However, with the data presently available are inconsistent and for this reason the billed volume will remain to be used.

Another assumption in the facturation is that the discharges at the prises are in accordance with their design values. Measurements are done using a portable broad crested weir designed according criteria of "Flume" package (ILRI 1995). The portable flume is being calibrated at the hydraulics laboratory in Rabat inorder to verify the accuracy of the obtained values (+3.4% deviation with 9.4% standard deviation).

The target efficiency is derived from the system design. For the original design the following efficiencies have been applied: Main Canal 95%, Secondary and tertiary canals 95% and a field application efficiency of 70%. Distribution efficiency is not specifically mentioned but is assumed to be included in the application efficiency. Values covering the distribution and application losses are included in the *doses*.

At present the cumulative discharges at the turnouts (based on table of irrigation requirements) are multiplied with a factor of 1.25 - 1.30 to provide for losses. This means an overall conveyance efficiency of 70% - 75%. The extra water released at the head of the distribution systems is specific for each secteur to cover the specific losses.

Routine collection of the necessary data is already done. The outflow of the system is determined by accumulation of the volumes delivered at the turnouts and confirmed by the farmers on the signed "*feuilles de contrôle*". The inflow is reported by Public Works. The ultimate target values are established in the original design criteria (90%). The until recently used target value of 70% is achieved. Now target values are set to 75% for 1996-1997. This means that besides the measuring weir construction at the head of the system, no additional effort is necessary to arrive at this performance indicator.

Conveyance Efficiency

Main Canal

The main obstacle in determining the conveyance efficiency in the Main Canal is the unreliable measurement of the inflow at the tunnel. It was agreed to provide a measuring weir at the handing over point downstream the tunnel. However , as mentioned above, time was insufficient for construction and interruption of the canal flow is impossible. This activity is posponed for the time being.

The ADI-GERSAR study (reference) indicated an inflow downstream of the tunnel of 12,8 m3/s where a discharge of 14.5 m3/s was released at the Intake of the Barrage. With a lot of assumptions A-G came to an efficiency of the main canal of 81%. This would mean for the canal managed by ORMVAM an efficiency of 92%.

The system outflow as presently used is the accumulated net discharge to be delivered at the prises. Though losses are provided for, these are not included in the report sheet "*débit lâché en tête de secondaire*". Moreover, these discharges include the direct offtakes (P0) which cannot be verified directly unless discharge measurements are carried out.

To determine the conveyance efficiency of the main canal it requires:
- construction of measuring weir at system head
- calibrated turnouts to the secondary units
- improvement of water level control in main canal
- calibrated direct turnouts
- improved reporting procedures

Once these requirements are fulfilled, a data collection and processing activity is required which needs an adjustement of reporting requirements on inflow data to secondary units (see below). This is best done by automatic discharge measurement. For Triffa only already some 35 stations will be required!. The data can be directly analysed using the proposed software. A trial station is installed in S22.

