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MOROCCO WATER AND SOIL RESOURCES CONSERVATION PROJECT

Project Number 608-0213

FINAL REPORT

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PREFACE

This consultancy was performed under a contract between the USAID Mission to Morocco and the Irrigation Support Project for Asia and the Near East (ISPAN). The objective of the design effort was to gather relevant information and complete the technical, environmental, economic, financial, socio-institutional, policy and private sector analyses required for completing of the Morocco Water and Soil Conservation Project Paper to be finalized by USAID. The consultants were responsible for designing each of the major Elements of the project, in accordance with the approved project rationale as reflected in the Project Identification Document (PID), including the types and magnitudes of the recommended technical assistance, training and commodity inputs, and detailed cost estimates and terms of reference for securing said project implementation support services. The final report includes each of the major sections for the Project Paper, as per the requirements in AID Handbook 3.

The design team was composed of American and Moroccan consultants. The American consultants were:

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The consulting mission was conducted between 11 September and 1 November 1991. The first week of the mission was taken up with team planning meetings and consultations with USAID in Rabat. The next three weeks were devoted to field activities in the ORMVAT perimeter from a team base in Beni Mellal. The balance of the team's time was spent in Rabat writing, editing and revising the final report.

Between 5 and 27 November 1991, final editing of the report and annexes was done in the United States.

In submitting the final report, the design team wishes to express its appreciation to the many Moroccans and Americans in both official and private capacities who provided information to team members and otherwise greatly assisted with the successful execution of the consulting mission.

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ACRONYMS AND DEFINITIONS

ABT	Association des Betteraviers du Tadla/Tadla Sugar Beet Producers Association
ACT	Associations des Cotonniers du Tadla/Tadla Cotton Producers Association
ADB	African Development Bank
AET	Association des Eleveurs du Tadla/Livestock Producers Association of Tadla
AH	Administration de Hydraulique/Hydraulic Administration
AID	Agency for International Development -- used to denote AID headquarters in Washington, D.C. as distinguished from field mission denoted as USAID.
ANE	Former Asia/Near East Bureau of AID
ASAL II	Agricultural Sector Adjustment Loan (executed between the Government of Morocco and the World Bank in 1987 for the period 1987 to 1992)
ASIL	Agricultural Sector Investment Loan of the World Bank
ASPAM	Association des Producteurs des Agrumes du Maroc/Morocco Citrus Producers Association
BCD	Bureau des Cultures Diverses/Bureau for Other Crops of the ORMVAT/SPA
BE	Bureau d'Exploitation/Bureau for Management of the ORMVAT/SGRID
BEI	European Investment Bank
BGA	Bureau de Gestion et d'Approvisionnement/Bureau for Management and Input Supply in the ORMVAT/SPA
BTI	Bureau des Techniques des Irrigation et de Drainage/Technical Bureau for Irrigation and Drainage of the ORMVAT/SGRID
BV	Bureau de Vulgarisation/Bureau for Extension in the ORMVAT/SVOP
CA	Conseil d'Administration/Administrative Council of ORMVAT
CAP	Common Agricultural Policy of the European Community
CIP	Commodity Import Program
CMV	Centre de Mise en Valeur/Development Center
CNCA	Caisse Nationale de Credit Agricole/National Agricultural Credit Bank
COMAPRA	Compagne Marocain de la Production Agricole/Moroccan Agricultural Production Company
CRCA	Caisse Regionale de Credit Agricole/Regional Agricultural Credit Bank
CS	Cellule de Suivi/Monitoring Unit of ORMVAT
CT	Comite Technique/Technical Committee of ORMVAT
DER	Direction de l'Equipement Rural/Direction for Agricultural Equipment within the MARA
DPA	Direction Provinciale de l'Agriculture/Provincial Agricultural Office
DRH	Direction Regionale Hydraulique/Regional Hydraulics Direction of the Ministry of Public Works
ESF	Economic Support Funds
FADA	Arab Fund of Abu Dhabi
FADES	Fund for Economic and Social Development
FAO	Food and Agricultural Organization of the United Nations
GDP	Gross Domestic Product
GIS	Geographical Information System
GOM	Government of Morocco
IA	Irrigation Association

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IAV	Institut Agronomique et Veterinaire Hassan II/Hassan II Institute of Agriculture and Veterinary Medicine
IIMI	International Irrigation Management Institute
IMF	International Monetary Fund/Fonds Monetaire International
INRA	Institut National de la Recherche Agricole/National Institute of Agricultural Research
IQC	Indefinite Quality Contract
ISCAE	Institut Superieur de Commerce et d'Administration des Enterprises/ Graduate Institute of Commerce and Business Administration
LSI	Large-Scale Irrigation Scheme/Perimetres de Grande Irrigation
LSDAS	Limited Supervisory Data Acquisition System
MAP	Morocco Agribusiness Promotion Project of USAID
MARA	Ministere de l'Agriculture et de la Reforme Agraire/Ministry of Agriculture and Agrarian Reform
NGO	Non-Governmental Organization
O&M	Operation and Maintenance/Operation et Entretien
ODA	Overseas Development Administration of the United Kingdom
OMVA	Office de Mise en Valeur Agricole/National Agricultural Development Office
ONE	Office National d'Energie/National Energy Office
ONEP	Office National de l'Eau Potable/National Office for Potable Water
OP	Observatoire Permanent/Permanent Agro-Economic Monitoring and Evaluation Unit of the ORMVAT
OPEC	Organization of Petroleum Exporting Countries
ORMVA	Office Regional de Mise en Valeur Agricole/Regional Agricultural Development Office
ORMVAD	Office Regional de Mise en Valeur Agricole de Doukkala/Doukkala Regional Agricultural Development Office
ORMVAH	Office Regional de Mise en Valeur Agricole de Haouz/Haouz Regional Agricultural Development Office
ORMVAT	Office Regional de Mise en Valeur Agricole du Tadla/Tadla Regional Agricultural Development Office
PACD	Project Activity Completion Date
PAGI 1 & 2	Projet d'Amelioration de la Grande Irrigation/Large-Scale Irrigation Improvement Project (designated as PAGI 1 and PAGI 2 for the First and Second World Bank-funded Projects).
PID	Project Identification Document
PSDAGI	Projet de Soutien au Developpement Agricole de la Grande Irrigation/Agricultural Development Support Project for Large-Scale Irrigation Perimeters of the World Bank
RAM	Random Access Memory
RIG	Regional Inspector General Office
RT	Referentiels Technique/Crop Technical Reference Sheet
SAL	Structural Adjustment Loan
SE	Service de l'Elevage/Livestock Service of ORMVAT
SEAE	Service des Etudes Agro-Economiques/Service for Agro-Economic Studies of ORMVAT

SEHA	Service de l'Experimentation de l'Hydraulique Agricole/Service for Research on Agricultural Irrigation Systems of the ORMVAT
SGRID	Service de Gestion de Reseau d'Irrigation et Drainage/Service for Management of the Irrigation Network and Drainage of the ORMVAT
SH	Service Hygiene/Health Service of the Province of Beni Mellal
SIG	Systeme d'Information Pour la Gestion/Management Information System
SODEA	Societe du Developpement Agricole/Agricultural Development Group
SOGETA	Societe de Gestion de Terre Agricole/Agricultural Land Management Group
SONACOS	Societe National de Commercialisation des Semences/National Seed Company
SPA	Service de Production Agricole/Agricultural Production Service of ORMVAT
SPP	Service de Planification et de la Programmation/Service for Planning and Programs of ORMVAT
SUBM	Sucrerie de Beni Mellal/Beni Mellal Sugar Mill
SUNAT	Sucrerie National du Tadla/Tadla National Sugar Mill
SUTA	Sucrerie du Tadla/Tadla Sugar Refinery
SVOP	Service de Vulgarisation et Organisation Professionnel/Service for Agricultural Extension and Professional Organization of the ORMVAT
USAID	United States Agency for International Development
USGS	United States Geological Survey
World Bank	International Bank for Reconstruction and Development

MAIN REPORT

I. PROJECT RATIONALE AND DESCRIPTION

A. Rationale for the Project

1. Background

The Moroccan economy, after suffering from a series of severe external and domestic shocks and their subsequent fiscal ramifications in the early 1980s, has entered a period of economic recovery and consolidation. Since the inauguration of a comprehensive economic structural adjustment loan (SAL) program in 1983, economic growth has been sustained, with real growth in gross domestic product (GDP) averaging 4.6 percent per annum. However, while economic growth over the latter half of the 1980s and into the 1990s has been satisfactory, the average rate of GDP increase masks wide fluctuations related to interannual variability in precipitation and consequences for agricultural production.

The Government of Morocco (GOM) is proceeding on a core economic growth path which stresses a balanced approach to development among sectors, with critical development activities in light industry, agriculture, mining and tourism. It has progressively established a more open foreign trade regime where domestic resource allocations are increasingly governed by world market forces and prices. In the process, the Moroccan economy has moved away from its prior orientations toward import substitution, pervasive protectionism of inefficient domestic industries and agriculture, and heavy and direct state involvement of economic management at all levels. There is a new realization that development of a balanced, export-driven economy will require a more active and equal partnership between the public and private sectors, with public disengagement from commercial activities and much more emphasis on private investment and management in these key areas.

If the Moroccan economy is to proceed along its present growth path, all key sectors have a common need for reliable supplies of high quality water. Without this resource, the growing work force in urban areas cannot be sustained, many industrial enterprises cannot function efficiently, energy from hydropower plant cannot contribute to reducing Morocco's dependence on imported oil, and, most importantly, domestic agricultural and agro-industrial production cannot be stabilized to provide critical wage goods for domestic economic growth and for exploitation of export opportunities.

The emphasis in Moroccan development planning, therefore, is 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 on a sustainable basis. This directly reflects the GOM's central concern over this critical resource.

Enormous capital resources have been invested in the essential infrastructure to control surface water flows in Morocco. Infrastructure to capture and utilize about two-thirds -- or 10 billion cubic meters -- of surface water potential is in place and four major infrastructure projects are in advanced stages of planning and/or implementation to capture

most of the remaining 5 billion cubic meters of potential by the end of the 1990s.

As Morocco nears the end of the infrastructure phase of its national water development plan, emphasis is beginning to shift to the more sophisticated and difficult task of ensuring socially optimal 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 rate (2.4 percent per annum), the higher rate of migration from rural to urban areas (6 to 8 percent per annum), and the great temporal and spatial variability in annual rainfall between regions.

The major risk now is that water which has been captured at such great cost will not be used efficiently and that Morocco, therefore, will not be able to optimize the returns to its economy from all of the investments to date. Since Moroccan sub-surface water resources are limited and generally more expensive to exploit in both financial and environmental terms and desalination of seawater has not yet proven to be a cost-effective technology, conservation and optimal use of the existing surface water resources is a sine qua non for the country's successful economic development in the 1990s and beyond.

The Morocco Water and Soil Resource Conservation Project -- hereinafter referred to as the project -- will work in the second largest river basin in Morocco -- i.e., the Oum Er Rbia -- and, specifically, in the upper basin area consisting the Office Regional de Mise en Valeur Agricole du Tadla (ORMVAT) irrigation scheme on the Tadla plain, one of nine large-scale irrigation schemes (LSI) in the country. The interventions of the project will affect the quantity and quality of water available to produce a whole range of high value agro-industrial products for export and domestic markets in three of the nine LSIs of the country -- i.e. in the Tadla, Haouz (ORMVAH) and Doukkala (ORMVAD) perimeters. Presently, virtually all of Morocco's high value agricultural exports are produced in and processed near these nine LSI perimeters.

The project will also have significant impacts on the availability of potable and industrial water supplies for two of the largest urban concentrations in the country -- i.e., the Casablanca/Rabat coastal strip and the Marrakech area.

At the sectoral level, irrigated agriculture has a high priority in Morocco. Irrigated agriculture is viewed as the means by which Morocco will be able to meet the needs of its growing population and expand exports both of commodities and processed agricultural products in order to earn more foreign exchange and contribute to redressing imbalances in the country's external trade account.

In assessing the Moroccan development strategy, one is strongly drawn to the conclusion that improved water and soil resource management and more economical development of the country's irrigation potential are critical components of Morocco's core growth strategy. The project will deal with water and soil resource management primarily in the context of irrigation agriculture for two even more fundamental reasons:

- Water use for irrigation accounts for 88 percent of total surface water use in Morocco, as opposed to 8 percent for potable water supplies and 4 percent for industrial use. Therefore, if significant efficiency gains in water resource conservation are to be affected in the medium-term, work must initially be focused on irrigation as the largest and, probably, the most wasteful consumer of that water.

- Since the irrigated perimeters of Morocco produce essentially all of the high value export crops, interventions of the project will make an additional contribution to production of these crops in the context of Moroccan agribusiness development.

2. Relationship to USAID Country Strategy and Program

The project will promote more efficient economic and environmentally sustainable management and use of Morocco's water and soil resources. This goal is fully consistent with and supportive of all salient development policies, strategies and objectives of the Agency for International Development (AID) in Washington, D.C. and the United States Agency for International Development (USAID) Mission in Morocco.

At the AID level, the project directly support the new Mission Statement principle calling for programs to promote "responsible environmental policies and prudent management of natural resources". More specifically, it seeks to assist Morocco "to conserve and protect its environment and manage its exploited resources for sustainable yields" through economic and environmental policies, and improved technologies in the priority Asia/Europe and Near East Bureaus' areas of water and soil resources management, in agreement with the AID Policy Paper on Environment and Natural Resources (April 1988) and the new Environmental Initiative (1990 State Cable 317722). In addition, the project seeks to promote the long-term sustainability of Morocco's most valuable agricultural investments, in agreement with the recommendations of Ambassador Blake's Committee on Agricultural Sustainability for Developing Countries (December 1989).

From the Bureau's perspective, the project will provide a USAID vehicle for addressing some of the major environmental and natural resource problems confronting the future economic growth of Morocco -- i.e., inefficiency and waste in natural resources production and use; and pollution and degradation of environmental systems (ANE Environment and Natural Resources Strategy, January 1990). Moreover, these problems will be addressed in an undeniably critical area of the country's future economic growth through establishment of rational economic policies, a better definition of appropriate public and private sector roles and institutional functions in environmental and natural resource management and use, strengthened managerial and technical capacities for improved environmental and natural resource management and use, and increased private sector, non-government organization (NGO) and popular participation in environmental and natural resource decisions and management. In addition, the project will work on the environment and natural resource subjects where the United States has a demonstrated comparative advantage, especially with regard to the technologies to be transferred, and

where excellent potential exists for donor collaboration and leverage, primarily with the ongoing and planned Morocco program activities of the World Bank.

[USAID TO INSERT SECTION HERE RELEVANT TO THE ACTION PLAN BEING DEVELOPED IN THE MISSION AT PRESENT]

The current USAID Morocco Development Strategy document (USAID Morocco -- Programming for the 1990s -- A Concept Paper, July 1990) identifies water as a key emerging natural resources constraint in Morocco meriting additional USAID attention. The project has been designed to directly address this strategic bilateral program objective area. In addition, the project focuses on protecting and enhancing the sustainability and economic performance of some of Morocco's most valuable and significant agricultural investments. Accordingly, the project will be directly supporting both ongoing and major new USAID Mission agricultural sector development objectives, as embodied in the Morocco Agribusiness Promotion Project (MAP). As the fate of Moroccan agribusiness rests principally on the continued performance of the nation's irrigation infrastructure, the synergistic relationship between these two activities cannot be over-emphasized. Less directly, the project will also support strategic USAID Morocco development priorities in the areas of policy reform, private sector promotion, and women in development.

3. Relationships to Other Donor Activities

As a result of the continuing high priority the GOM places on the development and management of water resources in Morocco, a number of donor agencies and international and regional development fund programs are supporting various interventions in water control, transfer and/or use for irrigation, potable and industrial water supply throughout the country. Examples of such activities include:

- European Community funding of flood control structures in Moulouya, Ouarzazate and Haouz, and construction of a 92 kilometer canal from Tessaout to El Haouz; and

- Funding of expansion and/or rehabilitation activities in the Doukkala, Gharb, Loukos, Haouz and Tessaout irrigation perimeters by the African Development Bank (ADB), the European Investment Bank (BEI), the Arab Fund for Economic and Social Development (FADES), the Arab Fund of Abu Dhabi (FADA), the Saudi Arabian Fund, the Kuwait Fund, and the Organization of Petroleum Exporting Countries (OPEC).

While these activities are important to the general development and management of water resources in Morocco, they are of limited relevance to the USAID project because they have no direct effects on development in the ORMVAT perimeter. The only major donor currently having program activities in the ORMVAT and with planned follow-on activities is the World Bank. The Bank portfolio for Morocco over the past 15 years has included a

number of projects with both large and small-scale irrigation perimeter management/ improvement activities. The World Bank has also been very active in the areas of agricultural research and extension services in both irrigated and rainfed areas.

In the present context, the single most important World Bank activity is the ongoing program under the present Second Agriculture Sector Adjustment Loan (ASAL II) and the future Agricultural Sector Investment Loan (ASIL) to reform and modernize the agricultural sector. This program operates within the comprehensive SAL mentioned in Section I.A.1.. The ASAL II -- and its predecessor program -- has set the essential policy context within which all activities in the present project are to be undertaken. The principal reform themes of liberalization of input, output and factor markets, state disengagement from commercial activities, privatization of public and parastatal enterprises, orientation toward a more export-driven economy, and more effective mechanisms for dialogue among the partners in the economy were all formulated under the SAL and ASAL II. The present project has been designed to be fully compatible with and supportive of all of these major economic policy orientations.

Within the irrigation sub-sector, the most important GOM/World Bank activities affecting the USAID project are the two projects for improvement of irrigation in Morocco's nine LSIs. The Projets d'Amelioration de la Grande Irrigation, denoted as PAGI 1 and PAGI 2, and the parallel project for support for agricultural development in the large-scale perimeters -- i.e., Projet de Soutien au Developpement Agricole de la Grande Irrigation (PSDAGI).

PAGI 1, funded at $ 39 million, was initiated in 1987 as a comprehensive five year national effort to improve operating efficiency, management and financial performance in the nine large-scale irrigation perimeters. The project has been quite successful in addressing its principal objectives. Irrigation water fee schedules have been increased significantly to better reflect the real financial cost of water in each perimeter. Receipts in several ORMVAs now cover all or most of their operations and maintenance costs and in some -- i.e., Tadla and Doukkala -- are also contributing to capital costs.

