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Aït-Kadi M.

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Mohamed Ait Kadi

Introduction: the Irrigation Sector in Morocco

Irrigated agriculture has a high priority in Morocco, to meet the needs of its rapidly growing population and to expand export both of commodities and processed agricultural products.

In Morocco, there are approximately 7.7 million hectares of arable land of which 1.6 million ha are potentially irrigable (1.3 million ha of perennial irrigation and 300 000 ha of seasonal irrigation), water resources availability being the limiting factor. As of now, irrigation accounts for 88 % of the water use compared to 8 % for domestic use and 4 % for industry.

Government policy in the agricultural sector has always favored investments in the irrigation subsector. These investments have accounted for more than 60 % of the total public investments in agriculture since 1965. The goal is to put under perennial irrigation one million hectares by the year 2000. This is referred to as the "million-hectares" policy.

The whole irrigation subsector currently contributes 45 % of the agricultural value added and produces 75 % of the agricultural exports. In addition to boosting food production, irrigation development has also increased rural employment, promoted agroindustry and helped stabilize domestic production. It has also raised productivity and incomes significantly by bringing modern agriculture to small farm families and in several areas, has reversed the flow of people from rural to urban areas while contributing to natural resources conservation by relieving the pressure on areas with fragile ecology.

There are both Small and Medium Scale (SMI) and Large Scale (LSI) irrigation systems. The SMI projects range from few to several thousand hectares. They are mainly traditional systems some of which have been developed for centuries. Traditional water organizations in some form or

Président, Conseil Général Dévelop. Agricole (CGDA) Ministère Agriculture - Rabat, Maroc

other exist. SMI projects represent a potential of 510 000 ha of perennial irrigation and 300 000 ha of seasonal irrigation. Increasing attention has been given since the mid-1980s to improving SMI through rehabilitation and betterment. In 1990 a law was promulgated which provides a legal basis for irrigators to establish Water Users Associations with full responsibility of managing their systems. This law devised also a system whereby government irrigation authorities would enter into agreements with local water user associations to recover part of the investments costs. Water charges are generally fixed on an adhoc basis. Collections are generally made for payment of ditch riders, pumping energy, maintenance expenditures, etc... An interesting dimension at SMI perimeters is the existence of water markets since often water and land are not tied to each other. Water rights are sold on a seasonal basis. SMI projects contribute significantly to improving water use efficiencies at the basin level. Efforts are still necessary to increase cropping intensities and yields. The Government regards the development of SMI as a mean of alleviating rural poverty through the creation of agricultural production and services activities generating incomes and employment.

Morocco has made modern, large scale irrigation the centerpiece of its irrigated agricultural development and has rapidly built or modernized nearly 500 000 ha out of an LSI potential of 850 000 ha. LSI projects represent new investments in major civil works for water regulation, conveyance and distribution systems (including on farm) using modern technologies. There are nine LSI perimeters developed in the major river basins of the country. Each LSI is developed and managed by a regional irrigation and agricultural development agency called ORMVA. The ORMVAs are responsible for the design, construction , operation and maintenance of the irrigation networks. They integrate all the productive services required by farmers under one management structure. They provide assistance to rainfed farmers and those dependent on traditional irrigation located under their jurisdictions. ORMVAs are semi-autonomous organizations. Administrative and technically they are overseen by the Ministry of Agriculture, Rural Development and Fisheries and financially by the Ministry of Economy and Finances. Each ORMVA has its own budget.

Major Features of the Large Scale Irrigation Policy

In order to promote the rational use of its water resources and to overcome the constraints related to the situation of its peasants, Morocco has adopted an "interventionist" type of irrigation policy for LSI development. The basic philosophy of this policy is that "to attain the

desired objectives, it is not sufficient - as it has been done in the past - to construct irrigation infrastructure as rapidly as possible, the State must also create the conditions enabling development to take place". A comprehensive framework for this policy is defined by a variety of laws grouped in the "Code of Agricultural Investment" of 1969. This Code is regarded as a contract between the State and the farmers to build the national economy through irrigation development:

- The State pays for the dams, the irrigation network and necessary on-farm development. It provides credit, selected seeds, fertilizer, farm equipment etc...Finally, it guaranties the prices of certain crops (mainly sugar beet and sugar cane) through contracts.
- In turn the farmer is obligated to farm his irrigated land in the national interest, to follow the norms imposed for his hydraulic sector, and to repay the State 40 % of the investment costs and 100 % of O&M costs through a land improvement tax and volumetric water charges.

It is important to note that this concentrated comprehensive development effort in LSI perimeters is mainly dictated by the efficient and productive use of scarce water resources for the benefit of the country as a whole. It is to be achieved:

(i) technically through:

(1) defining cropping patterns that optimize the use of the available water resources taking into consideration local conditions and national planning goals of food security; and

(2) designing a model for land consolidation and the irrigation system layout known as the "Rationale Layout" which is unique and incorporates three important complementary features: (a) equitable and efficient water distribution by using state-of- the- art irrigation technologies and designing irrigation systems to supply crop allocations rather than farmers; (b)annual and seasonal crop diversity according to the mandatory cropping pattern; (c)accommodation of wide variations in individual land ownership patterns in such a way that limitations in the size of individual land holdings are not obstacles to the adoption of modern technologies both for irrigation and farming practices.

(ii) institutionally through:

(1) providing a comprehensive framework for conclusion of crop contracts and for price supports and subsidies and

encouraging cooperative arrangements to stimulate agricultural productivity;

(2) providing a legal framework for significant cost recovery of both investments and O&M costs;

(3) integrating under one management structure all the activities related to design, construction operation and maintenance of irrigation networks as well as all the agricultural support services required by farmers.

It appears therefore that the irrigation policy in LSI development has been designed as a " coherent whole ". Its merit lies in the holistic approach adopted. But this comprehensiveness is also a source for its weakness as if one component of the chain is missing " the whole " may loose its merit.