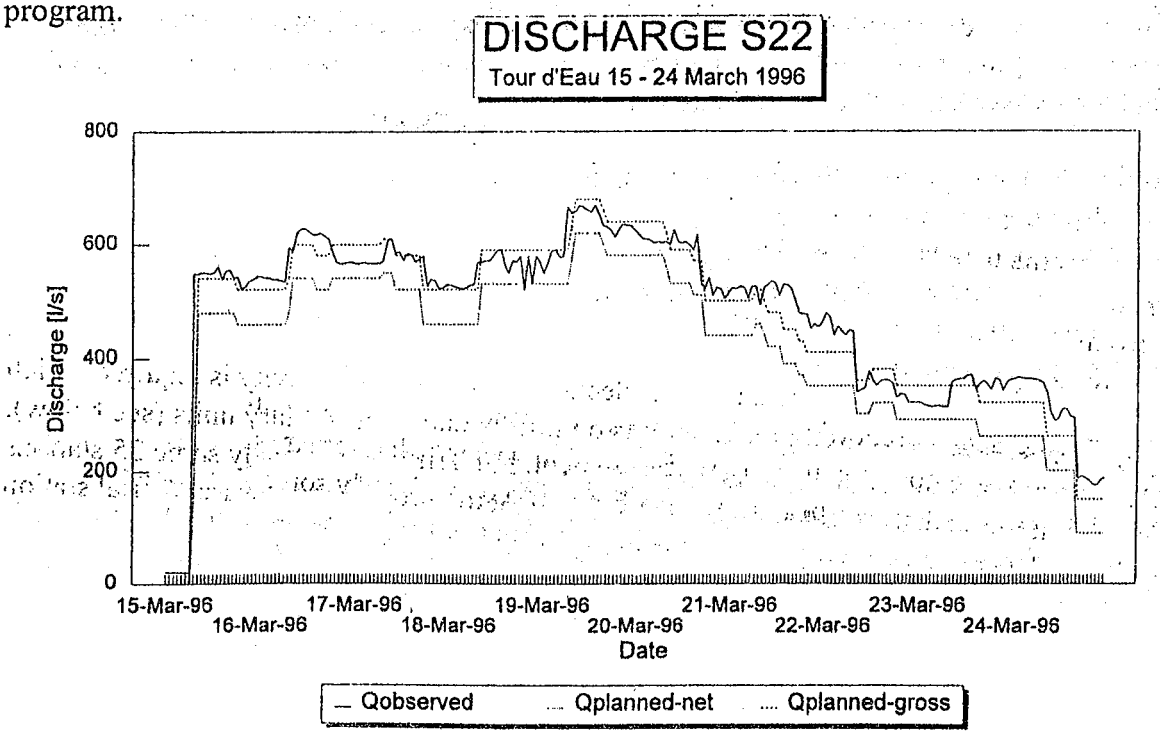
Secondary and Tertiary canal

Sector 22 (2150 ha) has been selected for trials on performance assessment. The inflow at S22 is measured continuously by the newly installed gauging station. At this point an extra 60 l/s on top of the irrigation requirements is allocated for losses. These losses are 20l/s, 10l/s and 30l/s for respectively T1, T3, and the combined T2-T'2 Sub-sectors. Unfortunately, data collection was troubled by debris in the canal which caused malfunctioning of the station. Alterations in the set-up have been made and the observations are made from september 1995 onwards.

The outflow of the system is measured at the turnouts. To check the outflow, duration and discharge of delivery are to be determined. The intended duration is fixed in the *"Feuille de Tour d'Eau* "(FTE). The actual delivery is presented in the "*Feuille de Contrôle*"(FC). For the 1st *Tour d'eau* in July,1994 a campaign is organized to measure the exact duration of the gate openings. It was shown that the timing of opening and closing of turnouts was done correctly in accordance with the FTE and FC. The assumption for water delivery was that the modules operate correctly and water is delivered with a discharge in accordance with the planning. The gauging campaign in the period October 1995- March 1996 of a selected number of modules gave insight in the accuracy of these modules. The portable measuring flumes which have been constructed for this purpose are now being calibrated.

To determine the combined conveyance efficiency of the secondary and tertiary canals it requires:
- construction of measuring weir at the system head
- calibrated turnouts
- regular inspection on timeliness of opening and closure of turnouts.

Once these requirements are fulfilled, a data collection and processing activity is required which needs an adjustement of the reporting system on inflow data to secondary units and the processing of data on water delivery. The latter will be covered in the proposed computer program.



Financial Performance

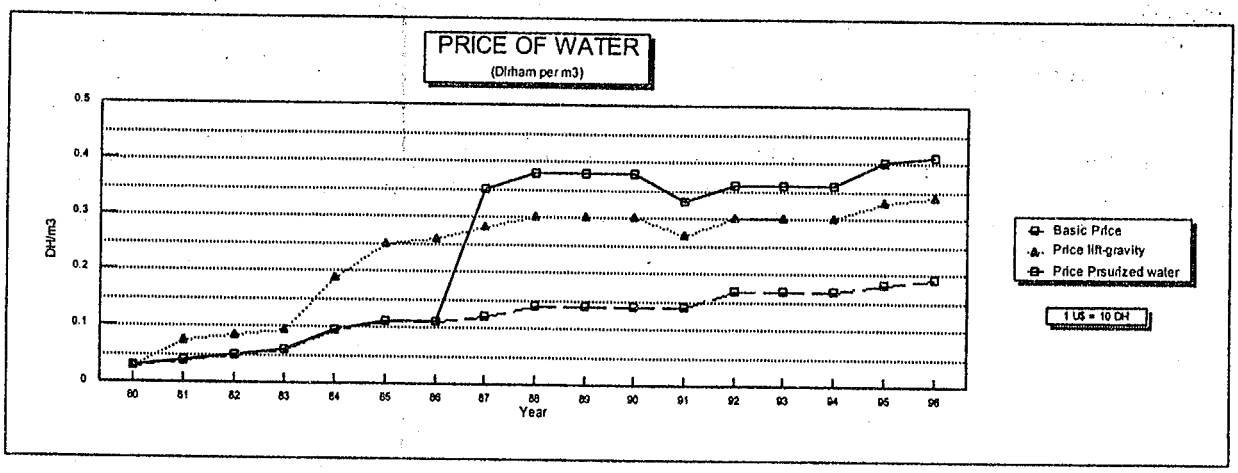
ORMVA's budget

ORMVAM has two main budgets: "*Budget de functionnement*" (BF) which mainly covers the ORMVAM operational costs and "*Budget d'Equipement*" (BEq) which covers the cost of rehabilitation, modernization and maintenance. BF is financed from water sales, direct participation in investment cost by farmers, other incomes and a balance subsidy from the National Government. BEq is financed through the central government and includes loans and grants from external financing agencies as World Bank (PAGI 1, PAGI 2), EC and ADF.

The BF is a general ORMVAM budget which is not specified for the different Services within ORMVAM. Direct allocation of costs for System Management is therefore only possible if a seperation of costs will be made. The management of budgets within BEq is done by different

services. The investment costs for rehabilition and modernization are e.g managed by SEQUI, where the maintenance cost are managed by SGRID. To come to an indication of the degree of financial autonomy of the irrigation and drainage system management, the available budgets must be properly assigned to the system.