The ORMVAs in each of the nine perimeters have been strongly encouraged to disengage from all commercial enterprises and to restructure themselves as public service organizations with primary responsibilities for water system management and agricultural extension activities. A process has been initiated to give farmers a much greater role in decision-making about desired crop and livestock enterprises, allocation of farm-level resources, and maintenance and management of tertiary and quaternary canal systems within the perimeters.

At the end of 1991, PAGI 1 is its final stages of implementation. As a result of favorable project evaluations, the GOM and the World Bank have decided to design a much larger PAGI 2, and the parallel PSDAGI to support agricultural research and extension. PAGI 2 design is now well advanced with a tentative funding level of $ 200 million and the next

World Bank appraisal mission is due to arrive in Morocco in November 1991. Design of the PSDAGI, with funding projected at approximately $ 40 million, has only just begun with the arrival of an expert team in September 1991. Both projects are scheduled for final approvals in late 1992 and loan signature in 1993, with first implementation activities to start in late 1993 or early 1994. If these schedules are adhered to, PAGI 2 and PSDAGI implementation activities would start approximately two years after initiation of those envisaged under this project.

The principal objectives stated for the PAGI 2 are:

- To improve the financial and economic viability of the existing national irrigation infrastructure; and

- To improve administrative and financial management of the ORMVAs.

The principal components of the PAGI 2 -- with their approximate funding percentages -- are as follows:

- Demonstrations to improve applications of irrigation water at the field level -- 3 percent of the total project cost;

- Provision of vehicles and equipment, construction of administrative buildings and houses, and provision of computer equipment to improve ORMVA management -- 13 percent;

- Other support measures (9 percent) including:

  * Intensive training and retraining programs for ORMVA personnel and eventually for Ministry of Agriculture and Agrarian Reform (MARA) personnel at the central Directions;

  * Specialized technical assistance as needed;

  * Various studies needed to complement the management studies already underway in the context of PAGI 1; and

  * Reinforcement of the MARA central Directions in project management techniques necessary to implement PAGI 2.

- Support for rehabilitation work in the modern and traditional sectors of the irrigation perimeters -- 37 percent;

- Support for work on stabilizing and/or resurfacing of rural roads within the irrigation perimeters -- 13 percent;

- Provision of equipment for rehabilitation of old pumping stations within the perimeters -- 8 percent;

- Support for supplementary maintenance activities within the perimeters -- 9 percent; and

- Creation of a reserve fund for urgent interventions made necessary by flooding in the irrigation perimeters -- 8 percent.

While the general activity areas for PAGI 2 were defined as of April 1991, there is still considerable uncertainty at the ORMVAT as to which activities will actually benefit the perimeter and at what levels of resource allocation. At this point, it is uncertain as to whether the World Bank mission anticipated in November 1991 will be charged with making these final planning and resource allocation decisions or whether they will be made sometime in 1992.

The principal PSDAGI objectives set out in the preliminary design documents are as follows:

- To improve irrigated crop production in terms of yields and rates of cropping intensities in line with market prices and demand;

- To promote the restructuring of the development services offered by the ORMVAs in line with the findings of the Systeme d'Information Pour la Gestion (SIG) study financed by the World Bank;

- To encourage the development of professional organizations and their participation in development; and

- To encourage greater participation by Moroccan universities in development activities.

Preliminary planning documents for the PSDAGI list the following activities as anticipated components and sub-components:

- Agricultural Extension

  - General support to the extension services;

  - Support for the women's extension program (Animation Feminine) to include studies to identify special needs and extension programs which can benefit from PSDAGI support in increasing revenues; and

  - Promotion of professional associations.

- Education and Retraining of ORMVA Personnel, Extension Agents, Farmers and Members of Professional Organizations

- Applied Agricultural Research

  The program could cover experimentation by the ORMVAs with support from technical institutes and/or contracts with those institutes to carry out direct research. This program of research will be defined once the regional committees established at each ORMVA, together with other ORMVA staff, representatives from MARA, INRA, the universities and the professional associations, have established their priorities.

- Other Activities in Support of Agricultural Production

  These activities remain to be identified but could include the following items among others:

  * Investments in soil analysis facilities to encourage more efficient application of chemical fertilizers to crops and in agricultural mechanization; and

  * Work on "cleaning up" (assainissement) the legal situation with respect to collective land located in the perimeters.

- Monitoring and Evaluation Activities

  * Support to the installation of a permanent monitoring and evaluation system within the ORMVAs and the central Directions of MARA; and

  * Support for better tracking of development activities at the ORMVAs.

- Studies

  * A diagnostic study of production systems;

  * A study of the distribution of the "factors of production" -- i.e., inputs -- and controls on their quality;

  * A study of accounting management for farms; and

  * A study of the organization of commercial marketing channels.

There are a number of important differences and complementarities between the World Bank PAGI 1 and 2 and PSDAGI programs/projects and the USAID project. They are as follows:

- PAGI 1 and 2 and PSDAGI are or will be national-level projects. This means resources are or will be spread among the MARA national agencies and all nine ORMVA irrigation perimeters. Insertion of an activity into the PAGI 1 or 2 or PSDAGI projects at the national-level has not meant or does not necessarily mean that all nine ORMVAs benefit from or share equally in the resources devoted to that project activity.

- As can be seen from the budget allocations above, PAGI 1 was and 2 will be very heavily oriented toward loan investments in construction of buildings and roads, structural rehabilitation of existing perimeters, and equipment purchases. The USAID project, using grant funding, is heavily people-oriented in its activities at the ORMVAT. These activities will create human capacities and otherwise contribute to increasing the economic viability of whatever World Bank/GOM investments are made in Tadla. PSDAGI, in very preliminary outline form, contains some of the same elements at the national-level as the USAID project in a regional context. The present position of the MARA is that PSDAGI investments will be tailored to accommodate the known activities and results of the USAID project in Tadla.

- The USAID project, under the anticipated implementation schedule, will start implementation fully two years ahead of the PAGI 2 and PSDAGI. This means that the USAID project will be generating important results and initiating pilot activities well before World Bank project activities come on line. The present planning in the MARA and at ORMVAT is to use the USAID project information and results to more precisely target the PAGI 2 and PSDAGI activities, both in Tadla and, as relevant, in the other ORMVAs. For this reason, the USAID design team has worked in close collaboration with GOM representatives at both the ORMVA and MARA levels to ensure -- to the maximum extent possible -- that all elements of the USAID project are not only fully compatible with PAGI 2 and PSDAGI as designed to date, but will also be contribute to the future planning and implementation of those activities after 1993.

There are two study projects operating in the ORMVA Tadla perimeter at present. One is jointly sponsored by the International Irrigation Management Institute (IIMI), the Service de l'Experimentation de l'Hydraulique Agricole (SEHA) in the Direction de l'Equipement Rural (DER) of MARA, and ORMVAT. The other is a collaborative study sponsored by Wye College and the Institut Agronomique et Veterinaire Hassan II (IAV).

The IIMI/GOM project is entitled Projet Avertissement a l'Irrigation dans les Perimetres Gravitaires du Tadla. The objectives of this long-term effort are to:

- Increase the financial viability of irrigation enterprises by increasing agricultural productivity of water used; and

- Solve the problem of the rising groundwater table by finding ways to reduce infiltration of irrigation water due to excessive applications by farmers.

The basic activity of the project is to convince farmers to adopt a more efficient approach to water applications. In this respect, evaluations will be conducted of the actual water requirements of the various crops grown in Tadla at various stages in their development. Mathematical models will be used in this activity to develop daily crop information for decision-makers. Finally, the project will study farmers' attitudes with regard to more efficient use of water from the gravity system.

USAID design team members had several discussions with the IIMI country representative about this project and means of coordinating activities in Tadla. Every effort will be made in project implementation to collaborate on field activities and to share information and field trial results.

Wye College initiated a three year academic exchange program agreement with IAV in July 1990. This agreement is funded at 226,000 Pounds Sterling by the British Overseas Development Administration (ODA). The agreement is centered around four principal research themes. They are:

- Microeconomic analyses of the impacts of changes in Morocco agricultural policies at the farm-level in the ORMVA perimeters;

- Determination of what kind of software packages are most appropriate for management information systems in the ORMVAs;

- Research on the use of expert systems in dealing with problems of irrigation and drainage; and

- Development of training modules on the information developed under research themes 1, 2 and 3 for presentation at two workshops to be held during the program.

B. Project Description

1. Perceived Problems to be Addressed by the Project

The project will address the existing productivity and institutional gaps with respect to resource management in the regional economy of the Tadla plain. In this context, the productivity gap is defined as the difference between water use and agricultural production potentials of the Tadla plain and the existing levels of resource use as expressed in actual crop and livestock production in the area over the last decade.

The institutional gap is defined as the transitional void created as the ORMVAT redefines its operational mandate and continues the process of implementing national policy directives to disengage from those public sector activities deemed to be commercial in nature and the time needed for private sector economic actors to develop capacities and assume new roles and responsibilities vis-a-vis the rural population on the Tadla plain.

2. Project Goal

The goal of the project is to promote more efficient economic and environmentally sustainable management and use of Morocco's water and soil resources.

3. Project Purpose

The project purpose is to increase the efficiency, economic yield and environmental sustainability of water and soil resources management and use in the Tadla irrigation perimeter of Morocco.

4. Project Outputs

The anticipated outputs from the project are listed below.

a. Element 1

- Improve the delivery of irrigation water to be efficient, reliable, flexible, and timely through:
  - A more comprehensive understanding of the capabilities and limitations of the hydraulic systems in the perimeters;
  - A flexible system of operating capabilities and procedures which is responsive to farmer's needs and the evolving cropping systems;

* Improved water delivery efficiencies in physical terms -- i.e., total savings from increased canal delivery efficiencies attributable directly to improved management of the ORMVAT perimeter of up to 68.4 million cubic meters per year by the end of the project and a total savings of up to 42 million cubic meters per year from improved field application efficiencies achieved 15 years after the start of the project;

* Near real-time measurement of crop water requirements and climatic variability within the perimeters;

* A micro-computer network, linking databases in system operation, system management, weather and groundwater levels for more timely system management decisions and responses; and

* Improved timeliness in water management decisions with an associated improvement in the ORMVAT's ability to respond to farmer's irrigation needs in a flexible and timely manner.

♦ Increase the availability of critical management information to farmers, processors, and other public and private agricultural interests in the region through:

* Daily weather data available to farmers, processors and other private sector actors on a near real-time basis for improved decision-making on all agricultural operations related to weather; and

* An improved understanding by farmers of the capabilities and limitations of the water delivery system and how these affect their enterprise decisions.

♦ An improved knowledge base for use in the irrigation planning process, resulting in increased system productivity from improved planning decisions through:

* An up-to-date hydrologic data base and the expertise necessary to analyze and make application to the irrigation planning process; and

* Improved definition and understanding of actual cropping and land-use patterns by the ORMVAT and how the elements are evolving.

b. Element 2

♦ An improved definition and understanding of actual cropping, land use and tenure patterns and how they are evolving;

- An improved understanding by farmers of the capabilities and limitations of the Tadla water delivery system and how these relate to and affect their enterprise resource allocation decisions;

- An improved understanding by the ORMVAT of farmers' decision making processes and enhanced Office capability to be more responsive to their clients' requirements;

- An understanding of constraints on the hydraulic system and economic efficiency at the farm-level;

- A series of tested pilot activities for dissemination to alleviate constraints to water use efficiencies and economic performance at the farm-level; and

- Improved water delivery efficiencies to farm and improved water application use efficiencies at the farm-level.

c. Element 3

- A more complete understanding of water balance and drainage system efficiencies in the Tadla perimeter;

- A groundwater model integrated with the near real-time management of surface water management;

- Improved management of groundwater resources and soil decomposition due to salinity problems;

- A more comprehensive understanding of water and soil quality issues related to agro-chemical use;

- An information exchange network to enhance awareness of critical water and soil pollution levels;

- A set of recommendations for agro-chemical storage, handling, use and disposal in the perimeter; and

- Improved management of the control of water quality problems.

d. Element 4

- An improved understanding of the private sector actors in the Tadla economy, the scope of their involvement and their capabilities and needs;

- A deeper understanding of operative agricultural commodity chains -- filieres -- at all stages;

- Increased capacity of the multi-service cooperatives to manage their production and service activities, develop marketing and financial strategies for their products and services, and begin their transformation to durable enterprise-based cooperatives;

- Strengthened professional associations providing greater value for assessments levied on producers' products, particularly in mobilizing financial and technical resources for members; and

- Irrigation Association board members trained in basic management skills.

At the purpose level, the principal outputs -- and, hence, the direct economic benefits -- of the project could be classified under the following categories:

- Cost savings from more efficient and reliable water delivery at the system-level;

- Cost savings and increased net farm incomes through better allocation of water and other resources at the farm-level affecting both the mix of crops grown and their yields;

- Cost savings to the government from disengagement of the ORMVAT from commercial activities and more efficient execution of its reduced operational mandate; and

- Cost savings through more efficient private sector agribusiness activities in the Tadla plain.

- Increased participation of the private sector in the marketing of key agricultural inputs and services, agricultural production enterprises, agro-industrial processing and marketing of agricultural products -- i.e., increases in the number of new private sector firms operating in the Tadla perimeter and increases in the volumes of business activity by existing firms;

- Improved competitiveness of local agro-industrial enterprises and businesses providing support services to farmers -- i.e., decreases in unit costs for agricultural inputs and services and in transaction costs for processing and marketing of agricultural outputs;

The indirect effects of project activities could yield additional economic benefits in two areas:

- Increased effectiveness of the capital investments provided under the World Bank-funded PAGI 2 and PSDAGI;

- Increased quantities of higher quality water available for alternative uses outside the Tadla perimeter -- i.e., as irrigation water for the upper Tessaout perimeter in the ORMVAH and as potable and industrial water for urban areas, particularly Marrakech and Casablanca.

5. Project Inputs

a. Element 1 -- Improving Knowledge and Management of Water Resources at the System Level in the ORMVAT

The Tadla perimeter is divided into two hydraulically separate sub-perimeters by the Oum Er Rbia river -- see area maps in the Preface. The Beni-Amir sub-perimeter is located on the right bank and has about 27,000 hectares irrigated from the Oum Er Rbia river via the Kasba Tadla diversion dam. The reservoir associated with this dam has an operating storage of about 120,000 cubic meters and provides water to the irrigated sub-perimeter through a canal along the left bank of the river connected to a small regulating reservoir of 100,000 cubic meters at Kasba Zidania about 20 kilometer downstream of the dam. Water discharges from this reservoir either through a small hydro-electric plant or into a siphon under the Oum Er Rbia river and into the main irrigation canal with a maximum capacity of 14 cubic meters per second.

The Beni-Moussa sub-perimeter is located on the left bank of the Oum Er Rbia river and covers about 70,000 hectares of land irrigated with water from the Bin El Ouidane dam on the Oued El Abid in Azilal province. This dam has a total storage capacity of 1,500 million cubic meters, with a regulated storage of 1,100 million cubic meters. Of this, 720 million cubic meters are allocated to the Beni-Moussa sub-perimeter and 235 million cubic meters will be allotted to the lower Tessaout perimeter in ORMVAH upon the completion of the T2 transit canal in the next few years. This new allocation will impose constraints on the water supply to the Beni-Moussa sub-perimeter from the Bin El Ouidane dam. Water for the Beni-Moussa irrigation sub-perimeter is supplied from a compensating dam at Ait Ouarda immediately downstream of the Bin El Ouidane dam and then passes through a tunnel 10.5 kilometers long to the second hydro-electric plant at Afourer. Water from the hydro-electric plant at Afourer discharges directly into the two main canals -- "GM" and "D" -- of the sub-perimeter. The upper reaches of both main canals serve as in-line storage reservoirs with a capacity of 300,000 cubic meters allowing evening peak hydro-electric generation needs to be met while supplying the relatively constant irrigation system demands. The principal hydraulic infrastructure for the two large-scale sub-perimeters, in addition to those mentioned above, include 200 kilometers of main canal, 360 kilometers of primary and secondary canals and 1,800 kilometers of tertiary canals in addition to many more kilometers of unlined field ditches -- or quaternary canals. Drainage is provided by a network of surface drains totaling 1,700 kilometers in length.

Approximately 28,000 farms are contained within the Tadla perimeter. Farm size varies considerably, with 82 percent of the farms less than 5 hectares comprising 41 percent of the

total area, and 2 percent of the farms more than 20 hectares covering 27 percent of the total area. The ability of water distribution managers to respond to farmers' requests is stressed by the sheer number of farmers and is compounded by the diversity of farm sizes and types.

The irrigation systems of ORMVAT were designed to meet the crop water requirement of mandatory crop rotation patterns. Changes from a fixed rotation type of cropping pattern opens the Tadla perimeter to highly variable crop selection and rotation patterns. Responding to these cropping patterns in a way that promotes the wise use of the limited water resource is the main thrust of this Element -- i.e., increasing the efficiency, flexibility, reliability and timeliness in distribution system operations. The feasibility of irrigation water delivery to meet crop water demands can no longer be assumed. Crops requiring a flexible water delivery schedule for high productivity will be grown by farmers. The demand for water will increase, increasing tension in the water distribution system. Distribution system managers will be expected to meet the water demands of the farmers, not of the fixed crop rotation.

Meeting these changes in a wise manner is best described as a demand for efficiency, flexibility, reliability and timeliness in irrigation water delivery. Efficient system operation will result in a maximum volume of water being made available to farmers. Flexibility in system operation also contributes to system efficiency and to productivity under alternative cropping patterns. Reliability in flow rates, volume delivered and time of delivery contribute to on-farm efficiency and develop a sense of trust in the water delivery process that promotes farmer participation in efforts to increase system-wide productivity and efficiency. Timeliness refers to the way in which the system meets the actual water requirements of the plants for maximum productivity.

In the context of the limitations of the physical system and present operating procedures, addressing demands for quality irrigation water delivery requires the development of the new systems and capabilities within ORMVAT.

(1) Development of a More Complete Quantitative Understanding of the Water Supplies for Each of the Sub-Perimeters

The first step of this process will be to develop a data base of water flows, both in the Oum Er Rbia river and into Bin El Ouidane dam. The Oum Er Rbia river flow data is available in computer format from the Administration de Hydraulique (AH), a division of the Direction Regionale Hydraulique (DRH) of the Ministry of Public Works in Beni Mellal. An agreement will be established with the AH for the regular importation of such data into the ORMVAT data base after it is established.