Irrigation Water Pricing

The Agricultural Investment Code provides a legal and institutional framework for significant recovery of both investment and operating costs in irrigation. It calls for full recovery of O&M costs and up to 40 % of initial investment costs. Three types of charges are established. Thus, farmers are expected to pay:

1. A Land Betterment Levy

A fixed betterment levy which covers 30 % of the original investment cost. The first five hectares of holdings of less than 20 hectares are exempt from this charge. Land betterment levy may be paid in 17 years at an annuity rate of 4%;

2. A Volumetric Charge

A Volumetric charge is intended to cover 100 percent of O&M costs , 10 percent of original investment cost and 40 per cent of replacement cost. Thus, this charge, VC, is computed as follows:

$$VC = (OE + ME + 10\% \ I + 40\% \ R) / (V * PF) \quad [1]$$

where:

OE = present worth value of total operation expenditures;
ME = present worth value of total maintenance expenditures;
I = original investment cost;
R = Present worth replacement cost; and
V = annual volume of water delivered
PF = present worth factor

O&M expenditures are fixed as a percent of the initial investment cost according to given engineering standards.

VC is computed for each irrigation sector as completed. The Code provides for progressivity of charges during the early years of irrigation. This progressivity is over 5 years with a 20% step for annual crops and it runs over 10 years with a 10% step for orchards. In addition, discount coefficients can be applied to take into account different conditions of water delivery. These coefficients are as follows:

- 0.3 if the farmer diverts water directly from the river, downstream a dam, without using the public infrastructure;
- 0.8 if the secondary and tertiary canals are not concrete lined
- 0.8 if farmers take in charge the maintenance of the secondary and tertiary canals;
- 0.8 if water salinity can reduce yields for the crops foreseen in the mandatory cropping pattern.

Furthermore, the volumetric charges are regularly revised to take into account the inflation. A formula is used for indexing the charge to the inflation rate in the construction sector. Prices are adjusted whenever the computation leads to an increase greater to 5%.

A farmer is charged for a minimum volume of water equal to 3 000 m3 per hectare per year. In accordance with the obligation of farming his land, the farmer has to pay for the corresponding amount whether he has used the water or not.

3. A Pumping Charge

A supplementary charge adds to the above charge to cover the energy cost for pumping wherever applicable. Initially, the Code specifies that this charge is applicable if water is lifted from an irrigation main canal to supply a public water distribution system and / or if water is put under pressure for a sprinkler irrigation system.

Figure 1 gives an example of water charges in three different situations: (i) surface systems; (ii) surface systems requiring lifting water to canals and (iii) sprinkler systems.

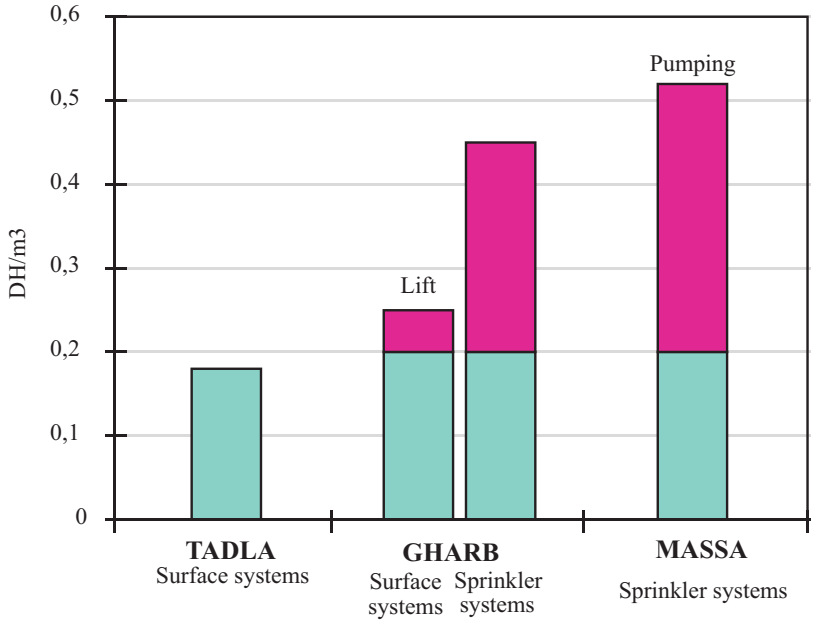


Fig. 1. Example of water charges in 3 different situations

Experience With Present Pricing Methods

The rate of collection of volumetric water charges has increased steadily. It varies now across ORMVAs between 70 and 95 %. But, recovery via the betterment levy is constrained by land tenure problems often due to inheritage and the vast number of landholdings (80%) that are less than five ha in size.

Despite the Code comprehensive framework for cost recovery in LSI perimeters current water charges represent only 25 to 50 % of the actual water prices derived from the procedure fixed by the law. Table 1 illustrates this situation.

Table 1. "Current" and "actual" irrigation water prices

Perimeter	P1 Dh/m³ (1)	P2 Dh/m³ (2)	P3 Dh/m³ (3)	P4 Dh/m³ (4)	Difference (3) - (4)	% (3) / (4)
Massa	0,058	0,230	0,19	0,753	-0,563	25,2
Issen	0,380	0,750	0,52	1,026	-0,506	50,6
Garet	0,058	0,196	0,19	0,642	-0,452	29,6
R'mel	0,058	0,183	0,19	0,599	-0,409	31,6
Drader	0,088	0,208	0,19	0,681	-0,409	27,9
STI Gharb	0,058	0,106	0,19	0,347	-0,157	54,7

P1 = water price adopted at the start of irrigation.
P2 = water price derived from the code for the sector.
P3 = Current water price.
P4 = updated value of P2

A number of distortions have been brought to the pricing method as prescribed by the Code. They relate mainly to policy options geared towards keeping water prices low to encourage farmer to irrigate their lands in the early stage of irrigation development. Hence, water prices have not been changed during the period 1969 - 1980 . Adjusting tariffs to take into account inflation has effectively entered into practice in 1983.

It was also sought to maintain water prices at the same level among irrigation perimeters. Indeed, the effect of fixed producer prices, at national level, for crops such us sugar beet, sugar cane and soft wheat prescribed in the mandatory cropping pattern has been often used as an argument to seek homogeneous water charges across LSI perimeters. This has led to the adoption of charges used in the existing projects that are far below those computed according to the law for new projects. It was difficult to make up for these distortions later on since the only possible increase of water charges provided by the law is indexed on inflation. However, since 1969 is about 7% per annum.

In 1980, as Morocco was entering into the Structural Adjustment era, a decision was made to double the water prices across the country.

Another issue related to the application of the provisions of the Code concerns the recovery of the pumping charge. Indeed, recovery of this charge became effective only in 1983. Furthermore, in many instances feasibility studies have often favored options of using the river as a conveyor of the water released from the dam and pumping it at appropriate sites to supply water to irrigation sectors unstead of building a conveyance canal. In these situations as per the code, energy costs are not recovered from the farmers as pumping is considered a design option. Energy bills are then paid by budget transfers to the ORMVA.