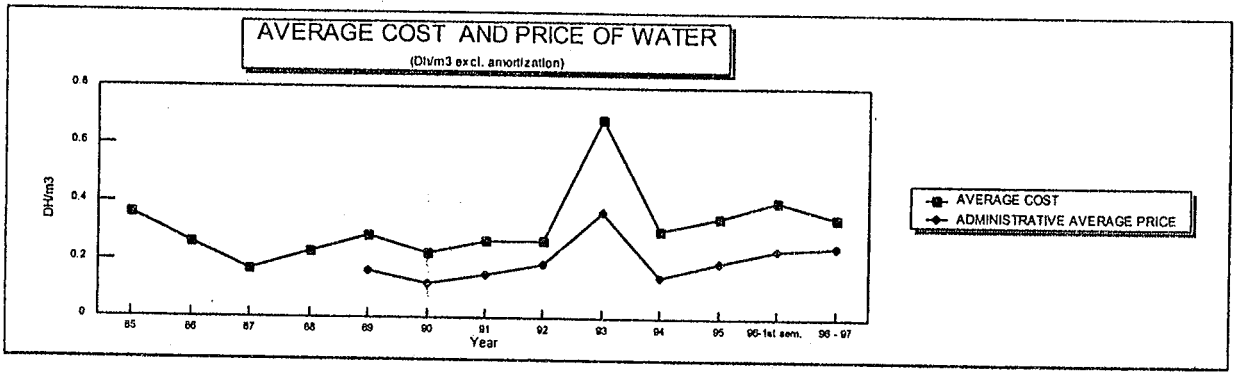
The income of system management is covered by the sales of water and the direct participation in investment costs by the farmers. Both data are available in the "*recouvrement*" sheets at SAF.



The level of irrigation fee is determined by the Ministry of Agriculture. shows the development of the level of the price for water and energy since 1980.

Cost and Value of water

The cost and value of water per m3 can be computed in several ways. The cost is computed by including and excluding central office overhead and amortization cost. Since 1994 SGRID in cooperation with SAF and SPP makes calculations for cost of water for the different areas. At present data used are derived from general accountant figures. However, an analytical



accountability system is being introduced which allocates all cost directly to management functions of the ORMVAM. Only after this system functions well, more exact figures can be provided on the cost of water.

The following components are included in the cost computation: energy cost for pumping stations, maintenance cost of the network, operational cost (incl. Salaries etc) and amortization. The amortization is based on the economic lifetime of infrastructure but not specified for individual structures. One of the reasons is that much of the infrastructure is already developed throughout a longer period of time.

The value of water is difficult to express in monetary terms. One approach can be the gross value of production per volume of water delivered at the farm gate. Using this parameter, the real value of water is overestimated for two reasons:

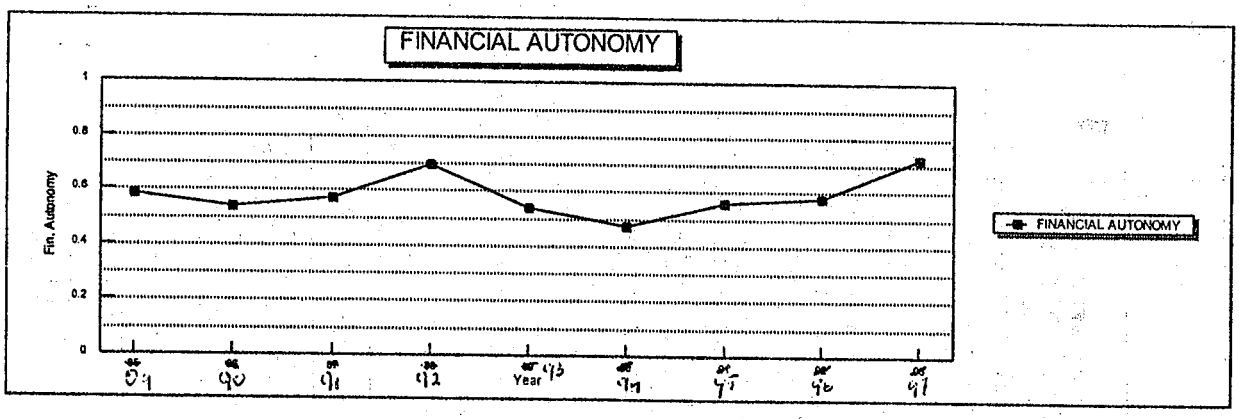
- the value should take into consideration the net value of production
- the value is based on supply from the irrigation system but, especially in periods of scarcity, many farmers use groundwater. Not all production can be assigned to surface water. Determination of volumes abstracted from the groundwater reservoir is not yet possible. Estimates are based on irrigation water requirements and cropped area. Confirmation is obtained via the *aiguadiers*.

Financial Autonomy

The financial autonomy for system management is defined as the ratio between the ORMVAM generated income from water sales and users share in investment cost (*participation directe)* and the total budget for system management.

$$\textit{Financial Autonomy} = \frac{\textit{total income water sales + direct participation}}{\textit{total cost system management}}$$

With the newly introduced accountancy system a specified allocation of budget lines to the management of the irrigation and drainage infrastructure has become possible. These includes actual operational costs and amortized values of capital costs.