In the case of the Beni-Amir system, the data base should include historical diversions into the principal canal of the system. A statistical analysis of the flow data for both the Oum

Er Rbia river at the Kasba Tadla diversion dam and the principal canal will be undertaken after the data base is established. This analysis is expected to yield a long-term mean hydrograph of the river at Kasba Tadla and a hydrograph of the diversions as well as confidence limits for the flow during any given time period within the year. This system currently has an upper limit set by canal capacity of 14 cubic meters per second and a lower limit depending on low flows in the river.

The Beni-Moussa water system supply is dependent upon the operating rules of the Bin El Ouidane dam and the control dam at Ait Ouarda, as well as the historical flows into the reservoir and releases to the system. In addition to historical flows into the reservoir, a data base will be established for the historical release of water at Afourer. A statistical analysis of these data will yield both a statistically defined inflow hydrograph for the reservoir and for the irrigation system of Beni-Moussa. A review of the operating rules of the dam and power plant at Afourer will reveal flows not directly tied to irrigation system demand and may indicate ways in which the operating rules of both the irrigation system and the dam could be altered to improve overall efficiency of water use in the system.

Statistical analysis of hydrologic data will require a computer and statistical software package as well as technical assistance to undertake the initial analysis. Training of the ORMVAT staff in use of the system and interpretation of results will also be required. The computer will have minimum specifications of a 386 microcomputer with 25 megahertz clock speed, 4 megabytes of random access memory (RAM), and an 80 megabyte hard drive. Software will be capable of detailed time series analysis of hydrologic data and of importing data from computerized data bases.

(2) Improved Reliability in Quantifying Water Demands

Improvement of the definition of the demand hydrographs will entail two types of actions, which will be undertaken on both sub-perimeters. The first intervention is utilization of a Geographic Information System (GIS) to provide quickly accessible information on the perimeter. The first step in this development would be to develop an accurate base map of the geographic features of the perimeter. Important overlays to be developed which will aid in the planning and management of irrigation and other agricultural activities in the perimeters, including cropping patterns, soil types, land holdings, salinity contours, water table elevations and irrigation system layout. All of which will be inputs into development of an integrated irrigation management plan. Other overlays of interest and use to the ORMVAT managers will include social data, such as the ethnic patterns within the population, and economic data. Baseline data for the system will come from current and past remote sensing data available for the perimeter. Development of an operational system will require an integrated GIS station, including a high capacity micro-computer, software and printer package.

This development will be supported by six person months of technical assistance. Long-term training, consisting of formal training as well as an internship, will be provided for 24

person-months.

The second intervention is the installation of automated meteorologic stations in each of the three distinct climatic zones within the sub-perimeter areas -- i.e., Beni-Amir, Beni-Moussa West and Beni-Moussa East. These weather stations will be radio-linked to a dedicated computer which will query them for data several times each day. Each station will have an on-site data logger, which will reduce analog data to a directly useable form and will perform real-time calculations of evapo-transpiration for various crops. The stations will also provide near real-time summaries of accumulated heat units -- which will define physiological maturity of crops and insect pest population dynamics. Weekly and monthly summaries of the data from each site will be made available in report form for the ORMVAT managers, farmers, processors and other public and private agricultural interests.

(3) Mastery of Water Transfers in the Main System

This mastery will be established by three primary actions as outlined below:

- Establishment of a Limited Supervisory Data Acquisition System (LSDAS)

Flow monitoring devices will be linked directly to a dedicated computer via radio links. Such linkages will allow real-time visualization of flows along the system and provide input for the hydraulic model, which will serve to monitor the system in more detail. In addition to measurement of flows in principal canals, measurement of unused return flows, either into drains or the Oum Er Rbia river, will be made to relate flows in the principal canals to water actually utilized in the sub-perimeters.

Along the single principal canal in the Beni-Amir system, installation of automated flow measuring structures and/or instrumentation of existing structures are recommended for five locations in the system. Placement of flow monitoring instrumentation in the Beni-Moussa sub-perimeter will be more complex and involve a greater number of monitoring locations. Descriptions of these locations and the functions of these structures are to be found in Annex F Part 1.

Selection of locations and measurement methods will be verified by a hydraulic engineer at the beginning of the project. Short-term training will be undertaken to train ORMVAT personnel in operation and maintenance of the data logging systems. Training of the ORMVAT managers will also include a study tour of similarly instrumented systems in the western United States, such as the Salt River Project, the Yuma Valley and/or Yuma Mesa Irrigation Districts in Arizona. This training will involve at least two persons and will consist of at least six person-months of training.

- Development of a Computerized Hydraulic Model of the Principal Hydraulic System in Each of the Sub-Perimeters

An existing hydraulic model may be utilized by configuring it for the ORMVAT systems and initializing it with relevant data such as those described in Annex F, Part 1. The model will be relatively simple. When linked to the data acquisition system, it will give real-time main system status based on gate settings and measured inputs. Utilization of an existing dynamic flow canal model, which can be configured for these systems, is recommended. The model and end-of-system flow measurements will serve to indicate the efficiency with which the hydraulic system is being operated and will be useful as a planning tool to increase system responsiveness and flexibility. This model will be the major main system management tool and thus must be operated on a dedicated computer system. Two 486 class microcomputers, with 4 megabytes of random access memory, a 33 megahertz clock, and an 80 megabyte hard drive are recommended -- one for each independent sub-perimeter. Model development and initiation will require technical assistance services as well as training of ORMVAT personnel in model operation and use.

- Development and Training of Mobile Monitoring Units within Each of the Sub-Perimeters

The purpose of the mobile monitoring units will be to develop a better knowledge base of the distribution of water at the primary, secondary and tertiary levels of the system. The units will achieve this by measuring and calibrating turnout gates in the canals starting at the primary canal level and working down to the tertiary level. The units will periodically measure spills from secondary and tertiary canals into the drains. They are necessary because it is impossible to put in place an automated data logging system which can monitor flows at all levels of the systems. The units will provide periodic measurements at the lower levels of the systems and data on the efficiency with which the canal systems are operated. The units will also serve to ensure that turnouts are properly set and accurate and to identify problems in the hydraulic system. The data collected by the units will be supplemental to those collected by the automated monitoring system at the principal canal level. They will be used in conjunction with those data to improve the flexibility and responsiveness of the system. The units will require a period of training, portable weirs with water-measuring devices, and vehicles. Technical assistance will be required to develop team procedures, help establish the units, and provide technical training.

(4) Development of an Improved Management System for the Distribution of Water in the Perimeter

Three actions will be undertaken to achieve these objectives:

- Integration of the Improved Information Base into System Operational Management

Initially, computerization of the water ordering and delivery procedures will be done to relieve the burden of repetitive paper work from the ditch riders -- aiguadiers -- and to allow them to devote more time to the effective implementation of delivery schedules and to discuss problems with farmers. Additional benefits of the new system will be quicker response times in dealing with system fluctuations and more accurate management of water delivery scheduling data. This will require a computer for each of the three ORMVAT Sub-Divisions of the same type as those being used for system hydraulic modeling. From this point, effort will be concentrated on integrating information developed in a process of iterative improvements. This will include integration of the GIS, system hydraulic, hydrology and weather data into the Tadla management systems for water distribution. Networking of computers in these offices will provide for quick transfers of relevant data. The long-term irrigation engineer will be responsible for this development in its entirety.

A diagnostic study of the water distribution system in each of the sub-perimeters will be undertaken early in the project. The objectives of this study will be to understand what is actually happening in the system at all levels and to identify problems with and constraints on the water delivery system. A second diagnostic study will be undertaken in Project Year 5 to assess the directions and degrees of change in system management in response to farmers' needs, as well as to make mid-course corrections in the system. Analyses will focus on the irrigation distribution systems and the interface of the systems with operative farming systems. Analyses will focus on the main distribution systems in the two sub-perimeters and a representative sample of the primary, secondary, tertiary and quaternary canals.

The diagnostic analyses will require short-term technical assistance, local ORMVAT specialists, and farmers participating in analytical teams. The technical assistance level of effort for the two diagnostic analyses is estimated at 18 person months.

Integration of the improved information base into the seasonal irrigation planning process will be done by the long-term irrigation engineer. Once the main elements of these systems are in place -- i.e., by Project Year 3 or 4 -- it will be determined how these elements can be integrated into the irrigation system planning process in such a way that the liberalization of cropping patterns is encouraged, farmers are given information useful to farm-level planning, and optimal use can be made of the soil and water resources.

Additional special studies will complete the integration process. Possible topics are:

- How best to integrate Irrigation Associations in ORMVAT managerial decision-making; and

- Analysis of operating rules of Bin El Ouidane and Afourer systems to determine opportunities for improving efficiency in the overall water allocation system.

A national workshop will be organized to provide an opportunity for interaction with irrigation system managers dealing similar problems in the other ORMVAs.

b. Element 2 -- Improving Knowledge and Management of Resources at the Farm Level in the ORMVAT

Project Element 1 will develop a comprehensive understanding of the hydraulics and hydrology of the ORMVAT irrigation system and implementation of a more responsive system-wide water management system. Project Element 3 will be concerned with the environmental impacts which irrigated agriculture has had and is having on Tadla perimeter soil and water resources. And, Project Element 4 will address the potential for an expanded private sector role in agriculture in the Tadla perimeter.

However, the potential for innovation and development in the agricultural economy of the Tadla perimeter will not be fully realized without an intimate link with and responsiveness to the evolving situation at the farm level. To bring forth an economy which is both more productive and sustainable, the project must establish clear priorities and focus attention on those problems which have high potential for response to improved management. In this context, three activities are fundamental.

First, ORMVAT managers must begin to operate a water delivery system that is much more oriented to the needs of the client-farmers in the sub-perimeters. Second, they must start to factor in water quality and soil resource preservation considerations in their management decisions. And, third, farmers, as participants in the Tadla irrigation system, must have a much better understanding of the technical capacities and managerial constraints of that system and their implications for farm-level enterprises and resource allocation patterns. The key point is that neither ORMVAT managers nor client-farmers will be able to make efficient resource allocation decisions without, first, having comprehensive and reliable information on the workings of the whole perimeter system and, second, without having a structured and continuous dialogue on system operations in the context of a common and accurate base of knowledge.

The four activities under Element 2 are designed to, first, find out what is actually occurring at the farm-level in Tadla in terms of the owner/manager/household decision-making process(es) for selecting and managing crop, livestock and off-farm enterprises, allocating available resources -- i.e., water, land, labor, capital and managerial expertise -- to these enterprises in attainment of household objectives, and selecting which techniques to adopt and which inputs to purchase over time. And, second, to help local decision-

makers to assess what is technically, financially, economically and environmentally possible in the future.

Detailed farm-level knowledge is critical to the discovery process. This is so because even a brief tour through the sub-perimeters leaves one with two impressions. The first is that the actual farming practices, crop rotations and resource allocation patterns bear little or no relationship to the precise crop rotation pattern anticipated when the ORMVAT irrigation systems were designed. The second is that farming systems are quite heterogeneous both between sub-perimeters and within them. This means that one cannot talk about or relate to farm households in Tadla as if they were one homogeneous population. One must define the interests, motivations and capacities of each sub-population before accurate assessments can be made of future potentials.

For all the discussion in the Moroccan irrigation literature about the benefits of the Trame A and Trame B irrigation systems -- or variants thereof -- it is evident that farmers on the Tadla perimeter, have modified the original engineering approach to meet their own technical and socio-economic objectives and resource constraints. Recognition of this basic fact is central to being able to design successful interventions at the system and farm levels in Tadla. It is also clear that the managers at ORMVAT, while possessing much factual information about the perimeter, have less than adequate knowledge of the motivations and objectives of the farm households in the perimeter or of the directions agricultural enterprises will take in a more liberal and market-oriented economic environment.

On one level, farm management information will be important to the development of the system-wide hydraulic management model because it will determine if and how the system can be operated to more adequately respond to the changing demands of the water users. Farm enterprises have evolved considerably since the Tadla system was originally designed and constructed. The ORMVAT staff needs to know how these enterprises are currently constituted, how they actually function as decision-making units, what farmers perceive as their scarce resource(s) and what constraints they face, and what they see as their prospects for the future. In sum, the managers at the ORMVAT need to know their clients much more intimately than they appear to now if they are to be successful in discharging the more focused water delivery management and soil/water resource stewardship mandate which they will have in the medium-term.

In addition to addressing the immediate informational requirements of the ORMVAT, Element 2 will also actively seek to broaden the knowledge base of the farming community as to what is technically possible and economically feasible within the Tadla perimeter. This element will address the mirror image of the problem described above -- i.e., it would instruct farmers as to the technical constraints imposed upon their farming operations by the physical and managerial realities inherent in the ORMVAT hydraulic system as designed. The objective would be to present farmers with practical information as to how far they can stretch the capabilities of the Tadla irrigation system in their attempts to better adapt their farm enterprises to market forces. The central premise is that successful

farmers as entrepreneurs need increasingly detailed and precise information on all aspects of the economic environment in which they must operate if they are to make sound resource allocation decisions.

At a third level, the results from the activities under Element 2 will be regularly and broadly disseminated through local cooperatives, professional organizations, and private sector input suppliers and output buyers. Moreover, the pilot field interventions, wherever feasible, will be designed, jointly funded, executed, and evaluated in collaboration with private sector input suppliers and firms promoting development of specialized cropping systems.

Element 2, therefore, will be comprised of four principal activities:

- Developing an accurate inventory and typology of farm enterprises in the Tadla perimeter (Annex F, Part 2 contains an initial typology) and conducting an intensive diagnostic study of a representative sample of those farm enterprises (200 to 300 farms) over, at least, two full cropping cycles -- i.e., winter and summer crop rotations in two successive years;

- From the intensive diagnostic studies and other sources, critical constraints in farm-level resource allocations will be identified and pilot interventions will be specified and tested at the farm-level to alleviate those constraints. Results of these pilot interventions at the farm-level will then be disseminated to farmers, ORMVAT personnel, cooperatives, professional organizations, and private sector firms.

- Assistance to the Service des Etudes Agro-Economiques (SEAE) to be created at ORMVAT in developing a permanent capacity to follow up on the intensive diagnostic study and to collect and analyze information on farm households and their operations in the perimeter over time.

- Support for a series of assessments of special topics of mutual interest to USAID, ORMVAT and/or other participants in the project. These assessments could include studies of particular agricultural and irrigation policy issues, detailed appraisals of crop production/harvesting/processing/marketing chains -- i.e., filieres -- and assessments of farmers' attitudes toward particular types of innovation.

With respect to the first activity, ORMVAT staff have already amassed a considerable amount of inventory information on the types and distributions of farm enterprises in the Tadla perimeter. The design team has reviewed this information and proposed an initial farm typology for consideration. After detailed review and updating of these inputs and other information, a farm enterprise typology would be developed and used to draw a representative sample of farms to be studied under the intensive diagnostic study. This activity would be completed in the last six months of Project Year 1.

The intensive diagnostic study will be conducted during the first two full agricultural years after the start of the project. The study period would be from the start of the first summer crop season in Project Year 2 to the end of the second winter crop season in Project Year 3. The study would be designed in such a way that data collected could be fully processed and analyzed on a season by season basis. Data collected during the first full agricultural year of the project would constitute baseline information to be used by the project monitoring and evaluation unit at subsequent points in the project to quantitatively assess changes in economic activities at the farm level.

The primary function of the intensive diagnostic study, however, would be to identify farm-level constraints in resource allocation and specify pilot interventions to be tested to alleviate constraints. Given the paucity of detailed farm enterprise data from the Tadla perimeter, it is impossible to specify a priori and with certainty what constraints farmers see as impinging upon their resource allocation decisions or what specific pilot interventions might best address their needs in the medium-term.

From the outsider's perspective, it would appear that farmers might face significant constraints to supply responsiveness and resource allocation in the following areas:

- Tradeoffs between providing subsistence requirements of the extended farm household and being fully responsive to commercial opportunities and market forces;
- Increasing fractionalization of land holdings within the perimeter and the potential divorce of the ownership and management functions in resource allocations;
- Matching actual water deliveries from the system with crop requirements and efficient resource use at the farm-level;
- Inadequate knowledge of crop production techniques and potential on the one hand and real market possibilities on the other;
- Financial constraints in reorienting or developing new farm enterprises in the face of new opportunities; and
- Labor constraints in producing, harvesting and marketing higher value crops.

A series of pilot interventions at the farm-level will be designed and implemented after the first year of the intensive diagnostic study is completed. The interventions in Project Years 2 and 3 are expected to focus primarily on more efficient water/soil management in farmers' fields and on demonstrating more efficient conjunctive use of groundwater and water from the gravity system. Other pilot demonstrations will be designed and implemented as detailed information on farm-level constraints becomes available in the second year of the intensive diagnostic study and, subsequently, from the SEAE.

In all activities, information generated and recommendations advanced will be thoroughly discussed and debated at a series of annual workshops. Participation in these workshops will be open to all interested parties including: ORMVAT personnel, representatives of farmer groups, cooperatives, professional organizations, and private sector input suppliers and output buyers. Representatives from other ORMVAs with similar problems and opportunities will also be invited to participate in these workshops so as to maximize cross-fertilization of ideas and dissemination of project results.

In addition, the project will work closely with the extension agents, professional organizations, and other interested parties at the local and national levels to develop and disseminate, both orally and in written form, summaries of the information collected with detailed recommendations as appropriate. Field days will be organized for farmer and other groups to visit pilot demonstration sites and discuss with project staff and participating farmers how new interventions could be adopted. This process of dialogue and dissemination will start immediately after Element 2 has begun to generate useful information and recommendations and will continue over the life of the project.

c. Element 3 -- Mitigation of the Adverse Environmental Impacts Associated with Resource Misuse

The sustained use of soil and water resources within the two Tadla sub-perimeters is severely threatened by waterlogging, salinity and the presence of agro-chemical pollutants. Conditions vary widely across the area due to variations in water table depths, salt concentrations in ground and surface water, on-farm applications of agro-chemicals -- i.e., pesticides, herbicides and fertilizers -- and discharges of agro-industrial and urban wastes into drainage canals and the Oum Er Rbia river. These environmental management problems, although widely recognized, are not being adequately addressed in the management strategies currently employed by either the ORMVAT or the private sector. Furthermore, the health of the Tadla population, as well as populations downstream, is directly threatened by the use of polluted ground and surface water for domestic purposes.