Table 2 gives an example of the budget transfers to 3 LSI projects during the period 1980 - 19990. It shows the importance of the transfers to the Loukkos project which is a highly energy intensive project. Of course, these transfers result from the combined effect of both underpricing irrigation water and a relatively moderate rates of collection of water charges in these three LSI which vary between 45 and 75%. These transfers would be even greater if the ORMVA followed adequate maintenance practices.

Table 2. Budget Transfers for 3 LSI projects (MDH)

	Moulouya (67 000 ha)	**Gharb (86 000 ha)**	**Loukkos (16 000 ha)**
Recurrent expenditures	297 123	636 792	817 008
Total collection: Water charges + energy tax	209 956	336 511	287 794
Transfers to cover: Recurrent charges	87 167	300 280	529 214
DH/ha	1 301	3 500	33 000

In fact, in the early stages of development of irrigation in LSI, water charges were kept purposely low as part of a general price policy in the agricultural sector. At present water charges, most ORMVAs still need Government financing to close the gap between billed charges and actual direct costs of water. Figure 2 shows the balance between the amount recovered from water charges and the total O&M expenditures.

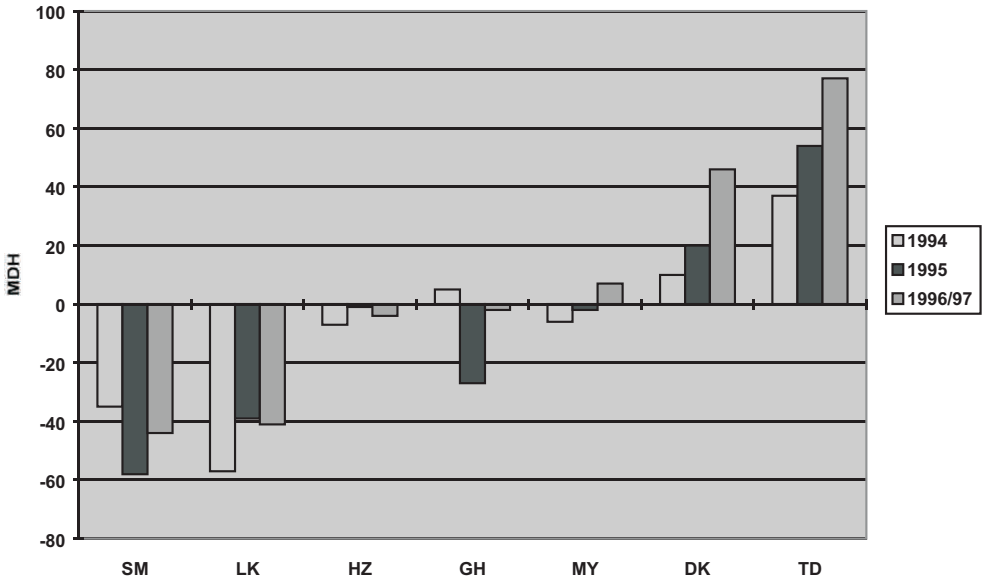


Fig. 2. Balance of the O & M account for each ORMVA (MDH)

In addition to budget transfers, the consequence of under pricing of irrigation water is differed maintenance of the infrastructure which leads to increasing needs of rehabilitation.

The New Context

Since the mid-1980s the irrigation sector has entered into a new era marked by two major changes. The first change relates to the Agricultural Sector Adjustment reforms. The second change is linked to the growing concerns about impeding water shortages and the need of conserving water and managing demand.

1. The Agricultural Sector Adjustment Reforms

In parallel to a macro-economic restructuring, a number of reforms in the agricultural sector have taken place to liberalize agriculture and food prices, reduce subsidies and restructure public expenditures in the sector. A long term program has been also initiated to restructure public enterprises across the economy including the agricultural sector.

In this context, the reforms in the LSI perimeters have included more specifically (i) ORMVA divestiture from commercial activities, (ii) liberalization of cropping patterns, (iii) promotion of farmer associations, (iv) reduction of budget transfers to the ORMVAs with increased autonomy.

In addition, input (fertilizer, improved seeds, etc..) and agriculture prices have been progressively liberalized. A comparison between 1979-80 and 1995-96 shows that prices of fertilizers, seeds and treatments for sugar beet have more than trebled, while the producer price has been multiplied by a factor of 2.41 (see Table 3). As a matter of fact, sugar beet and sugar cane producer prices have been formally " liberalized " only in 1996. But, the prices negotiated between the producers and the sugar factories are kept almost at the same level to avoid increases in the consumer prices or in the budgetary burden for compensation.

Of course, these important reforms have substantially changed the terms of the " contract " that the code used to represent by providing a comprehensive framework for conclusion of crop contracts and for price supports and subsidies.

Table 3. Evolution of producer and input prices for sugar beet production

Designation	Prices 1979-80	Prices 1995-96	Rate of increase
• Sugar beet producer price (DH/T)	135	325	2,41
• Fertilizer (N, P, K) (DH/Q)	85,36	265,3	3,11
• Fertilizer (urea) (DH/Q)	93	254,86	2,74
• Seeds (DH/Kg)	24	87,38	3,64
• Irrigation (DH/m^3)	0,064	0,22	3,47
• Treatment (DH/l)	126	460	3,65
• Labor (DH/day)	10,15	37,43	3,64

2. Meeting the Challenge of Growing Water Scarcity

In Morocco, the consequence of increased industrialization and a rapidly growing population, accentuated by a progressive shift from rural to urban living is the growth of requirements for the quantity and quality of water resources, their more intensive and comprehensive use.

The emphasis in Moroccan development planning has been for the last three decades on maximizing the capture of the country's surface water resources and providing for their optimal use in irrigated agriculture, potable water supplies, industrialization and energy generation.. Enormous capital resources have been invested in the essential infrastructure to control surface water flows. Infrastructure to capture and utilize about two-third of surface water potential is in place and a number of major infrastructure projects are in advanced stages of planning and/or construction to capture most of the remaining potential.

As Morocco nears the end of the infrastructure phase of its national development plan, emphasis is beginning to shift to the more sophisticated and difficult task of ensuring socially and technically efficient allocation of the existing water resources among competing consumer groups on a sustainable basis. This task is ever more complex given Morocco's relatively high population growth (2.06 % per annum), the higher rate of immigration from rural to urban areas (urban population has increased from 42.7 % in 1982 to 51.4 % in 1994) and the great spatial and temporal variability in annual rainfall with droughts of frequent occurrence.