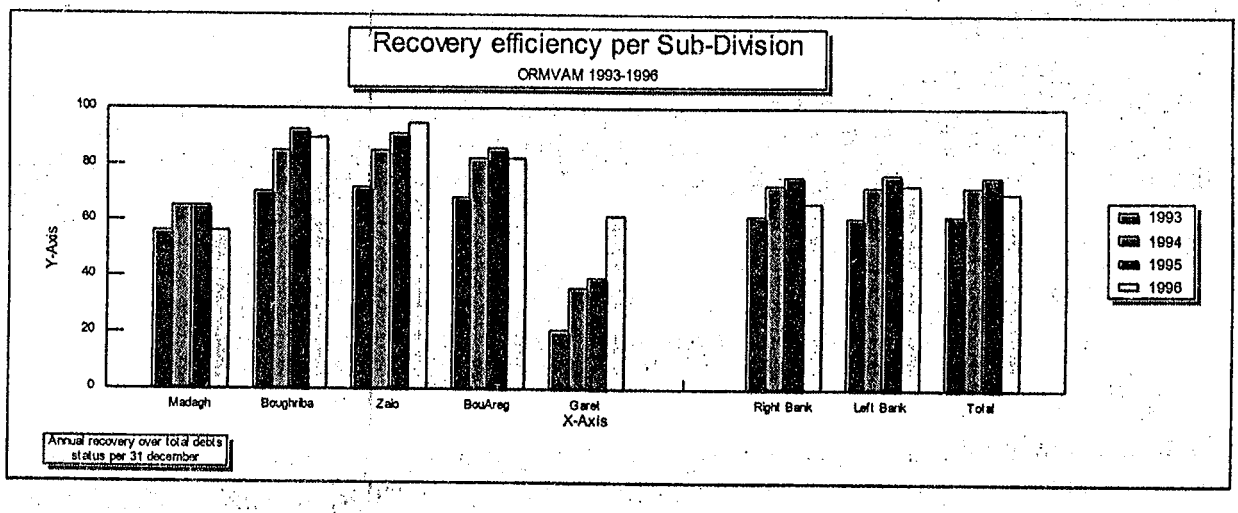
If used on a annual basis, this indicator will give big fluctuations because of the variability of the water sales (especially the "Billed Volume") and the relative constant price of water. In dry years a low level of autonomy will be found whereas in years where water was no constraint, a relative

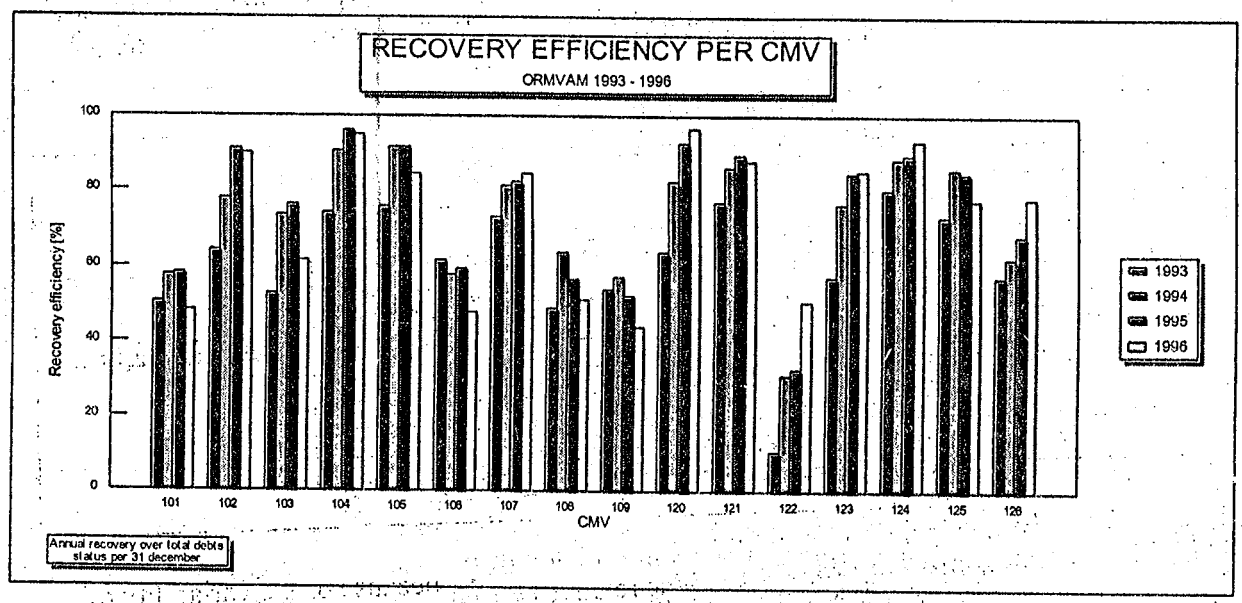
high level of financial autonomy can be reached. It is therefore suggested to have a definition of level of autonomy using a progressive average for a period of say five years.

The cost of system management are related to the funds available. At present the level of maintenance (mainly curative) is below the required level (curative and preventive). This might indicate a higher level of financial autonomy than is actually the case. A better denominator could be the total required cost for system management. However, this is at present difficult to establish.