The activities under Project Element 3 will provide technical assistance, training, and commodity support focused on improving the understanding of these environmental problems. The knowledge gained will be used to improve decision-making and overall management of water and soil resources within the perimeter. Major activities proposed for Element 3 are aimed at mitigating the adverse environmental impacts associated with the misuse of soil and water resources. These include:

- Developing a monitoring system and database of groundwater resources and drainage system efficiencies to be applied to a real-time management model which simulates current resource practices;

- Developing a second, complementary system to monitor the soil modification process and water quality within the two sub-perimeters; and

- Providing a detailed assessment of and monitoring system for agro-chemical storage, use and disposal within the Tadla, making recommendations, and providing forums for improving the region's capacity for sound handling, application and disposal of these agro-chemicals.

(1) Groundwater and Drainage Monitoring and Management

The first activity will establish an information system for real-time management of water table fluctuations and water quality to determine the impacts of irrigation in the two sub-perimeters. Activities will include:

- Establishing data collection points for a permanent groundwater monitoring system;
- Assessing drainage management practices;
- Developing an adaptive groundwater model, including calibration to allow realistic simulations of real-time conditions and integrating the model into the ORMVAT management process; and
- Conducting a study of alternative methods for handling drainage problems and conjunctive use of ground and surface water.

In Project Years 1 and 2, the contractor will work with the Service de Gestion de Reseau d'Irrigation et Drainage (SGRID) to establish the groundwater and drainage monitoring network. A minimum of 100 permanent sample points will be established to monitor water table fluctuations. SGRID personnel will ensure that these sample points are established in a manner that will complement the 56 points currently being monitored within the sub-perimeters by the Direction Regionale Hydraulique (DRH) in Beni Mellal under the Ministry of Public Works. It is paramount that close collaboration and information sharing occur between SGRID and DRH.

The contractor will also work with SGRID to construct a minimum of 20 gauging stations on the drains, streams and collectors within the sub-perimeters. These will serve to complement the 35 stations within the perimeter and the 5 on the Oum Er Rbia river that are currently monitored.

To better understand the dynamics of waterlogging and drainage, a study will be conducted in an area prone to waterlogging -- i.e., a site to be selected by the contractor and the Bureau des Techniques des Irrigation et de Drainage (BTI). Groundwater fluctuations will be closely monitored in the selected area in Project Years 2 and 3.

Continuous data collection from these two monitoring networks and the waterlogging study will serve as the database and provide the inputs necessary to model the region's

groundwater resources. Existing software models of similar monitoring systems developed by the United States Geological Survey (USGS), the United Nations Food and Agriculture Organization (FAO) and others -- including the one being used by the DRH -- will be thoroughly evaluated by the contractor for applicability to perimeter problems. The model will be developed in Project Years 2 and 3, with calibration and verification in Project Year 4. The model will be available for use as a management tool by the SGRID and will be integrated into the management process by the end of Project Year 5.

Data collected will be integrated into the GIS being developed under Element 1. The contractor and SGRID personnel will ensure that the information from the monitoring systems will interface with the outputs from Project Element 1. Real-time management of water resources in the perimeter will necessitate the integration of Elements 1 and 3.

This integration will be enhanced by the study in Project Years 4, 5 and 6 of the conjunctive use of surface and groundwater and drainage system alternatives. Using the data collected in this Element and complemented with outputs from Elements 1 and 2, the contractor in association with SGRID will develop different strategies of water use and determine priorities for sub-surface drainage and vertical drainage systems. This will be of particular importance during drought periods and as more efficient use of water from the Bin El Ouidane Dam becomes mandatory with water transfers to the upper Tessaout area of ORMVAH.

(2) Soil Modification and Water Quality Monitoring

These activities will focus on monitoring soil modification and water quality in the sub-perimeters:

- Establishing monitoring systems for soil decomposition from salinity and leaching and water quality, including -- but not limited to -- nitrates and other pollutant flows in the groundwater, drainage systems and soil profile; and

- Integrating soil and water quality data into the groundwater model to enhance real-time management of resources in the sub-perimeters.

The first activity will establish permanent sampling points for collecting soil, water quality and agro-chemical residue samples during Project Years 1 and 2. Soil data collections will consist of 3 samples per site from a minimum of 20 sites three times per year over the life of the project. Analyses of samples will include pH, salinity, total nitrates, mineral nitrates and cation exchange capacity. Water quality samples will be collected from 200 sample points once a month for Project Years 1, 2 and 3 and 6 times per year in subsequent years. The water quality samples will be analyzed for Ph, dry residues, nitrates, nitrites and salinity. Agro-chemical residue samples will be analyzed in Project Years 2 through 5 from 100 different sample points three times per year. The analyses will be done to determine the presence of a minimum of 5 toxic substances selected and prioritized in conjunction with

the SPA, local agro-industry representatives and the Ministry of Health's Service Hygiene (SH) in Beni Mellal.

The analyses of these samples will be done through a project sub-contractor. One option is to use a private laboratory for this work. A second is to supplement equipment and strengthen the capacity of the existing ORMVAT soils and water laboratory in Fkih Ben Salah. Cost will be the primary criterion for making a final decision but present estimates indicate that the second option might be the best alternative.

The second activity will integrate data into the management processes of the SGRID. Results from the soil and water quality monitoring will be part of the ORMVAT GIS. Data, when viewed with other overlays of farming practices -- i.e., crop areas and their agro-chemical demands -- and surface and groundwater water use, will enhance the decision making capabilities of SGRID managers.

It is extremely important that water quality and pollution information reach the local population. To accomplish this, the project will work through the ORMVAT Service de Vulgarisation et Organisation Professionnel (SVOP) to develop an information network with regional institutions. The most relevant groups in this regard are the DRH, Office National de l'Eau Potable (ONEP), and the extension agents of the SH in Beni Mellal.

(3) Agro-Chemical Storage, Use and Disposal

This activity will concern storage, use and disposal of agro-chemicals. The ORMVAT, agro-industries and farmers are involved with agro-chemical purchases, storage, mixing, handling and disposal. The ORMVAT provides guidance to farmers as to agro-chemical application rates and application procedures -- including safety precautions -- but there is little follow-up and very little is known about actual field practices. Crops like cotton have agro-chemical requirements that are handled by an aerial crop spraying service. Little is known about what environmental precautions are taken by this service. As the process of disengagement by the ORMVAT continues, there is apt to be even less control of these practices and a greater dispersal of agro-chemical storage and disposal sites, if greater care is not taken immediately.

Public health concerns about pollutants in the soil and water from the application of agro-chemicals is growing. The concerns are well-founded. The majority of farmers purchase, mix and apply their own agro-chemicals and most of the people living within the sub-perimeters obtain their domestic water from the irrigation canals and the 9,200 wells in the area. In order to gain a better understanding of agro-chemical use, make recommendations regarding improved handling procedures, and interact with the local institutions and the general population regarding these issues, three activities will be carried out:

- Inventory and description of agro-chemical storage points and disposal sites within the perimeter and establishment of a simple monitoring system that will incorporate new sites as they develop;

- Evaluation of farmer and agro-industry use practices -- i.e., application rates, mixing and application procedures, handling precautions and means of disposal -- that are associated with individual crops and agro-industrial processing sites; and

- Conducting a special study to integrate the information from these assessments and make recommendations for improving agro-chemical management, handling and safety in the region.

The activities are interlinked and are listed as discrete activities only because the timing in implementation and their relationships to other Project Elements differ.

The inventory of agro-chemical storage and disposal sites will be conducted during Project Years 1 and 2 by an agro-chemical specialist in collaboration with the ORMVAT Bureau de Gestion et d'Approvisionnement (BGA) and local agro-industries. This activity will establish a diagnostic baseline of current practices at each site. The data will be integrated into the ORMVAT GIS.

The second activity will be integrated with the intensive farm management diagnostic work and the permanent agro-economic survey described in Element 2. The contractor will work with an agro-chemical specialist to integrate the required elements into the on-going diagnostic work scheduled throughout the project. The objective will be to evaluate actual practices regarding uses of agro-chemicals and determine the relationships between crop applications and subsequent leaching into the groundwater. Information obtained will be used to develop recommendations for improving safety in handling these materials. The data related to actual crop-specific applications will be integrated into the ORMVAT GIS and be used in management of conjunctive use of surface and groundwater resources.

The third activity, a synthesis of the first two activity outputs, will be conducted in Project Year 4. with the specific objective of providing recommendations on improved practices in storage, handling, application and disposal of agro-chemicals in the Tadla area. The contractor will work with the Service de Planification et de la Programmation (SPP), SVOP and the BGA to improve the management of these materials in the ORMVAT and with local populations to improve on-farm handling and disposal practices. The ORMVAT will need to collaborate and share information with area agro-industries and the SH in Beni Mellal through development of technical notes -- in Arabic and French -- regarding the use and handling of these chemicals and workshops with farmers' groups, professional associations and local communes.

d. Private Sector Resource Allocation, Management and Use

The activities of this Element are directed at increasing private sector participation in the rural economy and increasing effective dialogue between private and public actors. They are directly related to the GOM-mandated disengagement process which started in ORMVAT in 1990. Disengagement for the ORMVAT means discontinuing all activities of a commercial nature with the expectation that the activities will be assumed by the private sector. By shortening the lead time for private sector assumption of these commercial activities, Element 4 will reduce disruptions in delivery of essential inputs and services during this process. In this context, the private sector is broadly defined as farmers, cooperatives and professional groups, as well as agribusiness companies.

Element 4 will provide technical assistance and training to increase private sector participation in water and soil resource allocation, management and use. Element 4 will assist selected multi-service cooperatives. These cooperatives have dairy production and milk marketing enterprises which have allowed them to accumulate large capital holdings and which guarantee regular cash flows throughout the year. They also have diversified sources of income -- i.e., milk receipts, animal sales, agricultural input sales, fuel sales and custom machinery operations -- and are beginning to reduce their dependency on ORMVAT facilities and management services. Their constitutions permit them to engage in a wide variety of input and service supply, production, marketing and processing activities. The cooperatives may also own shares in agriculturally-related companies.

The cooperatives have been dependent on ORMVAT since their creation for very basic bookkeeping, as well as more complex accounting, management, investment planning and operating supervision. Cooperative Directors are currently ORMVAT employees. An annual financial audit is done under ORMVAT supervision. ORMVAT staff have been the major organizers and guarantors of technical services and the principal negotiators of input supply, milk inspection, membership store purchases, and milk marketing agreements.

Under the ORMVAT disengagement process, the cooperatives are being charged increasing amounts for the services of Cooperative Directors, rent on use of ORMVAT Centre de Mise en Valeur (CMV) facilities, accounting services and other non-extension services. In response to the rising costs, cooperatives are beginning to move out of CMV facilities into their own milk collection, storage and office facilities built and/or upgraded with their accumulated capital reserves. These cooperatives are also seen by banks as reliable clients with sufficient incomes to permit them to establish lines of credit.

Overall, these multi-service cooperatives appear likely to grow and take advantage of new opportunities in input supply and farmer services resulting from ORMVAT disengagement. However, to increase their independence and sustainability, they must be able to manage their own affairs, orient new investment towards productive uses, and learn to evaluate their activities using commercial and enterprise-based criteria.

Element 4 will strengthen selected cooperatives' capacities to disengage to the extent permitted by their charter and subsequent ministerial orders -- arrêtés -- which still delegate financial oversight responsibilities to the ORMVAT. The GOM will retain the right to review cooperative management plans and audit accounts. These public prerogatives are intended to ensure that cooperative activities are compatible with GOM sector development priorities and to protect the rights of cooperative members.

Element 4 activities will begin with a diagnostic assessment of multi-service cooperatives and the prospects for restructuring their businesses. Short-term technical assistance from an American multi-service cooperative and Moroccan sources will be used to:

- Evaluate current business management practices, their costs -- personnel, direct and indirect cost, contributions and subsidies from various partners -- and the cooperatives' means and opportunities to respond to the disengagement process;

- Strengthen bookkeeping and financial management by cooperative members, employees and contractors;

- Evaluate production and service enterprise management and efficiency and recommend improvements;

- Assess assets and liabilities in developing operational financial objectives;

- Identify needs in strategic planning and business plan development within a cooperative improvement strategy;

- Evaluate the potentials for selected cooperatives to serve as input distributors at the wholesale and/or retail levels;

- Examine the potential for cooperative confederation in Tadla to take advantage of economies of scale in commodity purchasing and general services.

The diagnostic work will detail a technical assistance program in cooperative development which will maximize use of local sources of technical assistance and training and entail contributions from cooperatives and their members. The program is envisaged as a long-term relationship with an American multi-service cooperative. Maximum use will be made of Moroccan resources in bookkeeping, accounting and cooperative management training.

Working with selected cooperatives presents an opportunity to recognize and strengthen the role of women in the cooperatives. The cooperative diagnostic, supplemented by information coming from the Project Element 2 on-farm studies, will examine issues of women as decision-makers in farm enterprises and in cooperative investment and services. Activities for women will be arranged to run parallel to those with the male directors, staff and board of the cooperatives, if, for social reasons, they cannot be run in concert.

The second activity in this Element will be directed at strengthening Professional Associations. Morocco has a long history of professional associations -- Associations Inter-professionelles -- which borrow from European models where there are often close ties and a continuum of interest among individuals, companies, public agencies, research and educational institutions. In Morocco, professional associations benefit from their public interest charter which identifies their public responsibilities as in the national interest, while granting them operational autonomy. While associations are required to communicate the nature of their activities to relevant public agencies, their directors do not have to be civil servants. And, their day-to-day operations and financial management are not subject to a priori supervision by public agency staff, as is the case with most cooperatives.

There are several professional associations representing producers in the Tadla. The project will work with those associations which have the greatest potential for affecting the efficiency of soil and water resources in the perimeter. One of these is the Association des Eleveurs du Tadla (AET). It currently plays a role in organizing the importation and distribution of purebred dairy cattle. It is supported by an assessment levied on milk deliveries. The ORMVAT disengagement committee has identified the AET as a possible recipient in the transfer of the regional dairy cattle artificial insemination program to the private sector.

The focus of project work with associations will be on business and management planning, as ORMVAT's future role in ensuring technical program support and agricultural extension for the associations is better defined. Short-term expatriate technical assistance will be used in this effort. Professional association staff will participate in bookkeeping and management training programs with cooperative officers and members.

The nascent Irrigation Associations have a tightly defined charter. It appears to exclude their diversification into income-generating activities. The associations, therefore, are presently focused entirely on water management and canal maintenance activities. The associations are seen by most participants and observers primarily as a vehicle for transferring the costs of operating and maintaining tertiary and quaternary irrigation systems to the farmers. The Social Soundness Analysis suggests that, as a consequence, these organizations will suffer from internal and external conflicts which may not be resolved with external mediation. The technical analysis in Annex F, Part 4 suggests that the ORMVAT's objective of rehabilitating the tertiary network in the Beni-Amir sub-perimeter before turning it over to the associations may be stymied by uncertainties about the extent and cost of such rehabilitation. Although the PAGI 2 has pledged support Irrigation Association activities and perimeter rehabilitation costs, the pace of work with associations has been slowed in Tadla -- and elsewhere -- because the extent of support for specific rehabilitation activities in the perimeter remains to be negotiated between MARA and the World Bank.

Under Element 1, much of the information on flow measurements and water handling techniques needed to adjust the existing system in accordance with farmer requirements will

be provided. The Social Soundness Analysis (Annex I) recommends that the GOM and the ORMVAT proceed slowly with the campaign to organize Irrigation Associations so as to permit time for adjustments in strategy as needed and in working out mutually-acceptable responsibilities and management practices between the ORMVAT and the associations.

The project will help train the association presidents and board members in bookkeeping, financial management practices, and organizational goal and program planning. In addition, short-term technical assistance will work with the associations, the ORMVAT and the local water commissions to evaluate each association's financial obligations, determine whether the association's best interests with respect to discounts available on water charges, and evaluate how farmers' interests can be best represented in negotiations over desired crop rotations and feasible water deliveries.

In addition to the activities under Element 4 directed at increasing the role of the private sector supply of inputs and services, Project Elements 1, 2 and 3 will also facilitate greater private sector participation in improving system and farm-level allocations, management and use of soil and water resources. These include:

- Element 1 of the project will assist the SGRID and the SEHA to better evaluate the costs and returns of distribution network rehabilitation. This should result in increased demand for waterway elements and contractor services for re-levelling and rehabilitation of canals;

- Element 2 will broadly disseminate the results of its on-farm tests and financial analyses of land leveling, land preparation, pump and motor matching, long-furrow, border check and corrugation irrigation, and pressurized irrigation systems;

- In Element 2, private equipment and service suppliers will be invited to participate in pilot demonstration programs in the surface and pressurized irrigated areas to permit them to participate in comparative demonstrations of the performance and economy of their equipment and services -- i.e., land leveling, land preparation, header canal; and

- Element 2 diagnostic and demonstration work will provide the opportunity for market analyses of demand for equipment, services and inputs. Element 4 will work with cooperatives, professional associations and private companies to study options for the organization, start-up, and/or expansion of equipment, input supply, custom field operations and consulting service operations, all on a cost-sharing basis.

- Element 3 will use private laboratory services for those water, soil and plant tissue analyses, as feasible, in the monitoring program, where the frequent and repetitive sampling required are best done by a service laboratory, rather than a research or classification laboratory.

II. COST ESTIMATE AND FINANCIAL PLAN

A. Cost Estimates and Financial Plan

The total cost of the project is estimated at $ 19.472 million. The project will be supported with contributions from USAID, the participating GOM agencies -- i.e., MARA, DER and ORMVAT -- and the private sector.

1. USAID Contribution

USAID will provide $ 15.577 million in grant funds from the Economic Support Funds (ESF). Projected annual obligations by functional category are shown in Text Table 1 below.

2. Projected Contributions from the GOM and the Private Sector

The GOM contribution to the project will be the in-kind costs for provision of technical and administrative personnel, office space and logistical support for project operations. The GOM will also continue salary payments for government employees while they participate in training sponsored under the project. As per standard GOM/USAID procedures, airline tickets and other travel costs for Moroccans participating in external training will be paid by the GOM. The projected GOM contribution to the project is estimated to have a value of $ 3.120 million.

Private sector firms and individuals benefitting directly from project interventions, training and/or technical assistance support will contribute to project support costs. This private sector support is anticipated to include payments for airline tickets and other travel costs for employee participants in domestic and external training; salaries and logistical support for personnel working with project specialists on collaborative pollution reduction/-environmental protection activities, export market surveys, and other activities. The projected contribution from the private sector is estimated to have a value of $ 0.775 million.