Despite remarkable achievements, Morocco faces a growing challenge in the water sector. One of the main issues is the decline in available water resources. The mean annual rainfall across Morocco under average seasonal conditions is estimated to total 150 billion cubic meters

(Fig. 3). However, the renewable water resources do not exceed 29 billion cubic meters (BCM). Taking into account potential storage sites and groundwater development possibilities only 20 BCM are divertible annually, 16 BCM from surface water and 4 BCM from groundwater.

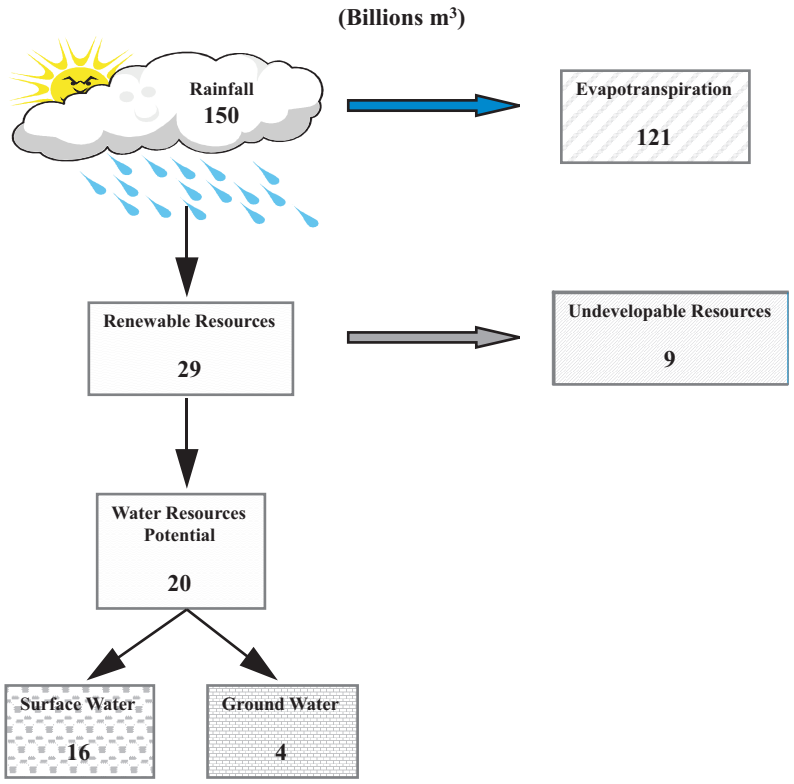


Fig. 3. Morocco's water resources

Some 88 large dams have been built increasing the storage capacity from 2.3 billion cubic meters in 1967 to 14 BCM 1997.

Morocco is also endowed with groundwater resources. Some 32 deep aquifers and more than 46 shallow ones scattered all over the country have been inventoried. Groundwater withdrawals have increased from 1.5 BCM in 1960 to 3.6 BCM in 1997.

Some 11 BCM are now committed to agriculture, domestic and industrial uses. As population numbers increase, coupled with demands for high per capita domestic and industrial consumption resulting from improved standards of living, the sustainable upper limit or "carrying capacity" of water resources utilization will be approached by the year 2020 (Fig.4). Thus, a growing scarcity is anticipated as a result of rising demands resulting from expansion of irrigated areas and urban

development and a slowing of the growth in available supplies, the depletion of aquifers and the pollution of available resources per capita renewable water resources are expected to fall from 850 cubic meters to 410 cubic meters in 2020, when all renewable resources are projected to be mobilized. That is in 2020 Morocco will move from being defined as a "water stressed" to being a "chronically water stressed" country. A number of river basins are already experiencing water shortages which will impose costly interbasin transfers (Fig. 5). Some of the more intensively used aquifers are now considered to be under stress with serious draw downs with salt water intrusion in the coastal ones.