Fee Collection Efficiency

Fee collection consists of recovery of water sales and direct participation (part of investment costs). ORMVAM is using the ratio between emissions and recovered sum. Since 1994 the indicator is used at ORMVAM level but also at more specified CMVs level.



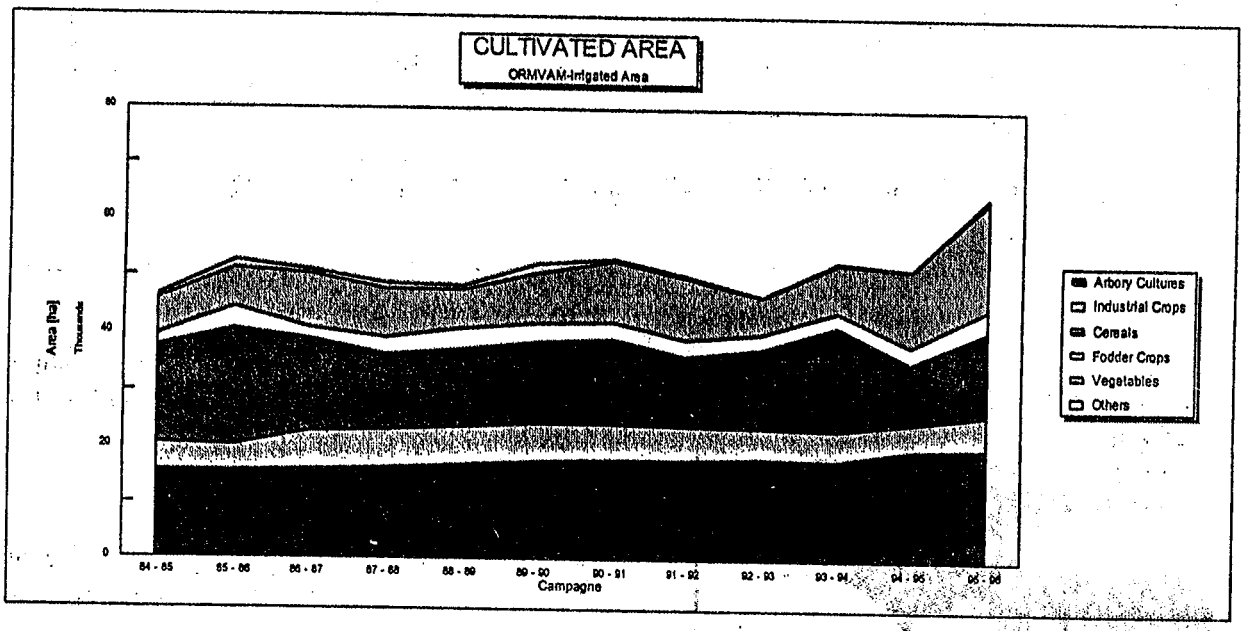


5.4 Impact Indicators

Agricultural Performance

Cultivated area

The main crops in the Moulouya Irrigated area are arboricultures, industrial crops, vegetables and wheat. Citrus, sugar beet and patatoes are the most important ones. Crop areas are obtained from the inventory of cropping plans (*Recensement*). The accuracy of these data depends on the reliability of the data provided by the water users. Development of remote sensing techniques for crop surveys might be a viable option for the near future.