B. Methods of Implementation and Financing

The methods of AID disbursement to be used in this project will include:

1. Direct Payments

USAID may make direct payments to suppliers or contractors for goods and/or services delivered.

[INSERT TEXT TABLE 1 ON THIS PAGE]

2. Reimbursement

Under the reimbursement method of financing, the GOM implementing agency or private contractor will disburse its own funds and be reimbursed by USAID upon submission of appropriate documentation.

Text Table 2 summarizes the expected implementation and financing methods for disbursement of AID funds.

TEXT TABLE 2

Type of Expense	Implementation Method	Financing Method
Training	AID Direct Institutional Contract	Reimbursement
Technical Assistance	AID Direct Institutional Contract	Direct Payment
Commodities and Supplies	AID Direct Institutional Contract or Direct Purchase from Supplier	Reimbursement Direct Payment
Evaluation and Audit	AID Direct Contract	Direct Payment

C. Recurrent Costs and Flow of Funds

1. GOM

Recurrent cost obligations incurred by the GOM as a direct result of project activities are expected to be modest. They are estimated to be approximately $ 0.750 million per year in real terms. Given that ORMVAT, the principal GOM agency participant, is progressively divesting itself of the cost of many commercial activities at the same time that its gross revenues are increasing due to higher irrigation water fees and better collection procedures, it should be an excellent position to assume the projected recurrent cost obligations by the end of the project.

2. Private Sector

No significant recurrent costs are anticipated for private sector firms or individuals as a result of their voluntary participation in the project.

3. USAID

Once funds are obligated for the project, earmarking, commitments and disbursements will

follow, depending on the project's pace of activity. Flow of USAID funds will be subject to standard rules and regulations.

All foreign exchange costs under AID direct contracts or project grants will be paid directly by USAID. USAID may make direct payments or reimbursements to suppliers/contractors.

D. Project Audit Requirements

Primary responsibility for audits of USAID projects lies with the Regional Inspector General's Office (RIG). However, in the event that the RIG is unable to carry out direct audit activities, an external auditing firm will be contracted for the purpose. An amount of $ 150,000 will be provided for two non-federal audits. It is anticipated that such reviews will comply in all respects with United States Government requirements for financial and program audits.

E. Standard USAID Project Financial Tables

USAID project financial tables are presented in Annex G. They are Annex G Table 1 -- Summary Cost Estimate and Financial Plan; Annex G Table 2 -- Costing of Project Outputs/Inputs; and Annex G Table 3 -- Projection of Expenditures by Fiscal Year.

III. IMPLEMENTATION PLAN

A. Project Staffing and Relationships

The life of the project will be seven years from the date of signing of the USAID/GOM Project Agreement to the Project Activity Completion Date (PACD). The bulk of the project will be implemented by an institutional contractor. Because of the nature of the project and the level of local technical assistance required, a joint venture between Moroccan and American universities or private firms recognized for their capabilities in the implementation of technical, social and institutional initiatives in irrigation management is needed.

The institutional contractor will provide long and short-term advisors -- both Moroccan and expatriate. The contractor may also be required to procure equipment and commodities required by the project on behalf of USAID. Training opportunities -- both local and external -- will be provided in coordination with the USAID Office of Training. Additional short-term technical services for external evaluations and audits and/or special studies will be provided by "buy-ins" to appropriate centrally-funded projects and/or Indefinite Quantity Contract (IQC) firms.

The project will be based in Fkih Ben Salah to facilitate necessary interactions with ORMVAT staff and other project participants working in the Tadla perimeter. The project will maintain its own office, administrative and logistical organization. The project staff will include, at a minimum, the following long-term positions: contractor chief of party (7 years), irrigation engineer (5 years), agricultural economist (3 years), administrative office manager (7 years), monitoring/evaluation officer (7 years); two accountants (7 years each), two secretary/ translators (7 years each), and two chauffeurs (7 years each). These long-term resident project staff members will be complemented by short-term contractual personnel -- both Moroccan and expatriate -- as needed to implement the project Elements.

B. Relationships to the ORMVAT

The key GOM counterpart agency for this project will be the ORMVAT, which is one of the oldest and best established regional irrigation authorities in Morocco. It has a solid reputation for sound perimeter management and a positive orientation towards implementation of the country's new irrigation policies.

The project has been designed to develop and institutionalize critical new capacities and activities within the ORMVAT. It is committed to sustainability -- i.e., the continuing capacity of ORMVAT to manage effectively its new responsibilities beyond USAID support -- and to adaptation to the changing needs in the irrigation sub-sector. Implementation will be geared towards strengthening ORMVAT staff capacities to ensure full staff involvement in project activities and fostering action-oriented mechanisms within the existing ORMVAT structure, albeit within a reduced sphere of ORMVAT activities. There will be no need for

creation of a new institution.

The project will require the substantive participation of private entrepreneurs and farmers, agribusiness firms, professional associations, cooperatives, Chambers of Commerce and Agriculture, and other non-governmental organizations. A variety of mechanisms, described in Section III.D., are designed to ensure that project implementation agents are fully prepared to assume their roles in the project.

The project staff will work with ORMVAT personnel, as coordinated through the ORMVAT Director. Close liaison will be maintained with the ORMVAT Comite Technique (CT) and, as necessary, with the ORMVAT Conseil d'Administration (CA). In collaboration with the SPP, the project staff will produce annual work plans, quarterly progress reports, and financial accounting reports. The annual work plans will be submitted to USAID and MARA for review and approval. The approved annual work plans will be made available to the Office of the Governor for the Provinces of Beni Mellal, the Provincial Technical and Administrative Councils, and the Provincial Development Council.

Counterpart relations, while not formalized, will be functionally as follows:

Project Resident Staff	Functional Counterpart
Chief of Party	Director, ORMVAT
Irrigation Engineer	Head of SGRID
Agricultural Economist	Head of SPA
Monitoring/Evaluation Officer	Head of SPP

C. USAID Staff Requirements

USAID's past involvement in the irrigation sub-sector and its close working relationships with various agricultural development, research and educational institutions and staff, under many different bilateral projects, will greatly facilitate the successful implementation of the project.

Within USAID, the Office of Agriculture and Natural Resources will be responsible for the implementation and monitoring the project. USAID will provide for one full-time USAID direct-hire manager for this project, assisted by Moroccan professional and clerical staff as required.

D. Methods for Implementation of the Project Elements

1. Implementation of Element 1

Given the complexity of the interventions and the need for continuity in integrating all the elements within a single functioning management system, the activities under Element 1 will

be carried out under the supervision of a long-term irrigation engineer through the first six years of the project. This engineer will be an expert in irrigation management, with extensive experience in hydraulics and computer modeling. The project will establish working units within the two bureaus of SGRID and its subdivisions as described below. The irrigation engineer will be responsible for development of linkages between units and their integration into a single management system. The implementation of Element 1 will follow a phased approach -- i.e., with 3 years devoted to establishment of the working units, 2 years to the finalization of linkages between units, and 2 years to the actual operation and trouble-shooting of this management system.

a. The Working Units

(1) The Water Resources Unit

The project will consolidate within the Bureau d'Exploitation (BE) of SGRID a Water Resources Unit which will be responsible for surface water hydrology, groundwater hydrology and water quality. The groundwater hydrology and water quality responsibilities of the BE are described under Element 3.

Surface hydrology activities will require agreements between the ORMVAT, ORMVAH, the Ministry of Public Works, and the Office National d'Energy (ONE). In order to develop and maintain a database of flows in the Oum Er Rbia river at Kasba Tadla diversion dam and into Bin El Ouidane dam, an agreement will be established with the Direction Regionale Hydraulique (DRH) of the Ministry of Public Works for the regular importation of such data into the ORMVAT data base. Statistical analysis of the flow data on the Oum Er Rbia river will yield the expected hydrograph of water available for diversion into the Beni-Amir main canal for use in the seasonal planning and water delivery scheduling process for this sub-perimeter. Statistical analysis of inflows into the Bin El Ouidane dam will serve as a basis for a review of the operating rules for the dam and power plant at Afourer taking into account the new constraints of supplies to canal T2 as part of the "corrected manifest of Bin El Ouidane" between ORMVAT, ORMVAH and ONE. ORMVAT will provide the necessary staff for the Water Resources Unit consisting of a surface hydrology specialist, a groundwater specialist and technicians.

(2) The GIS Unit

This unit will be established within the BE to provide easily accessible information on the Tadla perimeter. Initially, information will be collected which will directly aid in implementation of the seasonal irrigation planning and water delivery processes. The GIS will become the central unit serving ORMVAT information needs and be integrated into the SIG master plan for the ORMVAT, as supported by PAGI 1 and 2. The GIS unit will be staffed by one engineer -- i.e., an Ingenieur du Travaux Rurale or Ingenieur du Travaux Topographiques.

(3) The Agro-Meteorological Unit

Established within BTI, this unit will be responsible for operating the three weather stations to be supplied by the project, maintaining a weather database, publishing a weekly weather bulletin, and making the bulletin available to farmers, extension agents, aiguadiers, agro-industrial processors, and other public and private sector actors. Supplying this information on a regular basis will improve decision-making capabilities for all agricultural operations in the perimeter. The unit might also evolve to provide direct irrigation scheduling services for individual farmers. The Agro-Meteorological Unit will be staffed by one engineer and one technician.

(4) The Main System Supervision and Control Units

Two Main System Supervision and Control Units will be established in the perimeter -- i.e., one in the office of the Subdivisionaire of Beni-Amir sub-perimeter at Fkih Ben Salah and the other in the office of the Subdivisionaire of Beni-Moussa sub-perimeter at Afourer. Each unit will be composed of a Real-Time Remote System Monitoring Team and a Mobile Monitoring Team. These units will provide a better understanding of the hydraulics of the canal system through hydraulic modeling, canal calibration and real-time system monitoring.

Each Real-Time Remote System Monitoring Team will be responsible for monitoring real-time system flow measurements and for operating a hydraulic model of an irrigation sub-perimeter. Modeling will be used to give system status reports, in conjunction with real-time flow measurements and scheduled gate settings, and to keep a current database of the hydraulic characteristics of the distribution system. This database will be used by the Subdivisionaire in planning and scheduling water distributions. Activities will require the services of the mobile monitoring unit to verify actual canal and hydraulic control structures conditions and present gate settings. This team will consist of an engineer specializing in hydraulic systems and two technicians to operate the model and the real-time measurement system.

The Mobile Monitoring Team will be responsible for field measurement and verification of canal system operational parameters. They will work in close cooperation with the remote monitoring team. The team will consist of an engineer specialized in hydraulic measurement and three technicians with skills in surveying, hydraulic measurement techniques, and electronic data logging. Provision of transport and radio communications with the remote monitoring team will be necessary to permit investigation and prompt reporting of any variances between theoretical and actual system operations.

b. Integrated Distribution System Operation Management

Element 1 will integrate the different information gathering and processing units into a coordinated management system. The project irrigation engineer will work with the head

of the BE and the heads of each of the three subdivisions to formulate an operational policy, prepare annual and seasonal operating plans, prepare procedures for water delivery schedule preparation, and formulate an iterative process to improve system operational procedures based on actual system measurements and field monitoring.

Formulation of a detailed operational policy and general operating criteria for ORMVA/SGRID system operators and Irrigation Associations will require interactions with all relevant actors in the water distribution process. Identification of and interaction with these actors will be accomplished in the course of the two diagnostic analyses. These studies will be used to define the precise roles of the new working units in water policy decision-making. Preparation of the annual and seasonal operating plans will involve estimation of expected water supplies by the Water Resource Unit, and estimation of water demands for projected cropping patterns by the GIS and Agro-Meteorological Units.

Preparation of a specific set of procedures to operate perimeter head works and water conveyance systems to provide efficient water deliveries to farmers will involve the Main System Supervision and Control Units, Agro-Meteorological Unit, and GIS Unit. Definition of these procedures will require an understanding of actual hydraulic conditions in the system, water demand patterns, and near real-time weather data. Iterative improvements in these procedures over time will require definition of monitoring procedures to verify outputs from the Main System Supervision and Control Units.

2. Implementation of Element 2

a. The Process of Communication and Feedback

Project Element 2 will work as a systematic program of consultation and reporting. Planning, implementation, evaluation and dissemination of results for the activities in Element 2 will be centered in the SPA, which under the PAGI 2/SIG restructuring plan is soon to be converted into the Service des Etudes Agro-Economiques (SEAE). To facilitate work within the ORMVAT and with the private sector, a small working committee will be constituted, with ORMVAT staff from the SEHA, the SGRID, the SVOP; and private sector representatives relevant to each activity undertaken.

Starting in Project Year 1, a detailed annual work plan for Element 2 will be drawn up by the working committee and presented at a workshop. Participants at the workshop will include: members of the Element 2 working committee; farmer-representatives who have been selected by their peers at the CMV level; private agribusiness persons with commercial interests in the perimeter; professional association and cooperative representatives; and representatives of other concerned institutions within the GOM, other ORMVAs, and the donor community. Starting in Project Year 2, the annual workshops will include a presentation of Element 2 accomplishments vis-a-vis annual work plan objectives. Workshops will provide a major forum for general flows of information and feedback on Element 2 activities. The discussions and recommendations generated during each workshop

will serve as a vehicle to inform all participants and catalyze cooperation between project staff and the representatives for the following year's work.

As work under Element 2 proceeds, with results generated and recommendations formulated, additional other fora will be organized to aid in dissemination of information. Working with the SVOP and private groups -- i.e. input suppliers, cooperative leaders, etc. -- these fora will include demonstrations of improved technical packages in farmers fields, general farmer field days, and group-specific training sessions. The last activity is seen as especially important for informing the private sector of potential clients and business opportunities. However, all activities will focus on the economic value of the information and technical innovations being generated by Project Element 2 and will foster farmer adoption and adaptation of innovations.

Information and recommendations for discrete innovations and/or technical packages will be summarized as technical reference sheets -- Referentiels Techniques (RT) for specific farmer groups. These sheets, as well as occasional bulletins produced, will be circulated to all concerned parties -- i.e., farmers, private sector firms, professional associations, cooperatives -- in French and Arabic. A mailing list will be established for this purpose. In addition, Element 2 staff will seek to participate in radio broadcasts of agricultural information for Tadla farmers, if current plans for a regional agricultural radio program materialize.

b. Generating Information and Innovation

During Project Years 1 and 2, the major activity for Project Element 2 will be an intensive study of farm management strategies and practices. This study will be based on a farm typology for the Tadla perimeter -- see Annex F Part 2 for an initial typology. The work will be conducted by project's resident agricultural economists, other short-term technical assistance specialists, and personnel from the new SEAE. After the initial study has been completed, the staff of the Observatoire Permanent (OP) in the new SEAE will continue to collect farm-level information and will be supported by technical assistance, equipment and training from the project. This work will serve to guide project activities starting after Project Year 3 and results will feed directly into the project monitoring and evaluation unit, the ORMVAT Cellule de Suivi (CS) and the SPP.

Technical baseline studies required during Project Years 1 and 2 for the field production component of Element 2 will include work on: conjunctive use of groundwater and gravity system water at the farm-level; farm water application methods and field efficiencies; and farm-level use of chemical fertilizers and agro-chemicals. The water-related activities will be implemented with the BTI in the SGRID. The third activity will be implemented in cooperation with the Bureau des Cultures Diverses (BCD) of the SPA.

The intensive farm management study will provide on-farm baseline information on crop yields which will be used as benchmarks in establishing the potential and actual impacts of

improved crop production packages on the various farm types in the Tadla perimeter. Information on average crop production for the entire perimeter is currently gathered by the SPA and changes in these figures will be used in developing indicators of project impacts.

Since level-field borders and checks have not been tested as an irrigation method on the perimeter and pressurized systems have not been tested systematically, field trials using these methods will be implemented in Project Years 2 and 3, with the BTI and Station Experimental d'Hydraulique Agricole at Oulad Ganou. Station data on furrow irrigation, using gated pipe and other irrigation techniques, will contribute information for development of improved technical packages for irrigated crops.

Post-diagnostic trials will demonstrate tested crop production packages under different farm conditions. They will be implemented with staff from the SPA, SVOP and private input suppliers. Demonstrations will start as soon as valid production packages have been developed. The earliest possible time for setting out demonstration trials would be Project Year 3, but it is unlikely that most packages will be ready for demonstration before Project Year 4. Individual techniques and/or elements in packages, however, could be available for field day activities starting as early as Project Year 2. Demonstrations, field days and workshops will be done in cooperation with the SPA and the Bureau de Vulgarization (BV) in the SVOP.

3. Implementation of Element 3

Element 3 will have three major activities:

- Provision of technical assistance and training for ORMVAT staff in development of a permanent system for collection and use of groundwater and drainage data in resource management;

- Provision of technical assistance and training for ORMVAT staff in the development of a permanent soil degradation and water quality monitoring system and use of these data in resource management; and

- Provision of technical assistance and training for ORMVAT staff, extension personnel, public health workers, and private sector firms in proper storage, handling, use and disposal of agro-chemicals.

The activities are all important to the task of improving safety and sustaining use of soil and water resources in the Tadla. Short-term technical assistance specialists provided under the project will work with personnel from the SGRID, SPA and SVOP in implementing Element 3 activities.

a. Groundwater and Water Quality Monitoring Systems

The first two activities focus on the development and use of a permanent monitoring system and database of groundwater fluctuations, water quality and drainage system efficiencies in the Tadla perimeter. Using the services of a short-term hydrologist and agriculture engineer in Project Years 1 and 2, the contractor will work with BE to install groundwater monitoring equipment and establish sampling points and procedures to collect water quality data. The monitoring sites will be coordinated with those already established within the perimeter by the DRH. The short-term services of a GIS specialist will insure that data collections are consistent with the overall GIS system. The Water Resources Unit in the BE will be responsible for collecting field data and insuring that they are integrated with Element 1 activities.

The monitoring of drainage and water collectors will begin in Project Year 1 with the installation of water volume and flow measurement equipment at approximately 20 sites in the two sub-perimeters. This equipment will complement stations already being monitored by the SGRID. The contractor's hydrologist, soil scientist and agriculture engineer will work with the BTI to improve the monitoring system and provide training necessary to upgrade ORMVAT staff skills. The BTI will also be responsible for overall functioning of the monitoring system, regular collection of data, and ensuring that information is shared on a regular basis with the GIS Unit.