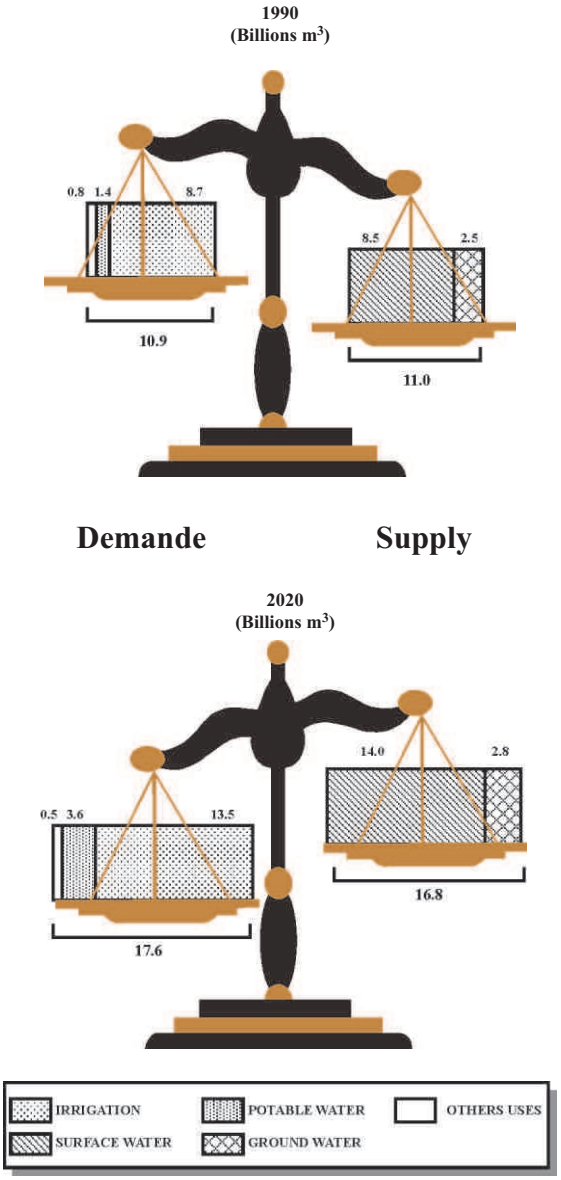


Fig.4. Morocco's water balance 1990-2020

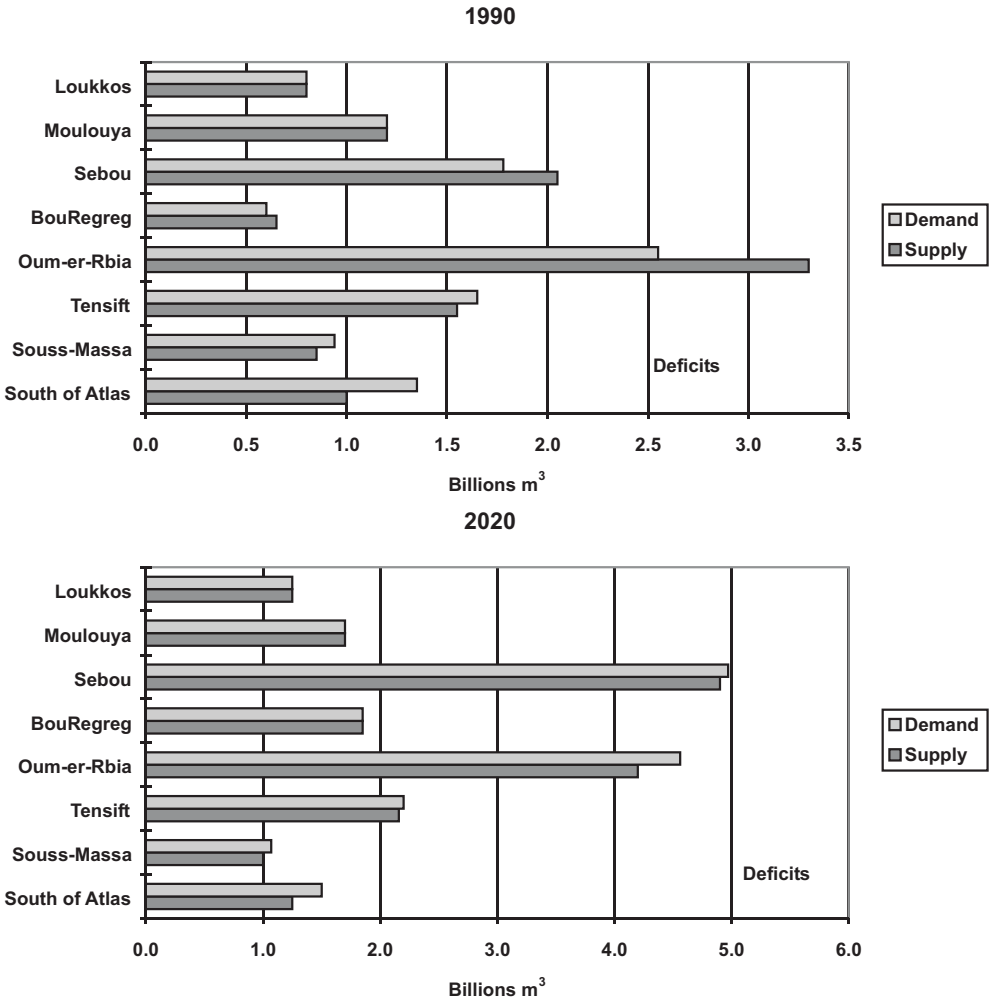


Fig. 5. River basins' water balance

Increasing water resources development costs, along with severe financial constraints and competition for scarce public funds have fostered a substantial change in attitudes to water conservation and serious questions have been directed towards water use efficiency in the irrigation sector while recognizing its strategic role in the economic and social development of the country

Morocco's water economy is now characterized by sharply rising costs of supplying additional water and more direct and intense competition among different kind of water users and uses. In this context, a better mix of increasing supply and demand management can be considered as the most rational response to water scarcity.

To meet the challenges posed by the growing water scarcity, Morocco has adopted an integrated approach to water resources management

through mutually reinforcing policy and institutional reforms. The major policy reforms adopted are the following:

- The adoption of a long term strategy for an integrated water resources management. The National water Plan will be the vehicle for strategy implementation and will serve as the framework for investment programs until the year 2020;
- The development of a new legal and institutional framework to promote decentralized management and increase stakeholder participation;
- Introducing economic incentives in water allocation decisions through rational tariff and cost recovery;
- Taking capacity enhancing measures to meet institutional challenges for the management of water resources; and
- Establishing effective monitoring and control of water quality to reduce environmental degradation.

All these policy features are inbeded in the new water law promulgated in 1995. It provides a comprehensive framework for integrated water management. Some of the salient features of this law are:

- Water resources are public property;
- The law provides for the establishment of River Basin Agencies (RBA) in individual or group of river catchments. It clarifies the mandates, functions and responsibilities of the institutions involved in water management. In particular, the status and the role of the High Water and Climate Council has been enhanced as the higher advisory body and a forum on national water policies and programs. All the stakeholders from public and private sectors including water users associations seat in this council;
- The law provides for the elaboration of national and river basin master plans;
- It has established a mechanism for recovery of costs through charges for water abstraction and introduction of a water pollution tax based on the principle " user - pays " and " polluter-pays ".
- The law reinforces water quality protection by defining environmental mandates and enforcing sanctions and penalties.

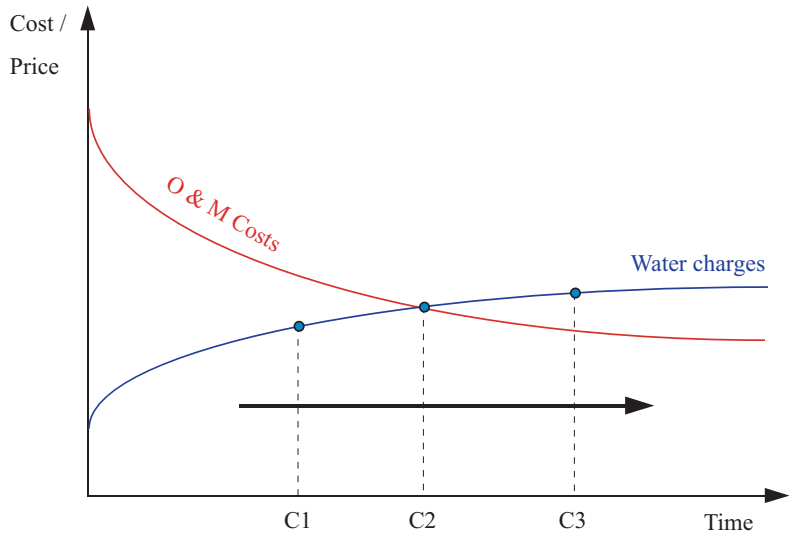
Concerning the institutional set up, the major change is the establishment of River Basin Agencies empowered to manage individual or groups of river basins. The three principal responsibilities of these agencies consist of the development of water resources, the allocation of water as defined by the master plan and the control of water quality. The agencies reinforce the network of existing institutions in charge of different water management functions.