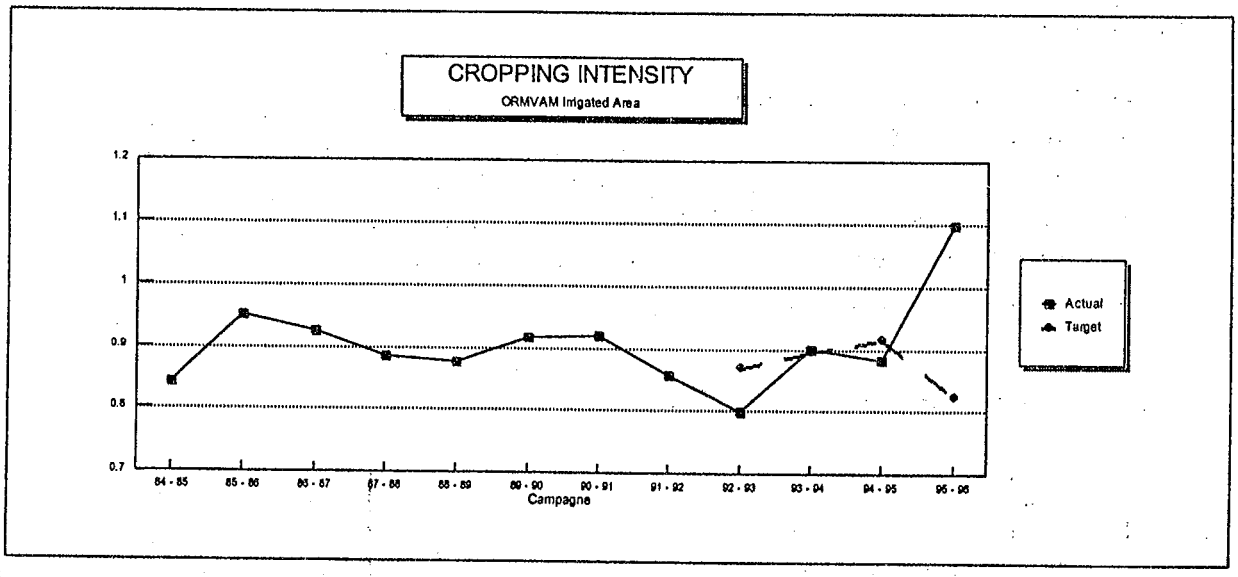


The value of the parameter is presented for the whole area and clearly shows variations over the years. The arboricultures do not show any important fluctuations due to constrained availability of water. PPS - AP 1 shows clearly that effects of drought are to be found in the vegetable and wheat areas. During the drought of 92-93 farmers moved from vegetables to wheat which is more economic in water use. The vegetable area is thus an interesting indicator for monitoring of the impact of water delivery on the crop production. This also confirms the water delivery policy which in case of scarcity relates the delivery to the priority of crops. Vegetables are of low priority because of their relatively high consumption of water.

Cropping Intensity

Cropping intensity is defined as the ratio between actual cultivated area per year and developed area defined as the net irrigable area. The value of this indicator must be intepreted with caution. The area with perennial crops is 30 % - 40 % of the total cultivated area. and not very sensitive

to fluctuations in water availability. The effect of water shortage is also clearly shown in the cropping intensity in PPS - AP1 where area variations are found in crops like vegetables and wheat.

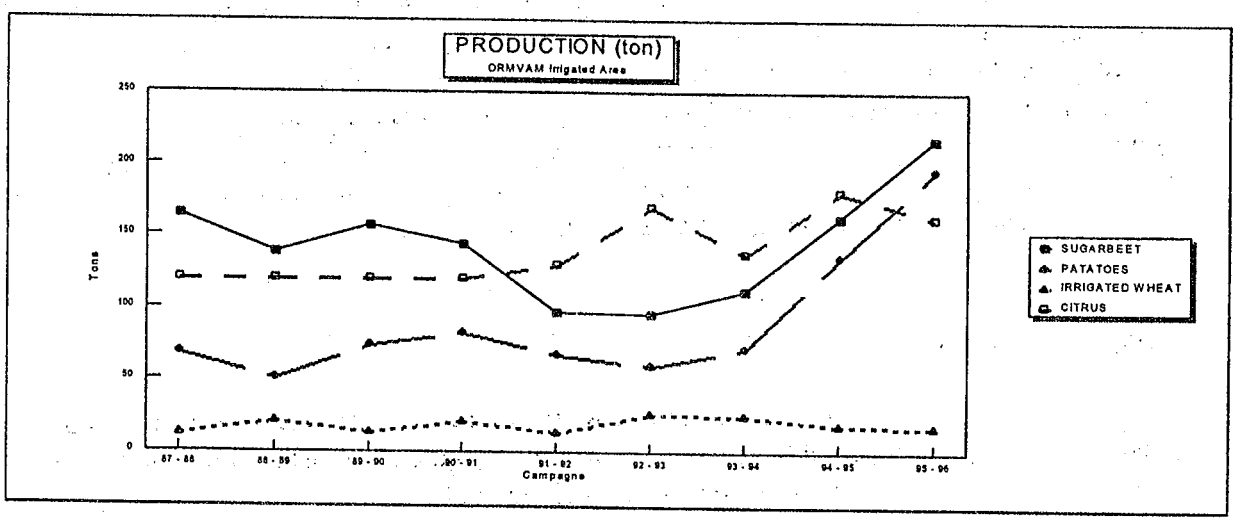


The total gross area developed is 65.398 ha. The net area after system development was completed was 58,710 ha. However, at present part of the area is taken out of production due to urbanization, or other uses of land. The reduction of productive land is recognized and an inventory of presently productive or potentially productive area is being made.

The target level for cropping intensity uses the ratio target production area over original net area. These are reported annually in the provisional water delivery programme at the beginning of each campaign.