Data will be used by the contractor's hydrologist in Project Years 2 and 3 to develop a groundwater model for the Tadla. In Project Year 4, the model will be calibrated and verified by the short-term hydrologist and agriculture engineer. By Year 5, the model will be integrated into the ORMVAT's water management system. Technical assistance will be required to train SGRID personnel in the application and use of this tool in their decision-making processes.

The contract hydrologist, soil scientist, and agriculture engineer will provide assistance in conducting a case study of the effects of waterlogging in Beni-Moussa West in Project Years 4, 5 and 6. Working with ORMVAT staff from the Water Resources, Drainage, and Soil Monitoring Units, the technical assistance specialists will use case study results, with surface and groundwater data, to develop strategies for improved drainage techniques and conjunctive use of surface and groundwater resources in Tadla.

Soil degradation -- including salinity -- and water quality analyses will need to be conducted beginning in Project Year 1 and throughout the project. The contractor will investigate two alternatives for accomplishing these analyses: contracting the tasks out to a private laboratory or supplementing existing equipment and training technicians at the ORMVAT soil and water laboratory. Cost will be the principal factor in carefully weighing the alternatives.

To improve ORMVAT staff understanding of and management capabilities with respect to

management of surface and groundwater resources, the contractor will provide external observation missions for SGRID managers. These training missions will be conducted in Project Years 2, 3, 4 and 5 to complement activities planned under Elements 1 and 3. To fulfill the objectives of Element 3, visits will be made to areas where groundwater management models, water quality pollution and GIS information are used in resource management programs.

b. Agro-Chemical Storage, Handling, Use and Disposal

During Project Year 1, the contractor will provide a short-term agro-chemical specialist to investigate and catalogue agro-chemical storage and disposal sites in the Tadla perimeter. Working with the SPA and the MARA/SPV staff, this specialist will develop a monitoring system to track the evolutions of these sites over time. The SPA will be responsible for maintaining this database and sharing the information with the GIS Unit in the BE.

To gain more comprehensive knowledge of on-farm and agro-industrial handling, application and disposal of agro-chemicals, the project will provide technical assistance to survey the farms and agro-industrial firms in the Tadla. To make the process more efficient, the agro-chemical/environmental specialist will work with the resident agricultural economist and short-term agronomist to develop specific questions related to agro-chemicals for the Element 2 intensive farm management study. The agro-chemical/environmental specialist will then be responsible for analyzing these data in Project Years 2 and 3 as study results are accumulated. Because this information is closely linked with water quality, the Water Resources Unit, with the assistance of the GIS Unit, will be responsible for integrating the data into the SGRID management decision process within the BE.

The short-term environmental specialist will work with the SVOP to synthesize the information from storage/disposal database and the on-farm survey to develop recommendations for improving the management of agro-chemicals in the Tadla perimeter. This task will be completed by the end of Project Year 3. In order to improve awareness of the impact of these pollutants in the region, the environmental specialist will work with the SVOP to develop informational materials and a network of institutions in the Beni Mellal Province to work on these problems. This network with be comprised of the SVOP and other water quality action-oriented institutions like the DRH, ONEP and SH. It will serve to inform the local population about improved management of agro-chemicals and will provide a mechanism for joint actions to mitigate the impacts of agricultural and agro-industrial pollutants on human and animal health when and where they occur within the Tadla perimeter.

4. Implementation of Element 4

Element 4 has five major activities:

- Technical assistance and training in multi-service cooperative management;

- Technical assistance and training for selected professional associations;
- Technical assistance and training for Irrigation Associations;
- Developing increased private sector supply of inputs and services; and
- Increasing private sector investment in production and value-added agro-industry.

The first two activities are closely related. To ensure continuity and coordination of effort, these two activities will be implemented with the assistance of an American multi-service cooperative whose activities include input supply, producer services, marketing, banking, and investment. The option of implementing these services through a centrally-funded program, such as the Dairy Cooperative Program, was set aside because it appeared that a sub-contract arrangement offered better prospects for coordination and efficiency in the project. A centrally-funded program could still be called upon to provide complementary resources in the technical production and processing activities.

A diagnostic study will be done in Project Year 1 by the American cooperative. The objective of the study will be to develop an appropriate technical assistance and training program and establish a long-term working relationship with cooperatives and professional associations in the Tadla perimeter. The sub-contract between an American cooperative and overall project contractor will permit better coordination of this effort and serve to reduce support costs for the cooperative/professional association management improvement activity. One of the requirements of the sub-contract will be that the American cooperative will maximize the use of Moroccan training institutions, including private business schools, in its work. This approach will permit cultural and linguistic translation of training materials in the Moroccan context and allow the American cooperative to concentrate on cooperative management and development of cooperative marketing strategies. In Project Year 1, internships in cooperative management will be offered for two individuals. These trainees will return to Tadla and serve as coordinators for the cooperative and association management improvement program. One will be an ORMVAT staff member currently working to implement the ORMVAT disengagement process.

The Irrigation Associations are of substantial concern to the GOM. The project's long-term irrigation engineer will be working closely with the ORMVAT and the Irrigation Associations on rehabilitation and maintenance of irrigation network infrastructure and water delivery system improvements. The project's long-term agricultural economist will provide continuity of effort in the development and demonstration of improved resource management practices and technologies. Element 4 will provide short-term technical assistance and training in organization and management of irrigation associations.

Short-term technical assistance under Element 4 will be used initially to diagnose and define how Irrigation Associations can manage their operations and maintenance mandate, working with the long-term chief of party and in consultation with ORMVAT, provincial

agencies, and irrigation commissions at the district (commune) level. It is very important in this regard that Irrigation Association presidents and board members learn how to calculate operation and maintenance costs, to manage Association accounts, and to reduce costs in planning for ORMVAT disengagement.

Element 4 will provide training for Association members and technical assistance to help them manage their operations. The long-term assistance team will prepare terms of reference for training and put out bids for training services from public and private business and management schools. The long-term team and the ORMVAT, with inputs from the participating training schools, will produce an Irrigation Association management manual in Arabic. Irrigation Association presidents and board members will participate in the cooperative management program offered to the multi-service cooperatives under the first two activities.

Increasing the private sector supply of agricultural inputs and services will be fostered by all four project Elements. The project will procure a range of goods and services from the local private sector. Element 2 will generate and disseminate information which will identify new market opportunities in commercial supply of inputs, equipment and services. Element 3 will provide short-term technical assistance to individuals, cooperatives, associations, and private firms on proper handling, storage, use and disposal of fertilizers and agro-chemicals. Both the chief of party and the agricultural economist will work with the private sector as ORMVAT disengages and major input and service suppliers -- i.e., the Societe National de Commercialisation des Semences (SONACOS), the two sugar beet mills (SUBM and SUNAT) and the sugar refinery (SUTA) are privatized over the next few years. They will assist in identifying and defining options for transferring these commercial operations to the private sector. Increasing private sector investment in production and value-added agro-industry will be fostered by provision of short-term consulting assistance to develop feasibility studies, business plans or provide limited start-up assistance on a 50/50 cost shared basis. Element 4 assistance will be oriented primarily toward those crops and related activities falling outside the purview of the USAID MAP. Project staff will orient investors interested in horticultural crops to the MAP.

TEXT FIGURE 1
INDICATIVE IMPLEMENTATION SCHEDULE FOR MAJOR PROJECT ACTIVITIES

General Project Activities	Year 1 1234	Year 2 1234	Year 3 1234	Year 4 1234	Year 5 1234	Year 6 1234	Year 7 1234
Project Agreement Signed With GOM	x						
Request for Proposals Released	x						
Institutional Contract Awarded	x						
Contractor Team Members Arrive	x						
Project Office Established and Local Project Staff Hired	x						
Commodity Procurement Initiated	x						
Annual Work Plans Developed	xx	x	x	x	x	x	x
Long-Term Staffing							
Chief of Party	xx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Irrigation Engineer	xx	xxxx	xxxx	xxxx	xxxx	xx	
Agricultural Economist	xx	xxxx	xxxx	xx			
External Project Evaluations			x			x	
External Project Audits			x			x	
Element 1 Activities							
Hydrology Unit							
Commodity Procurement	x						
Equipment Installation and Training	x	xxxx	xxxx				
GIS Unit							
Commodity Procurement	x						
Equipment Installation and Training	x	xxxx	xxxx				
Agrometeorological Unit							
Commodity Procurement	x						
Equipment Installation and Training	x	xxxx	xxxx				
Supervisory and Data Acquisition System							
Preliminary Hydraulic Study and Development of Specifications	xx						
Commodity Procurement and Installation	xx	xxx					
Construction of Control Sections	x	xxxx					
External Observation Tours	x	xxxx					
On-Site Training	x	xxxx	xxxx				
Hydraulic Model Development							
Procurement of Modeling Software		x					
Hands-On Training		xxxx	xxxx	xxxx			

Mobil Monitoring Unit							
Commodity Procurement	xx						
On-Site Training	x	xxxx					
Calibration of Baffle Modules	x	xxxx	xxxx	xxxx	xxxx	xxxx	
Development of Operational Procedures and Feedback Mechanisms			xxxx	xxxx	xxxx		
Diagnostic Analysis		xxxx				xxxx	
Computerization of Water Delivery Schedules							
Commodity Procurement	x						
Technical Training		xxxx					
Special Studies			xxxx				
Integrated Water Management	xx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
National Workshop							x
Element 2 Activities							
Intensive Farm Management Survey	xx	xxxx	xxxx	xx			
Semi-Annual Crop Reports	x	x	x x	x x	x x	x x	x x
Commodity Procurement and Installation		x	x	x	x	x	
Pilot Field Trials		xxxx	xxxx	xxxx	xxxx	xxxx	
Pilot Field Demonstrations				xxxx	xxxx	xxxx	xxxx
Annual Workshops		x	x	x	x	x	x
Support for ORMVAT Agro-Economic Studies Service		xx	xxxx	xxxx	xxxx	xxxx	xxxx
Special Studies		xx	xxxx	xxxx	xxxx	xxxx	xxxx
Element 3 Activities							
Water Balance and Drainage							
Procurement and Installation of Monitoring Equipment	x	xxxx					
Long-Term Data Collection		xxxx	xxxx	xxxx	xxxx	xxxx	
Development of Groundwater Model		xxxx	xxxx				
Calibration/Verification of the Model				xxxx	xx		
Waterlogging Experiment				xxxx	xxxx	xxxx	
Integration of Model with Water Management System					xxxx	xxxx	xxxx
Soil Modification and Water Quality							
Procurement and Installation of Monitoring Equipment	x	xxxx					
Long-Term Data Collection		xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Soils, Water and Pollutant Analyses		xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Integration of Water Quality Data with Water Management System			xx	xxxx	xxxx	xxxx	xxxx

Agro-Chemical Storage, Use and Disposal							
Inventory of Storage and Disposal Sites	xx						
Monitoring of Storage and Disposal Sites		x	x	x	x		
Survey of Farmer and Agro-Industry Practices	xx	xxxx					
Analysis of Farmer and Agro-Industry Practices			xxx				
Recommendations for Improved Management of Agro-Chemical Storage, Use and Disposal				xx			
Establishment of Pollution Information Network				xxxx	xxxx		
External Observation Tours		xxxx	xxxx	xxxx	xxxx		
Element 4 Activities							
Cooperative Improvement							
Cooperative Diagnostic Study	xx						
Internships	x	xxxx	xxxx	xxxx	xxxx	xxxx	
In-Country Training with Business Management Modules		xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Professional Associations Improvement							
Business Plan Development							
Circuit Transfers							
Transfer of Purebred Cattle Imports							
Irrigation Associations							
Board Member Training		x	x	x	x		
Operations and Maintenance Costing	x	x	x				
Leveling Feasibility Study			xx				
Leveling Service Operational				xx			
Aiguadiers Transferred			xxxx	xxxx	xxxx	xxxx	xxxx
Input Services and Supply Feasibility Studies	x	x	x	x	x	x	
Private Sector Promotion							
Horticultural Referrals to USAID MAP	x	x	x	x	x	x	
Filiere Feasibility Studies	x	x	x	x	x	x	

IV. MONITORING PLAN

The project monitoring and evaluation plan is presented in two sections. The first deals with tracking of project activities by USAID and the GOM. The second concerns the internal project mechanism to monitor and evaluate the impacts of the project in the Tadla area.

A. Tracking of Project Implementation

Routine tracking of project activities will be the responsibility of USAID. The institutional contractor will be responsible for preparing an annual project work plan and submitting quarterly reports on all project activities. This monitoring function will be complemented by project management meetings to be held in Fikh Ben Salah every two months. Participants in these management meetings will be the institutional contractor's chief of party, the representative of the Moroccan technical assistance sub-contractor, the USAID project officer, and the Director of ORMVAT. Other project staff and representatives of participating agencies will attend meetings, as needed.

In addition to the bi-monthly project management meetings, an annual project management review will be held with the participation of representatives from the institutional contractor's home office and those of the sub-contractors. These annual project reviews will serve to provide timely external feedback on project implementation and to assist in addressing any particular project issues.

Project funds have been provided for two external project evaluations and two external audits. This external monitoring system will include a mid-term evaluation at the end of Project Year 3 and a final impact evaluation at the end of Project Year 6. The timing of the final evaluation will afford sufficient time prior to the end of the project to properly assess project accomplishments and to disseminate promising project results.

B. Project Impact Monitoring and Evaluation

The project impact monitoring and evaluation plan will be organized around two fundamental themes.

1. Reactions in the ORMVAT Perimeter to Project Activities

- To provide a structured comparative analysis of planned project objectives and actual results obtained;

- To identify and analyze factors which explain adoption of planned interventions or, conversely, account for resistance to adoption and divergences from planned outcomes; and

- To review the project goal, purpose and objectives at periodic intervals in light of the observed and evolving needs of the area.

2. Project Impacts in the ORMVAT Perimeter

- To identify, characterize and, wherever possible, quantify the types of change and the transformations in the regional economy induced by the project; and

- To evaluate impacts of planned activities on anticipated and actual project beneficiaries in quantitative and qualitative terms.

Underlying the conceptual framework for the impact monitoring and evaluation plan is the raison d'etre for the project -- i.e., to increase the efficiency, economic yield and environmental sustainability of water and soil resources management and use in the ORMVAT perimeter. To this end, the project is directed at assisting in the disengagement of the ORMVAT from commercial activities, the restructuring of its remaining functions to make it more responsible to the needs of its clients, and the progressive transfer of many economic activities and prerogatives to farmers, private sector firms, cooperatives and professional associations.

3. Central Elements of the Monitoring and Evaluation Plan

The principal questions to be addressed in the project monitoring and evaluation plan are:

- How can adequate levels of confidence be guaranteed in the data to be collected?

- How is continuity in data collection to be assured?

- How can efficient data entry and analysis be assured?

- What will be the process for centralizing the information collected and making it accessible to USAID and the GOM?

To ensure that these four items are professionally managed, the project will have a internal monitoring and evaluation unit -- Cellule de Suivi/Evaluation -- which will function independently of the four Elements of the project. It will work in close collaboration with the ORMVAT Cellule de Suivi, which is charged with similar evaluation responsibilities for all ORMVAT activities. The internal unit will be composed of personnel hired by the project -- i.e. a full-time project evaluation officer and support staff -- and professional staff seconded by the ORMVAT. The unit will have a life-of-project budget of $ 300,000 to be used exclusively for internal monitoring and evaluation activities.

The activities of this unit will be coordinated by a three person technical committee consisting of the institutional contractor's chief of party, the head of the ORMVAT SPP,

and a representative of the private sector or Moroccan university community to be appointed by mutual consent of USAID and the ORMVAT.

The professional staff of the monitoring and evaluation unit will serve as the secretariat and implementing unit for the committee. As such, they will work as necessary with representatives of all ORMVAT Services, ORMVAT staff at the CMVs, long and short-term project staff, and the representatives of the private sector -- including farmer groups, professional associations, and private firms.

The project monitoring and evaluation unit will have trained staff to manage data-entry, analysis, and distribution of output to the relevant project participants -- i.e., the ORMVAT Director and the Service heads, the resident project manager, the USAID project officer, relevant Directions of MARA, and representatives of the private sector. Second, the unit will have the capacity to create archives for accumulated data and discrete analyses. It will constitute a data base of pre-existing information -- e.g., studies, reports, theses, results of field diagnostic studies -- and constantly update these materials over the life of the project. Third, the unit will have specific responsibility for production on an annual basis of an independent Status of the Project Report which will be submitted to coincide with the project's Annual Work Plan. And, fourth, the monitoring and evaluation unit will bear primary responsibility at the project level for preparing materials for the two external project evaluations scheduled in Project Years 3 and 6 and for responding to requests from the USAID Mission Evaluation Officer in the interim periods.

4. Implementation of the Monitoring/Evaluation Plan.

The various diagnostic studies described in Project Elements 1, 2, 3 and 4 will provide points of departure for monitoring and evaluation unit activities. The unit will carefully analyze the data and analyses flowing from these studies and assess what additional information it will need to fulfill its evaluation functions. Secondary source information will be available from the ORMVAT and MARA, professional associations, Chambers of Agriculture and Commerce, farmer groups, other GOM agencies, and other donors working in the perimeter. How much additional primary data collection will be necessary can only be judged accurately during project implementation. As a general rule, however, additional primary data collection activities and time requirements should be kept within reasonable bounds, in order to limit unnecessary costs and avoid overburdening project personnel. On the other hand, necessary supplementary studies should not be so widely spaced as to blunt the sensitivity and/or timeliness of information received concerning the beneficiaries' reactions to the project and/or fail to capture significant events and trends.

5. Objectively Verifiable Indicators to be Tracked

The following indicators are recommended by the design team as:

- Reflective of the objectives of the project and its major Elements;
- Quantifiable by the monitoring and evaluation unit; and
- Necessary to the successful evaluation of the impacts of project activities, either by project, USAID and ORMVAT staff or by external evaluators.