New Irrigation Water Rate Setting

Irrigation water pricing is now being revised in response to water savings requirements and reduced budget transfers to ORMVAs.

An in - depth water pricing study has been carried out. A major conclusion of this study is that LSI systems have to evolve toward financial sel-sufficiency through cost-effective O&M, improved water use efficiency and, above all, increased cost recovery. Water pricing policy has been reconsidered with the basic principle that farmers should be progressively forced to incur O&M costs themselves.

In application of this principle, target O&M costs have been pragmatically worked out for each ORMVA. They take into consideration forecasted volumes of water to be annually delivered and a set of measures to optimize O&M costs. Then, a plan has been established for each ORMVA to increase water charges in order to meet O&M costs over a number of years which varies according to the existing gap and the farmers' ability to pay. Figure 6 shows the process followed for balancing O&M costs and recovery of O&M expenditures from water charges. The progressive increase of water prices is accompanied Three categories of ORMVAs can distinguished. The first category is made of highly energy intensive ORMVAs where, despite reasonable increases of water prices, a gap will remain and will be covered by budget transfers. For the second category



C1: *Energy intensive ORMVAs, with remaining budget transfers to pay partly the energy bill.*
C2: *ORMVAs recovering recurrent O & M charges.*
C3: *ORMVAs with a surplus that can be invested in rehabilitation or to cover other public services provided to farmers.*

Fig. 6. Water charges and O & M cost balancing and process

Some Policy Issues

Since the inception of the LSI policy, the principle of recovery of full recurrent costs of irrigation has been adopted. It was partly implemented for the reasons discussed above. Now, the new restructuring of the irrigation water tariff to better reflect the trend to water scarcity in Morocco and the growing economic competition from other sectors and to cover the entire estimated O&M costs has raised some issues related to macroeconomic policies with regard mainly to agricultural commodity prices and energy prices.

1. Agricultural commodity prices

As mentioned earlier, despite the liberalization of the producer prices for all the crops grown in LSI projects, the prices of strategic crops such us sugar beet and sugarcane were kept at politically acceptable levels to prevent substantial increase in consumer prices and/or in budget expenditures to compensate the prices.

Water charges represent on the average 8 to 34 % of the production costs varying from one irrigation sector to the other and among LSI projects depending on the crops, the yield and type of irrigation and the resulting water price. In terms of gross income the irrigation bill represents 6 to 68 %. Figure 7 gives an example from the Moulouya and Souss Massa LSI projects.

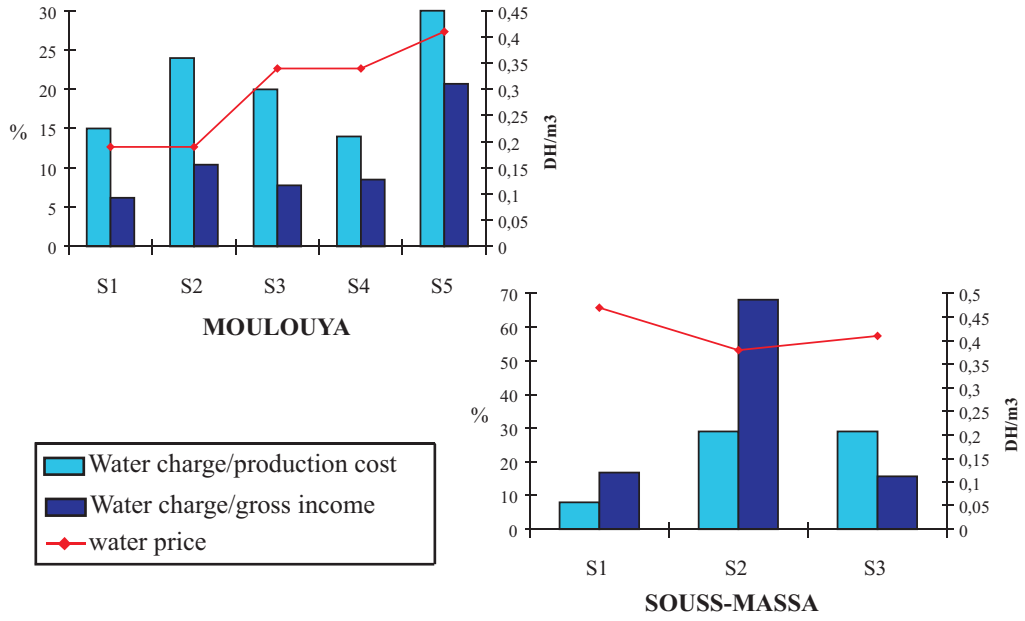


Fig. 7. Example of Variations of Water Charges / Production Costs and Gross Income Ratios

Furthermore, some crops, mainly sugar beet, cannot be economically cultivated beyond a certain level of water prices. Given the existing productivity gaps the farmer ability to pay can be reduced. The situation is often aggravated by the important fluctuations of prices of high value cash crops as shown in Figure 8 for potato in the Loukkos project for example. Therefore, substantial increases in water prices can pose serious questions about the sustainability of irrigation in some cases.

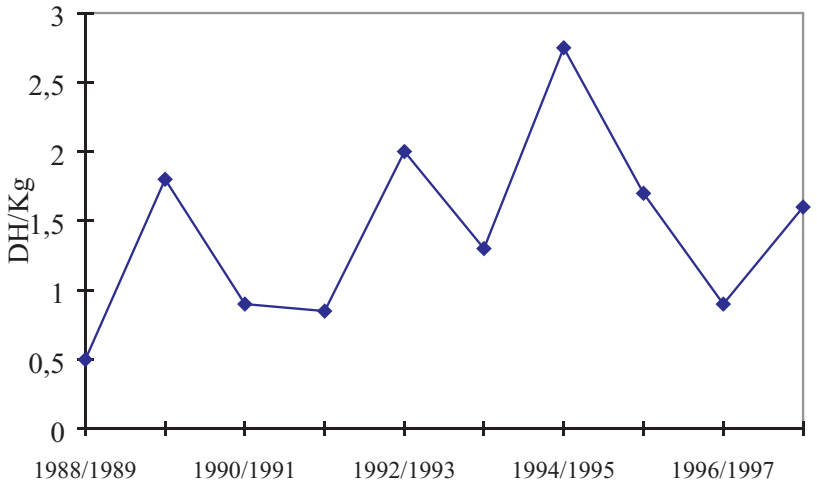


Fig. 8. Potato Prices in the Loukkos Project

In this context, it is important to mentione that Morocco's agricultural strategy has moved from the food self sufficiency objective to the food security objective. This means that food domestic needs will be met through strategic levels of national agricultural production and the gap will be covered by relying on the international market in order to make the best use of the country's competitive advantages given the water resources constraint.