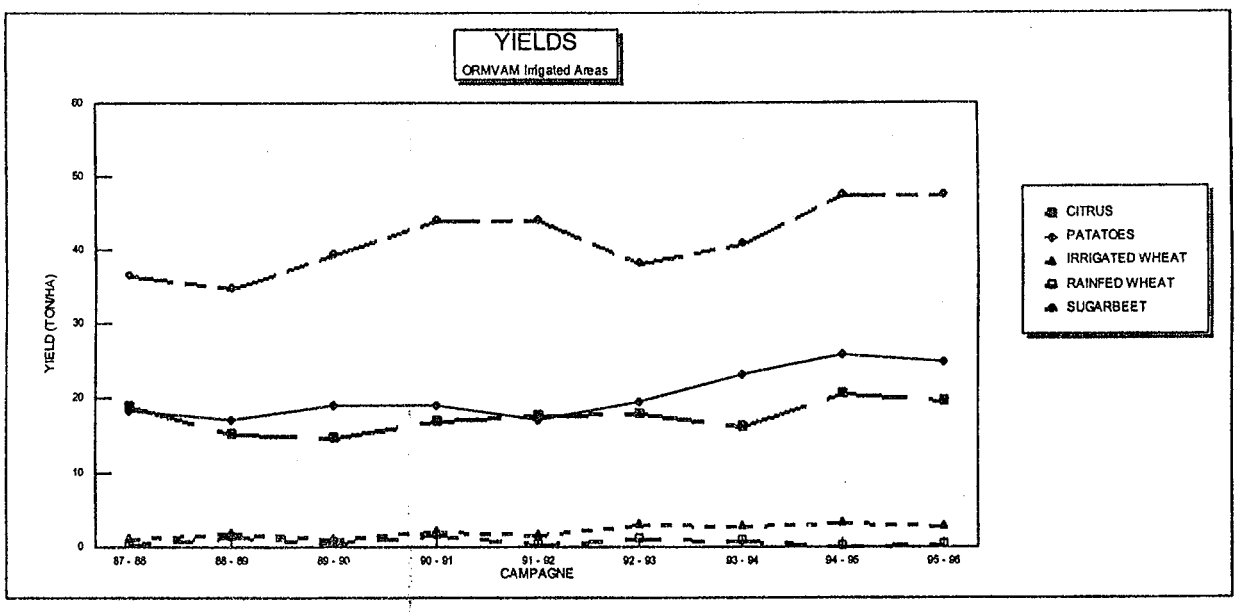
Production

Production is defined as yield multiplied by productive area. Production figures of the important crops are obtained from cooperatives, sugar factories etc.



Yields

Yields of citrus, sugarbeets and patatoes are derived from the production figures. The yields of vegetables and wheat are estimates based on samples and interviews. The accuracy of these data is questionable. Further investigations are required to improve the reliability and accuracy of these parameters. To allow analysis of the influence of water management on the yields, relative yields are introduced. The relative yield is the ratio between the actual yield and the average yield over a certain representative time period. Relative yield must be used with caution as the



variations can also be caused by other factors than water (e.g. disease, changed varieties, market situation).

The analysis on the effect of rainfall on yields shows that for citrus and patatoes no important trend can be distinguished. For irrigated wheat and unirrigated wheat the trends are clear. The yield of wheat cultivated in the irrigation scheme tends to increase with increasing rainfall because farmers minimize irrigation of wheat.

Environmental Performance

Data have been obtained on groundwater levels in the Triffa scheme for a period of 20 years by DRH (*Direction Régionale de l'Hydraulique*) . There is not yet a routine exchange on these data with ORMVAM but if requested they will be provided.

Water quality surveys in wells have been carried out during the extreme drought in 1993 to determine the priority of well owners on water deliveries. Farmers with wells with saline water were allowed to mix with irrigation water. Farmers with wells with fresh water were denied or reduced surface water supplies. The data are now under processing.

CONCLUSIONS

1. Introduction of performance oriented irrigation management (POIM) requires a commitment of all parties involved directly or indirectly in the management of irrigation systems. This commitment should be supported by financial means and legislative action.

2. POIM consists of a multitude of service relations and services. These service relationships and the services to be expected require a clear definition. Service agreements or service declarations should be established with clear definition of levels of service provided, payment for services and accountability mechanisms.

3. PIOM is about reliable delivery of agreed services and therefore demands effective accountability mechanisms. This requires a transparent system of planning and implementation of water deliveries, cost allocation for services and price setting mechanisms. Often a radical change in financial administration is required to cope with these needs. It also requires the facilitation of an easy access to legal action for the users of the systems.

4. POIM involves collection and processing of a large volume of data. Effective use can be made of information technology by development of site specific software packages.

5. POIM involves adjustments in relations, application of technology and operation procedures. It also requires a change in attitude of managers and staff members. Human resource development programmes including training programmes are required to familiarise operators and users with the new situation, to introduce the programmes and to commit and motivate staff members.

6. PIOM involves major cost due to modifications in administration, operations and public relations, HRD programmes and employment arrangements. It also involves changes or adjustments in hardware in setting up of monitoring systems.

7. Once started, PIOM triggers a continuous cycle of improvements on management procedures and infrastructure.

8. The introduction of POIM in ORMVAM has resulted in an increase of agricultural output per unit of water and per unit of land, an increase of water sales and water use efficiency and an increase of revenues and collection rates. The increase in income allows ORMVAM to invest in areas like preventive mainenance and automation of information streams.