The proposed indicators are listed below by project Element:

a. Indicators for Element 1

- Establishment and use of an integrated computer-based water management system within SGRID;
- Formulation and implementation of a detailed water delivery policy with operational criteria and procedures for each sub-perimeter;
- Increased flexibility of water deliveries as reflected in increased surface water use intensities;
- Increased operational efficiency of the system as evidenced by substantial reductions in return water flows; and
- Increased farmer involvement in the seasonal irrigation planning process and the water delivery process.

b. Indicators for Element 2

- Use by farmers of improved irrigation strategies leading to better timeliness in enterprise operations and increased net farm income -- e.g., improved timeliness of supplemental irrigation on wheat leading to yield increases of up to 50 percent;
- Use by farmers of improved water application methods leading to greater field efficiencies -- e.g., adoption of pressurized systems for some summer horticultural crops and replacement of the robta system by improved gravity systems for field crops;
- Modification of cropping patterns toward higher value crops and more intensive crop rotations -- e.g., by increasing the area devoted to summer horticultural crops;

- Greater efficiency in technical coefficients between crop output and units of chemical fertilizers and agricultural chemicals applied -- e.g., increased grain, vegetable or fruit yield per unit of N, P or K applied; and

- Efficient integration of groundwater resources into overall water use at the farm-level.

c. Indicators for Element 3

- Integration and use of water balance data and the groundwater model into the SGRID management process for conjunctive use of surface and groundwater resources;

- Better overall control of groundwater levels and decreased incidence of waterlogging;

- Integration of water quality data in the groundwater model and the use of this information in the ORMVAT's soil and water resources real time management process;

- Establishment of an information exchange network to improve awareness of pollution levels in the region, including development of mechanisms for joint action to mitigate the impacts of these pollutants on human and livestock populations; and

- Decreases in the quantities of agro-chemical residues detected in the water table and perimeter drainage system.

d. Indicators for Element 4

- Assumption of bookkeeping responsibilities for cooperative business activities by cooperative staff or members;

- Development of investment plans for cooperative resources which include clear goals for membership service and prioritization of commercial activities;

- Increased receipts from sales of cooperative products and services;

- Increases in the market shares for agricultural inputs, services and processing controlled by the private sector; and

- Development of new agricultural and agro-industrial enterprises and business volume with respect to higher value crops.

V. SUMMARIES OF ANALYSES

A. Technical Analysis

1. Element 1 -- System-Level Water Management Issues

The canal systems of the ORMVAT are vital links for conducting irrigation water to farmers in the perimeter. The physical infrastructure in Tadla was installed to operate under a set of specified crop rotations. Policy changes directed at liberalizing these fixed crop rotations require corresponding changes in the management of irrigation water distribution. This section summarizes the operational characteristics of the existing systems; the demands imposed on the system by policy changes; and how project interventions address new system demands.

a. Operational Characteristics of the Existing System

The physical characteristics of the ORMVAT perimeter were described in Section I.B.5.a.. Maps 1 and 2 in the Preface to this report present the geographical orientation of the perimeter.

The irrigation systems in the ORMVAT were designed to meet the peak crop water requirements of a fixed crop rotation. This pattern of crop rotation was specified to limit water losses in field application and to minimize the peak flows required from the system. Canals and turnout structures were sized to meet this minimal peak demand.

Control of the irrigation water distribution system is accomplished through the use of control structures upstream in the canal system. Operationally, this means that water released at the canal head is not held in reserve. If inflows and outflows are not balanced, irrigation water either passes through the system -- flooding farms and/or drains -- or is diverted only to upstream users.

In order to increase the operational efficiency of such a system and to insure that water is distributed throughout the system, it is necessary to use a system of arranged water delivery where a schedule of gate settings is determined in advance. This schedule takes into account the flow dynamics of the system and the ability of the system operators to make the necessary adjustments in distributing water released into the canal head to meet water demands in the system. For the fixed cropping rotation, the water distribution policy was set based on the system design. Schedules could easily be set based on the rotation of crops and standard system flow rates.

Implementation of this fixed rotation was rendered impossible when farmers deviated in any way from the prescribed pattern. Since farmers started modifying both irrigation techniques and the fixed rotations to suit their perceived needs almost as soon as they occupied their land, the ORMVAT soon discovered that it needed to schedule gate settings

on the basis of a water ordering system. This system requires the farmers request irrigation water the week before it is needed. Water ordering is implemented for each farmer in the group served by a tertiary canal using Request Form MV-1. Water orders for the tertiary canal groups are aggregated by an aiguadier who is responsible on average for about 500 farmers. During a period of extreme water shortages in 1982 and 1983, upper limits were placed on the quantities of water which farmers could order, based on weekly ORMVAT estimates of crop water requirements for those crops specified in the fixed rotation(s). These upper limits are still being used as guidelines in weekly water ordering.

The schedule of gate settings is determined by each aiguadier from the information contained in Request Form MV-I and recorded on Request Form MV-II. Steady-state conditions are assumed in the system at all times and the aiguadiers are instructed to, if possible, maintain constant flow rates for the week in the primary or secondary canals under their supervision.

When changes need to be made in system flows on short notice, due to canal breaks or plugging, rainfall, or changes in farmer water demand, operational losses of water will occur and/or farmers will not receive needed water at the proper time. Losses can be minimized if water already released into the system can be utilized on short notice by users in another part of the system. Present scheduling techniques have only limited ability to respond to rapid changes. This inherent inflexibility in the present system results in significant flows of unused irrigation water to system drains, the distribution and billing of water to farmers who no longer need and will not use the water delivered and/or delays in the deliveries of water to meet critical water demands elsewhere in the system.

b. Demands Imposed on the System by Policy Changes

The policy changes calling for the liberalization of the fixed rotation type of cropping pattern open the possibility of an unlimited number of cropping patterns in the Tadla irrigation perimeter. Responding to these new cropping patterns in ways that promote wise use of the limited water resource requires consideration of the following: irrigation water deliveries to fully meet all crop water demands may no longer be feasible in the perimeter; crops requiring more flexible water delivery schedules for high productivity will be grown by farmers; demands for irrigation water will increase and will cause increased tensions in the water distribution system because breakdowns in the system will result in increased financial losses for farmers; and system managers will be expected to meet the water demands of farmers who will no longer be following fixed crop rotations.

Meeting these changes in a wise manner will require greater efficiency, flexibility, reliability and timeliness in irrigation water deliveries than has been the case in the past. Efficient system operations will result in a maximum volume of water being made available to farmers. Flexibility in system operations will contribute to system efficiency and to productivity under alternative cropping patterns. Reliability in flow rates, volumes delivered, and times of delivery will contribute to on-farm efficiency and develop a sense

of trust in the water delivery process that will promote farmer participation in efforts to increase system-wide productivity and efficiency. Timeliness refers to the way in which the system meets the actual water requirements of the plants for maximum productivity.

c. How Project Interventions Address System Demands and Limitations

In the context of the limitations of the physical system and present operating procedures, addressing demands for improvements in irrigation water delivery -- i.e., greater efficiency, flexibility, reliability and timeliness -- must taken into consideration certain operational realities. For example, changes in one major element of the current ORMVAT operational policy is likely to require reformulation of the whole operational policy and the general operating rules system operators must use in determining detailed operational plans. Diagnostic analysis is the basic tool used for assessing existing procedures for and roles of system managers and participants where new systems are to be installed. It provides a sound basis for making policy changes.

Second, a well-run irrigation water delivery system is necessarily based upon the careful preparation of the annual and seasonal operating plans. Reliable estimations of system-wide water availability and the water requirements of anticipated cropping patterns are essential. Current databases for area hydrology, weather, cropping patterns, and soils are also needed in the planning process. Ultimately, farmers set cropping patterns and their informed participation in the planning process is essential to defining feasible cropping patterns or water allocation processes.

Third, effective operation of a water delivery system with upstream controls requires a specific set of procedures to operate the head works, and the water conveyance and delivery systems. This in turn requires an in-depth understanding of the actual hydraulic happenings in the system since all control events, barring accidents, are caused by system operators. Hydraulic modeling provides the most efficient way of determining system operational possibilities. The gate scheduling process is also a key element in refining operational procedures to make the system more flexible and efficient. Computerization of the process will increase flexibility and free the ORMVAT aiguadiers for the more important tasks of monitoring actual system operations and interacting with farmers about problems and needed changes in system operations.

Reliability ultimately is not measured by good intentions but by actual delivery performance. Development of procedures to monitor actual water distribution in the system will indicate if the system is performing according to the operational plan. It will also provide feedback for improving gate setting procedures and indicate where adjustments are needed in water delivery scheduling. Real-time measurements of the system at crucial points will allow for adjustments to reduce losses on a timely basis. Actual system status reports from the Mobile Monitoring Units to be created under the project will provide additional verification of the effectiveness of irrigation water distributions.

2. Element 2 -- Farm-Level Issues

a. Water Use Strategies

As currently managed, the ORMVAT perimeter is best understood as an arid region crop production scheme. Water resources for the perimeter include: an average of 350 millimeters of free but unpredictable water in the form of rainfall; 630 millimeters of affordable but inadequate canal water; and large quantities of more expensive well water of widely divergent accessibility and quality. Project Element 1 is concerned with increasing the utility of the system-wide canal water delivery system. Complementing this activity at the farm-level will be the most important objective of Element 2. The most crucial additional step in changing the effective cropping systems in the perimeter will be to increase the use of pumped groundwater from farm wells to complement the water supplied from the gravity system.

The number of farm wells tapping the shallow perched groundwater table -- premiere nappe -- under the perimeter has doubled to 9,220 in the last decade. In most cases, these wells provided added flexibility and security for irrigated farming. In some cases, however, this shallow aquifer is an immediate threat to soils and crops and, in others, it may be a long-term threat. This problem is of direct concern to Elements 2 and 3.

The cost of using groundwater for irrigation is a function of the fixed and variable costs of pumping it from the farm well. At present, pumped groundwater is estimated to be about three times more expensive than the water available from the gravity system, primarily because pumping systems used in the wells are often inefficient per liter of fuel used. The costs of using groundwater for irrigation could be reduced by using more efficient pumps and Element 2 field trials will concentrate on developing more efficient pumping systems. Moreover, pressurized irrigation systems using well water would certainly reduce irrigation costs by increasing the overall efficiency of the delivery and application system. The attractiveness of such systems for farmers, however, is diminished at present because GOM trade policies artificially raise system purchase costs. Element 2 will study this problem.

Finally, there is significant potential for improving field application efficiencies in gravity irrigation systems throughout the ORMVAT perimeter. The pervasiveness of traditional robta irrigation techniques, combined with lack of land leveling and poor field maintenance practices, has diminished the overall efficiency of the Tadla gravity irrigation system in the past. Element 2 will initiate a process of change toward more efficient on-farm use of canal water by testing improved water application and field tillage methods. In all cases, improved water application systems will be demonstrated on crops which are most likely to benefit from more efficient irrigation. This is as important for improved gravity irrigation as it is for pressurized irrigation systems.

b. Agricultural Chemical Strategies

There is a growing awareness in Morocco that adverse environmental impacts can result from irrigated agriculture. The uneconomic use of fertilizers in a manner detrimental to water quality is a common occurrence in Tadla. Proper fertilizer use will be part of the crop production packages to be tested and demonstrated under Element 2.

On-farm practices for storage, use and disposal of potent agricultural chemicals are virtually unknown and their use is essentially uncontrolled. Element 2 will be concerned primarily with promoting more economic use of insecticides, pesticides and fungicides at the farm-level but will work with Element 3 on chemical safety and pollution issues as well.

c. Crop Production Strategies

The GOM has liberalized its policy on mandated cropping rotations in irrigated perimeters over the last four years. Crop production packages for alternative crops which provide increased net farm incomes or more flexibility in rotations or both will be developed under Element 2. Improved production packages for some traditional crops -- i.e., hard and soft wheats, maize -- which should be highly responsive to more intensive management will also be developed.

Examples of water management interventions are improving the timeliness of supplementary irrigations on winter crops; improving gravity irrigation techniques for alfalfa; and improving water application efficiencies on summer horticultural crops by means of pressurized systems.

d. Impacts

The long periods of time often required to test and demonstrate improved production technologies are the most important problem to be overcome if innovations generated by Element 2 are going to have significant impacts during the life of the project. Several methods will be used to mitigate this constraint.

First, testing of innovations which are essentially new to the Tadla perimeter -- or which appear particularly promising -- will start in Project Year 1. Second, testing will be done on-farm. This will give farmers the opportunity to learn about and evaluate a given technology for themselves long before it is officially recommended or rejected. And, third, to the maximum extent possible, field testing of new technologies will be done in collaboration with agribusinesses having commercial interests in the Tadla perimeter. This will facilitate promotion of a proven technologies at the same time that local private firms are gearing up to supply required services/inputs/equipment for farmers.

3. Element 3 -- Environmental Issues

The activities in Element 3 have been selected to provide a more complete picture of the environmental changes which have accompanied the development of the Tadla irrigation sub-perimeters. Short-term technical assistance, training, equipment, and commodities will be provided to develop management tools that will provide an assessment of current conditions and allow for the long-term monitoring of key environmental indicators -- i.e.,groundwater fluctuations, waterlogging, soil decomposition, overall water quality and agro-chemical residues present in the perimeter. Integrating these data with the information collected in Project Elements 1 and 2 will enhance the soil and water management capabilities of ORMVAT decision-makers, as well as allow for more economically efficient and environmentally sound on-farm management practices. A summary explanation of the rationale for each of the three Element 3 activities is presented below. An in-depth discussion of the key issues for Element 3 is to be found in Annex F, Part 3.

a. Groundwater Resources and Perimeter Drainage Systems

Following the initiation of irrigated farming in Beni-Amir in 1938 and Beni-Moussa in 1954, the sub-perimeter water tables began to rise rapidly -- by as much as 2 to 3 meters per year at some sites. The pumping of groundwater from the more than 9,200 private wells constructed during and since the 1979/1984 drought period has contributed to significant drawdowns -- 2 to 3 meters -- of sub-perimeter water tables. Waterlogging and related problems, however, remain very critical at sites in both sub-perimeters where the water tables are close to the soil surface. In Beni-Amir, 36 percent of the irrigated area is potentially vulnerable to waterlogging and soil decomposition due to water table that is at or less than 2 meters below the surface. In Beni-Moussa, the problems affect about 30 percent of the land, mostly concentrated in Beni-Moussa West. The dense network of monitoring sites to be installed under Element 3 and the database resulting from monitoring the network will give ORMVAT managers a more complete picture of the dynamics of the groundwater system across the sub-perimeters and provide the basis for more comprehensive strategies for integrated management of soil and water resources.

To offset the waterlogging problems in the sub-perimeters, the ORMVAT has constructed a surface drainage system, with widely-spaced -- 400 to 700 meters apart -- open ditches. To supplement this system, 12 pumping stations were established along the East Median Canal in the Beni-Moussa sub-perimeter to pump 30 million cubic meters of water annually. Around 1,700 kilometers of drainage ditches and outlets need to be rigorously and continuously maintained to make the system work effectively, but the ORMVAT is currently only able to handle about 200 kilometers a year. The lack of system maintenance and the wide spacing of the ditches and drainage canals are certainly factors affecting the efficient functioning of this drainage network. Rigorous assessment and continuous monitoring of this system under Element 3 will allow for better estimates of its real efficiency. With these data, alternative management strategies for the complex groundwater system will be studied to provide better control of the water table below critical depths in the Tadla sub-

perimeters.

b. Soil Modification and Water Quality

The intensification and modernization of irrigated farming in Tadla has led to use of large amounts of fertilizers and other agro-chemicals to increase agricultural production. The low irrigation efficiency -- around 50 percent -- in the area has resulted in an increase in the leaching factors for salt, nitrates and chemical pollutants through the relatively permeable soils.

Significant salt accumulations have occurred, however, where the water tables are shallow -- i.e., aquifers of less than 1.5 meters -- in Beni-Amir and Beni-Moussa West. Maximum concentrations have reached 2.5 to 3.0 grams per liter. This is the result of a combination of soil leaching -- irrigation water with relatively high salt content from the Oum Er Rbia river -- and evaporation from shallow water tables.

The rate of nitrate accumulation has also become a matter of great concern during the last three years. Measurements in observation wells indicate annual increases of about 5 milligrams per liter, which has resulted in a high concentration of 50 milligrams per liter -- the upper tolerance level for drinking water -- in many parts of the two sub-perimeters. Agro-industries, including the three sugar factories, also contribute to nitrates and pollutants to the aquifer. Raw effluent from these sources are carried into the existing drainage system, which in turn flows directly into Oum Er Rbia river.

Water quality in the perimeter is also affected by raw sewage flowing into the existing drainage system from the urban centers of Beni Mellal, Afourar, Dar Oulad Zidouh, Fkih Ben Salah and Souk Sebt. Recent studies have indicated that pollution levels at some sites within the perimeter -- e.g., along the Beni-Amir canal and drain outlet G12 in Beni-Moussa West -- far exceed recognized national standards. However, these investigations have also shown that current pollution levels in the Oum Er Rbia river downstream from the Tadla perimeter do not pose a threat to public health, or to socio-economic activities of users of the water from the Massira Dam. The construction of the storage dam at Dechra El Oued -- upstream from Kasba Tadla -- is liable to exacerbate the pollution problem when water quantities, which contribute to the natural flushing action of the Oum Er Rbia river, are significantly reduced. Increases in pollution levels and decreases in water quality, combined with water stagnation along the irrigation canals and drainage network, explain the presence of water-related diseases -- i.e., schistosomiasis, cholera and malaria -- in the Beni-Amir sub-perimeter.

Present monitoring programs for water quality and soil modification are not systematic and are only partially undertaken by local or regional technical services -- i.e., SGRID, DRH, SH in Beni Mellal, and the sugar factories. The comprehensive database to be developed under Element 3 will enable environmental managers to make better assessments of soil and water salinity, nitrate, and chemical pollutant problems in the perimeter. This tool will

make possible integrated surface and groundwater management and help offset some of the negative environmental impacts brought on by irrigated farming activities within the perimeter.

c. Agro-Chemical Storage, Use and Disposal

With the ORMVAT disengagement, commercial supply of agricultural inputs, including fertilizers and pesticides, are being shifted to the private sector. The potential for increasing pollution hazards and environmental risks from these agro-chemicals will grow in this new economic environment if appropriate storage, handling and disposal requirements for these substances are not mandated and enforced by the government.

At present, however, information is lacking on existing agro-chemical storage facilities and disposal sites in Tadla. And, there is no existing mechanism for monitoring on-farm handling practices for these materials. The potential environmental benefits from better controls on the dosages and mixing and application procedures for agro-chemicals are great and adoption of proper disposal regulations, coupled with efforts to increase public awareness of the hazards associated with these materials, would significantly reduce present pollution problems.