Of course, the liberalization of agricultural trade widens the entire spectrum of economic possibilities offering countries like Morocco the potential to make efficient allocation of their water resources and to make the most of their comparative advantages. The challenge for them is to identify agricultural opportunities and start moving forward. Morocco is already on this track as shown by the evolution of its agricultural foreign trade (fig. 9).

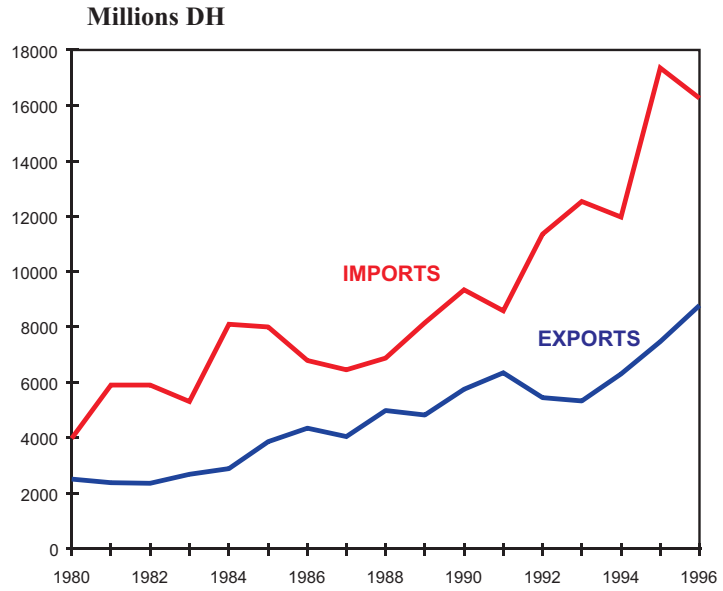


Fig. 9. Morocco's agricultural trade

But appropriate trade policies require astute understanding of the underlying economic competitiveness in any agricultural sector in liberalized world markets and strong government policy that encourage its development. The other essential ingredients are immense investments in infrastructure and technology to increase productivity and improve quality. It is also important to realize that there are transitional difficulties and adjustment costs both economic and human as in Morocco, agriculture has still an important role in the national economy. Although it contributes only 20 % of GDP its performance strongly influences the performance of the whole economy as depicted in figure 10 which represents the fluctuations of the agricultural gross production and those of GDP.

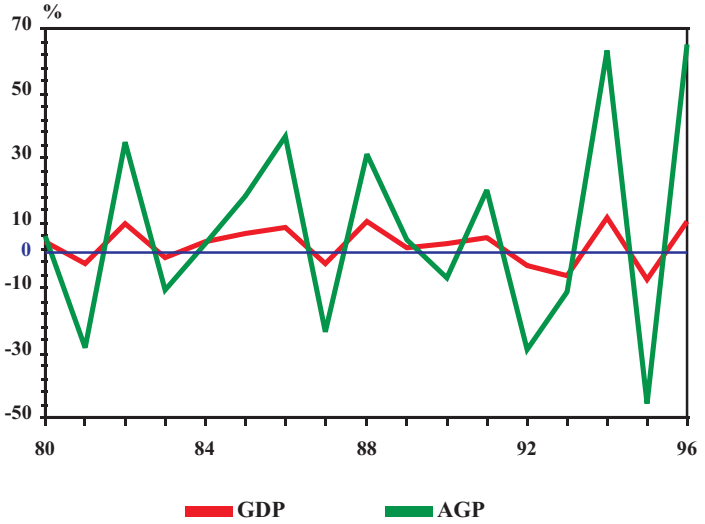


Fig. 10. Fluctuation of Morocco's agricultural gross product (AGP) and GDP

Furthermore, agriculture still provides employment to a large portion of the rural population. But the most limiting factor is that the agricultural trading system is not yet neither truly global nor truly free. Difficulties experienced with the European Union market which represents more than 70% of agricultural exports of Morocco lead to pessimistic prospects for the future.

2. Energy Prices

Morocco is not an oil producer country. Energy imports represent more than 16.5 % of the total value of the country's imports. Thus, electricity is expensive and its price is continuously increasing as depicted in fig. 11. Despite the fact that the agricultural sector enjoys a "green tariff" for electricity, i.e. about 20% bonus, energy is still very high and poses serious challenges to the sustainability of irrigation in areas relying on pumping. The debate on this issue is part of a general debate on the fiscal policy as it relate to the competitiveness of the economy as a whole.