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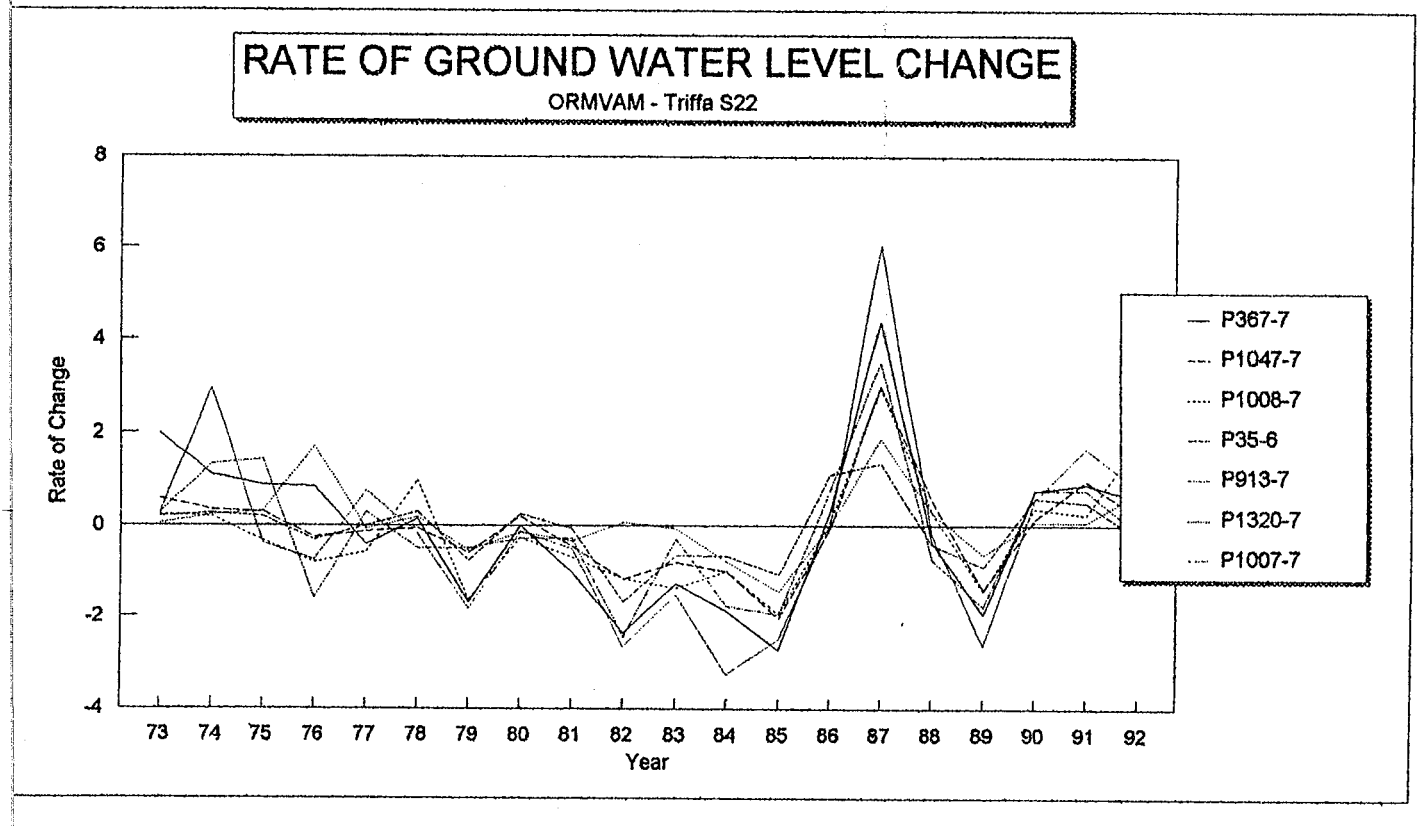
GROSS VALUE OUTPUT ORMVA DE LA MOULOUYA

	93-94	94-95	95-96	96-97	
CCA ORMVA- Moulouya	58710	58710	58710	58710	ha
Reference World Bank price wheat	167.00	167.00	167.00		U$/t
Volume of water released for agriculture	274.10	296.70	343.90		Mm3
Volume of water delivered at parcel	237.00	229.00	267.00		Mm3
Eff:	0.86	0.77	0.78		
Standardized Gross Value of Output	73.00	70.00	140.00		Million U$
Output/unitland	1123.00	1570.00	2520.00		U$/ha
Output/ net unit irrigation supply	0.31	0.30	0.52		U$/m3
Output/ gross unit irrigation supply	0.27	0.23	0.41		U$/m3
Cost of Irrigation	6.80	7.30	8.00		Million U$
COI	115.82	124.34	136.26		U$/ha
	0.025	0.025	0.023		U$/m3
COI/GVO	0.103	0.079	0.054		

PERFORMANCE ORMVA DE LA MOULOUYA

MAIN INDICATORS		1993	1994	1995	1996	1997
WATER USE EFFICIENCY		0.69	0.70	0.77	0.80	
PRODUCTIVITY OF WATER (gross value!)	U$/m3	0.27	0.23	0.41		
PRODUCTIVITY OF LAND (gross value!)	U$/ha	1123.00	1570.00	2520.00		
COST OF WATER	U$/m3	0.069	0.031	0.035	0.041	0.035
FEE COLLECTION EFFICIENCY		0.61	0.72	0.76	0.70	
FINANCIAL AUTONOMY		0.54	0.47	0.56	0.58	0.72
CROPPING INTENSITY		0.80	0.90	0.88	1.10	
AVAILABILITY OF WATER		0.58	0.63	0.72		
COST OVER INVESTMENT	U$/ha U$/m3	115.82 0.03	124.34 0.03	136.26 0.02		


RATE OF GROUND WATER LEVEL CHANGE
ORMVAM - Triffa S22
Rate of Change
8
6
4
2
0
-2
-4
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
Year
P367-7
P1047-7
P1008-7
P35-6
P913-7
P1320-7
P1007-7