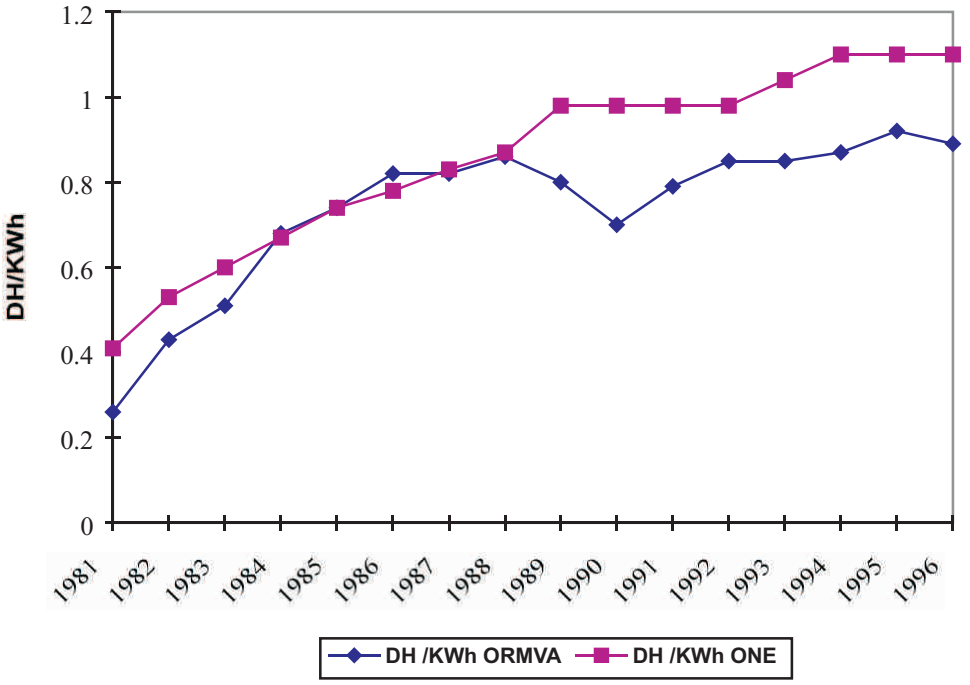


Fig. 11. Energy Cost

A holistic approach for implementation

It appears from the discussion above that irrigation water pricing cannot be considered simply as a "commercial affair". The implementation of the pricing reforms requires a holistic approach. Hence, in Morocco it is part an integrated program called the Large Scale Irrigation Improvement Program whose main objectives are efficiency, cost effectiveness and sustainability of the large scale irrigation subsector. As depicted in fig. 12 improvements are carried out in three major and interrelated areas:

- Improving hydraulic performance of irrigation systems through:
  1. rehabilitation of old systems;
  2. strengthening ORMVAs water management capacities through introducing modern O&M practices to provide reliable, flexible and equitable water supply to farmers at optimal costs involving as much as possible the private sector;
  3. improving on-farm water management through the reinforcement of irrigation management extension services and on-farm investments to introduce water saving irrigation technologies;
  4. developing Water User's Associations that are able to effectively participate in the management of their irrigation systems.
- Increasing cropping intensities and yields whose corollary is increasing farmers' ability to pay through:
  1. providing appropriate agricultural extension services to farmers;
  2. strengthening farmers' capacity to market their products through organizing professional commodity associations and enhancing the role of the private sector;
  3. optimizing cropping patterns in each irrigation schemes in terms of competitive advantages with regard to maximizing water use efficiency .
- Strengthening ORMVAs managerial capacities to make them more client oriented and cost conscious through:
  1. revising the organizational structure of the ORMVAs and introducing appropriate management information (MIS) mainly for better financial control including cost accounting systems;
  2. reinforcing human resources development programs.

This comprehensive set of actions is completed by policy and institutional reforms to clarify and formalize relations between Government, ORMVAs, farmers and the private sector.

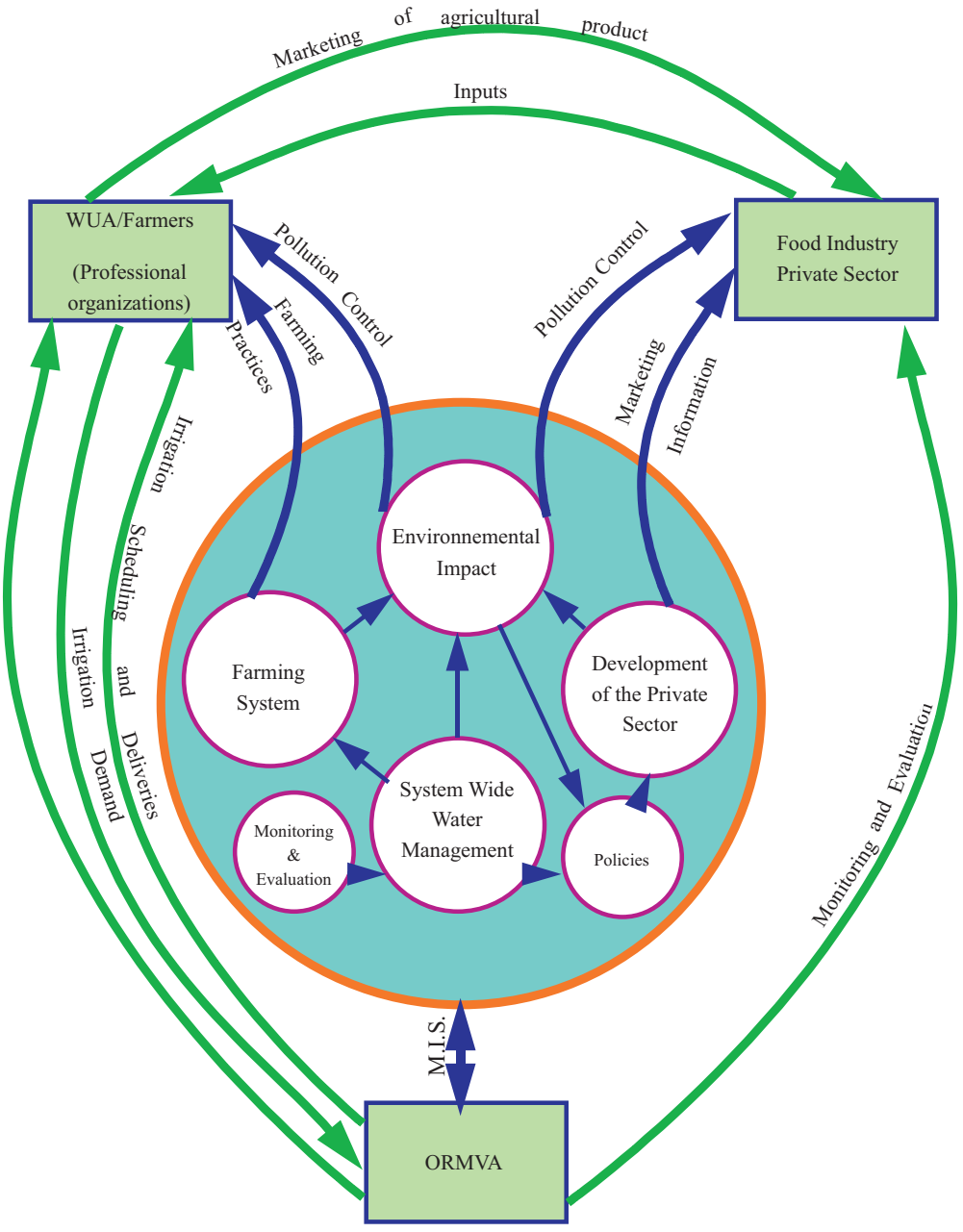


Fig. 12. Synoptic of the "Holistic" Approach