In addition the ORMVAT, there are a number of public institutions in Beni Mellal Province -- i.e., DRH, SH, ONEP, Eaux et Forets -- that have active interest in issues of water quality and the impacts of pollution on human and animal health. Unfortunately, at present there appears to be very little effort expended in sharing information between these agencies or coordinating resources. A network for information exchanges between all interested environmental actors will be established under Element 3.

4. Element 4 -- Private Sector Resource Allocation, Management and Use

The activities in Element 4 support disengagement of the ORMVAT and other parastatals from commercial activities. Elements 1, 2 and 3 will create commercial opportunities for private firms, cooperatives and professional associations in supply agricultural inputs and services. Element 4 will provide short-term technical assistance, training and material support to strengthen private sector capacities. The rationale for component activities is given here in summary form. Annex F Part 4 provides a fuller explanation.

a. Promotion of the Private Sector

In Morocco, the process of disengagement of public agencies from commercial activities and privatization of parastatal agro-industrial enterprises is managed by the government. The process follows a step-wise fashion to avoid shocks to productive capacity and undesirable impacts on consumer prices and employment. The government generally seeks assurances from potential private investors that any privatized operation will continue to operate at the same -- or, ideally, an increased -- level production or service in the future.

Element 4 of the project is designed to broaden the options for transfer of commercial enterprises from the state to the private sector and facilitate the creation of new enterprises in Tadla. It will build on the work of the Elements 1, 2 and 3, which will identify input and service requirements, fund new environmental monitoring activities, and demonstrate market potentials in input supply and services and agro-industrial processing and commodity marketing. Element 4 is designed to provide technical assistance to help private sector firms define their positions and evaluate market potential for expanding their operations and/or starting new enterprises. In this regard, there appear to be potentially large markets in Tadla for land leveling services, sales of pressurized irrigation systems, custom harvesting, and consulting on pesticide application, storage and disposal. The national seed and fertilizer supply industries are scheduled to undergo major restructuring with the privatization of the major parastatals and this should provide opportunities for expanded private distributor operations in Tadla. Element 4 resources will be made available to private sector firms in analyzing these new opportunities, preparing bankable proposals for business expansion, and improving current business operations.

Moroccan banks, Chambers of Agriculture and Commerce, and individual investors have remarked on the relatively low level of new capital flows into Tadla for commodity packing and processing enterprises. This lack of new investment is attributed partly to the strength of competing centers for commodity packing and processing in Marrakech, Fes, Meknes and Casablanca. It is also thought to be due to the high guaranty requirements imposed by banks for obtaining operating capital or opening lines of credit for agricultural enterprises and the fact that private capital tends to flow to the coastal cities and into non-agricultural investments in real estate or commerce.

In the Tadla area, the new capital inflows have tended to focus on center pivot irrigation development, where the government has offered very attractive financial incentives, and into paprika pepper production and processing for the European and American markets. As exemplified in these cases, major new investments in production and processing of horticultural or other crops appears to require an external investor who is able to bring proven production and processing technologies and an existing marketing arrangement into the local partnership. Local firms can do much to attract external partners in they are better organized and can present realistic assessments of local opportunities. To facilitate this process for medium and smaller firms, Element 4 will provide technical assistance to develop analyses of markets, enterprise feasibility studies, and business plans outside of the horticultural sector. And, resident project staff will direct firms with interests in horticultural enterprises to the USAID Morocco Agribusiness Promotion Project (MAP).

b. Assistance to Local Cooperatives and Professional Associations

Three activities will provide short-term technical assistance and training for selected cooperatives and professional associations to improve their management of costs and services, to develop their abilities to plan and undertake commercial operations, and to help them develop strategies for sustainability.

Multi-service cooperatives were selected as participants for several reasons. They have the best spatial coverage of the perimeter. They operate on a cooperative decree which gives them broad choice in their business activities. These cooperatives have dairy enterprises, which provide regular cash flow throughout the year. They have developed a diversified business base, including sales of consumer goods, supply of agricultural inputs, supply of fuel, and custom machinery services. These enterprises augment year-round cash-flows. They have accumulated capital reserves and are targeted for accelerated disengagement by the ORMVAT -- i.e., movement out of or rental of CMV facilities used as collection, storage, and retail space; and transfer of cooperative director salaries and accounting costs from the ORMVAT to cooperative accounts. With proper management of their transition to independent, business-based operations, these cooperatives could invest in the input supply and custom service opportunities arising from project activities and the privatization and sale of the Societe Nationale de Commercialisation des Semences (SONACOS), the two local sugar mills and the sugar refinery. Development of cooperative management skills will enable these cooperatives to provide cost-shared management services to the other type of cooperatives in Tadla.

Activities with the AET professional association were designed because of the large potential impacts of AET activities -- dairy and livestock production, breed improvement, etc. -- could have on the mix of agricultural enterprises in the perimeter and hence on the efficient use of water and soil resources. A successfully implemented activity centered on business training for membership services will serve as an example to the other professional associations housed in the Beni Mellal professional association building of how to structure and operate member-oriented business services.

Irrigation Associations are the newest local organizations in Tadla. They are being asked to assume both management and financial responsibilities in canal operations and maintenance. They are governed by a decree which greatly limits the possible range of their economic activities. And, their "income" is limited to the 20 percent reimbursement of water charges they are to receive to cover the costs of their operations and maintenance work and provide a small profit. Three Irrigation Associations have been constituted to date. They are expected to start their operations and maintenance work in 1992.

The design options with the Irrigation Associations were to devote a high level of resources to them early in the project, or to provide a somewhat lower level of assistance until main system operations had been adjusted to provide farmers with a more reliable and responsive water distribution system -- which is the sine qua non for successful local management of water and maintenance of tertiary and quaternary canals and drains -- and until it is clear exactly what resources will be available under PAGI 2 to support the Irrigation Associations and canal rehabilitation efforts in Tadla.

The design choice was taken to assist Irrigation Associations through management planning, training, and short-term technical assistance. This modest assistance will lay the groundwork for a more effective turn-over of operations and maintenance responsibilities

to the associations after Elements 1 and 2 have had the opportunity to address fundamental water allocation problems at the system and farm levels and PAGI 2 resources have begun to rehabilitate existing infrastructure.

B. Financial Analysis

1. Cost Estimates and Financial Plan

The total cost of the project is estimated at $ 19.472 million. The project will be supported with contributions from USAID, the participating GOM agencies -- i.e., MARA, DER and ORMVAT -- and the private sector.

USAID will provide $ 15.577 million in grant funds from the Economic Support Funds. Projected annual obligations by functional category are shown in Text Table 1.

The GOM contribution to the project will be the in-kind costs for provision of technical and administrative personnel, office space and logistical support for project operations. The GOM will also continue salary payments for government employees while they participate in training sponsored under the project. As per standard GOM/USAID procedures, airline tickets and other travel costs for Moroccans participating in external training will be paid by the GOM. The projected GOM contribution to the project is estimated to have a value of $ 3.120 million.

Private sector firms and individuals benefitting directly from project interventions, training and/or technical assistance support will contribute to project support costs. This private sector support is anticipated to include payments for airline tickets and other travel costs for employee participants in domestic and external training; salaries and logistical support for personnel working with project specialists on collaborative pollution reduction/environmental protection activities, export market surveys, and other activities. The projected contribution from the private sector is estimated to have a value of $ 0.775 million.

2. Methods of Implementation and Financing

The methods of USAID disbursement to be used in this project will include:

a. Direct Payments

USAID may make direct payments to suppliers or contractors for goods and/or services delivered.

b. Reimbursement

Under the reimbursement method of financing, the GOM implementing agency or private contractor will disburse its own funds and be reimbursed by USAID upon submission of

appropriate documentation.

3. Recurrent Costs and Flow of Funds

a. GOM

Recurrent cost obligations incurred by the GOM as a direct result of project activities are expected to be modest. They are nominally estimated to be approximately $ 0.775 million per year. Given that the ORMVAT, the principal GOM agency participant, is progressively divesting itself of the cost of many unprofitable commercial activities at the same time that its gross revenues are increasing due to higher irrigation water fees and better collection procedures, it should be an excellent position to assume the projected recurrent cost obligations by the end of the project.

b. Private Sector

No significant recurrent costs are anticipated for private sector firms or individuals as a result of their voluntary participation in the project.

c. USAID

Once funds are obligated for the project, earmarking, commitments and disbursements will follow, depending on the project's pace of activity. Flow of USAID funds will be subject to standard rules and regulations.

All foreign exchange costs under AID direct contracts or project grants will be paid directly by USAID. USAID will make direct payments to suppliers/contractors for procurement actions.

4. Project Audit Requirements

Primary responsibility for audits of USAID projects lies with the Regional Inspector General's Office (RIG). However, in the event that the RIG is unable to carry out direct audit activities, an external auditing firm will be contracted for the purpose. An amount of $ 150,000 will to be provided for two non-federal audits. It is anticipated that such reviews will comply in all respects with United States Government requirements for financial and program audits.

C. Economic Analysis

This section presents a summary of the economic analysis for the project with respect to the net benefits from increased water efficiency savings in quantitative terms. Full quantitative and qualitative analyses of the potential supplementary benefits from improvements in factor allocations in agricultural and agro-industrial enterprises and from the environmen-

tal component can be found in Annex H.

In the quantitative analysis, the value of the water savings was compared against the anticipated USAID grant investment in the project ($ 15.577 million) and against the total project cost stream -- i.e., USAID, GOM ($ 3.120 million) and private sector contributions ($ 0.775 million) to the project over seven years. This investment is projected to yield a total of $ 194.6 million in undiscounted benefits from water savings alone over twenty years from project initiation.

To add further reality to these figures, the assumption was made that the GOM would incur recurrent costs equivalent to $ 0.750 million per year after Project Year 7 to maintain the level of activities institutionalized by the project. The calculations were repeated taking these recurrent costs into account for Years 8 to 20 in the cost stream.

In the first case of USAID grant investment alone and without consideration of GOM recurrent costs, the present values of the net benefit stream discounted at 10, 20, 30 and 40 percent are, respectively $ 58.832 million, $ 17.203 million, $ 6.148 million, and $ 1.864 million. The internal rate of return on the investment was computed at 50.1 percent.

In the second case of total project investment and without consideration of GOM recurrent costs, the present values of the net benefit stream discounted at 10, 20, 30 and 40 percent are, respectively $ 48.1 million, $ 15.2 million, $ 4.6 million, and $ 0.6 million. The internal rate of return on the investment was computed at 42.8 percent.

In the third case of total project investment and with consideration of GOM recurrent costs, the present values of the net benefit stream discounted at 10, 20, 30 and 40 percent are, respectively $ 45.4 million, $ 14.3 million, $ 4.2 million, and $ 0.4 million. The internal rate of return on the investment was computed at 42.1 percent.

The projected net benefits from water savings alone, therefore, provide a very substantial cushion for adding in a higher estimate of the recurrent costs to the ORMVAT incurred in assuming project activities over a twenty year period. Since essentially all of the technical personnel required to implement project activities are already in place at the ORMVAT, recurrent expenditures for personnel will not be a very significant additional cost item. Expenditures will be needed over time to replace and/or update system-level equipment, computer hardware and software, and to pay for the services of Moroccan consultants for short-term special assignments at the ORMVAT after the project is over.

It appears, therefore, that the water savings to be derived from project Elements 1 and 2 are more than sufficient in themselves to justify approval and implementation of this project on economic grounds. This would be so even if there were to be no additional benefits forthcoming from project Elements 2, 3 and 4 -- which certainly will not be the case, as explained in Annex H.

In qualitative analyses, the potentials for additional benefits derived from better allocations of the factors of production, shifting to higher value crops at the farm level, more private sector involvement in agribusiness at the regional level, and improved environmental management are discussed. More specifically, Element 2 and 4 interventions are expected to have potential additional benefits which flow from:

- Cost savings from more efficient pumping and conjunctive use of groundwater;

- Increases in net farm incomes derived from a gradual shift away from uneconomic industrial and food crops -- i.e., sugar beets, hard and soft wheats, cotton -- to higher value crops -- i.e., forages, fruits, vegetables, specialty crops -- in the Tadla perimeter;

- Efficiency gains to the economy and cost savings to the government from increased private sector participation in agribusiness in the regional economy and privatization of inefficient public and parastatal businesses;

- Efficiency gains to the economy and financial savings to the government from ORMVAT disengagement from commercial activities and better management of its residual mandate; and

- Efficiency gains from use of infrastructure rehabilitated under PAGI 2 from the complementary activities undertaken in the project.

The economic benefits of the project's environmental component cannot be estimated ex ante in quantitative terms. It should be possible, however, to define categories of benefits and costs as the Element 3 interventions are initiated and refined. The activities associated with this component -- improved groundwater water quality and management and improved storage, use and disposal of agro-chemicals -- will lead to benefits that are directly linked to sustaining environmental resources. Mitigating the adverse effects of current practices will lead to reductions in abatement, damage, compensation and transaction costs related to environmental pollution. For the Tadla perimeter, these benefits will include:

- Improved human health and welfare -- particularly in those areas where water-related sicknesses, diseases, and impacts of chemical toxins present in the soil and water are prevalent;

- Increases in productivity of ecological systems -- i.e., increased yields in crop and livestock enterprises and fisheries;

- Decreases in corrosion and other materials damage, cleaning costs, and waste storage and disposal expenses associated with agricultural production and processing;

- Reduced alteration of ecological systems with consequences for human welfare -- i.e., species diversity, ecosystem stability, recreational use, etc..

D. Administrative Analysis

1. Introduction

The key GOM counterpart agency for this project will be the ORMVAT, which is one of the oldest and best established regional irrigation authorities in Morocco. It has a solid reputation for sound perimeter management and a positive orientation toward implementation of the country's new irrigation policies. In addition to the ORMVAT, a number of other GOM agencies will collaborate in specific project activities, particularly with respect to implementation of Elements 1 and 3. Third, the project will encourage participation from private entrepreneurs and agribusiness firms, Professional Associations, the Chambers of Commerce and Agriculture, and non-governmental organizations, particularly in activities under Elements 2 and 4. And, finally, selected cooperatives and irrigation associations will participate in project activities.

A variety of mechanisms for involving all of these agencies in project activities are described in the Project Implementation Plan -- see Section III. These mechanisms are designed to ensure that project participants are fully prepared to assume their roles in the pursuit of the project's objectives.

2. The ORMVAT

The ORMVAT was constituted as a civil agency, with legal autonomy to manage its own personnel, property, legal and financial affairs. It is administratively responsible to MARA. In addition to the tutorial role played by MARA, the Ministry of Finance also plays a role with respect to the ORMVAT's budget from the GOM and in assuring financial audits on a regular basis.

The mandate of ORMVAT originally was to develop and manage an irrigated agricultural system in Tadla and to improve agricultural production. In this role, the ORMVAT had a double character as public utility and parastatal commercial enterprise. This original mandate has changed recently in response to modifications in GOM economic policies. In the future, the ORMVAT's role is to be centered on water management as a public utility and on agricultural extension. It has and will continue to withdraw from direct involvement in commercial activities, which will be taken over by the private sector.

Within the ORMVAT, the Director is responsible to a Conseil d'Administration on which sit the Minister of Agriculture and Agrarian Reform, the Governor of Beni Mellal Province, the President of the Provincial Assembly, and the President of the local Chamber of Agriculture. This Conseil has major responsibilities for planning and implementing the ORMVAT's program. It is assisted these tasks by the ORMVAT Comite Technique. This

committee is chaired by the Governor of Beni Mellal Province and is composed of local representatives from all the concerned national Ministry Departments and local farmer representatives. It meets once a month -- or whenever necessary -- to examine the issues and problems faced by the ORMVAT. Local technical committees are organized by the ORMVAT SPA to deal with specific crops -- i.e., cotton and sugar beets. During each agricultural season, these committees assemble all interested parties and experts each week to discuss problems. Finally, a Commission Locale de Mise en Valeur is situated at each Cercle. It is chaired by the Super-Caid, who is the committee's reporter. It meets whenever necessary to examine the issues and problems faced locally by the ORMVAT.

In the design team's opinion, all of the committees described above are potentially useful vehicles for furthering project objectives. Given the nature of their different membership and mandates, they can and will be used to foster discussions and constructive dialogue on many of the issues raised by the GOM's new policies toward the irrigation sub-sector and the increased role envisaged for the private sector. They can also facilitate coordination of project activities and dissemination of results to all interested parties.

At headquarters, the ORMVAT is divided into departments -- Services -- each with several bureaus or sections -- see the ORMVAT Organizational Chart in the Preface. At the field level, the ORMVAT has established three Sub-Divisions to supervise the activities of the 31 CMVs operating within their territorial boundaries. They also coordinate the activities of the various ORMVAT Services -- i.e., SGRID, SPA, SE and SVOP -- in the field. The CMVs are the basic units through which crop and livestock development activities are integrated.

The project has been designed to institutionalize new capacities and activities within the ORMVAT. All the activities of the project are integral parts of the mandates of the Services. The implementation of project activities will not require creation of new administrative units per se within the ORMVAT, but simply the rearrangement of existing personnel resources within Services. However, processes and mechanisms to facilitate discussion and interaction among participants and partners will be created during the project implementation process.

The project is devoted to sustainability of activities started with project resources -- i.e., the continuing capacity of ORMVAT to manage effectively its enhanced responsibilities beyond USAID support -- and to adapt to changing needs in the irrigation sub-sector. Therefore, the implementation of the project will be geared towards building staff capacity to ensure full involvement in project activities and fostering action-oriented mechanisms within the existing ORMVAT structure of the ORMVAT. Since it is these people who will make integrated activities work, attention will be directed toward creating not only a positive internal organizational culture, but positive staff attitudes towards coordination of activities and dialogue with farmer-clients and other partners.

3. Other GOM Agencies

Given the multiple activities of the project under its four Elements, effective linkages and working relationships will need to be established with a number of key GOM agencies at the provincial and national levels. This section briefly outlines the nature of the activities envisaged with these agencies.

Under Element 1, the project will consolidate within the BE of SGRID a Water Resources Unit. This unit will be responsible for surface water hydrology, groundwater hydrology and water quality within the perimeter. Surface hydrology activities will require agreements between the ORMVAT, the ORMVAH, the Ministry of Public Works and the Office National d'Energy (ONE). In order to develop and maintain a database of flows in the Oum Er Rbia river at Kasba Tadla diversion dam and the inflows into Bin El Ouidane dam, an agreement will be established with Direction Regionale Hydraulique (DRH) of the Ministry of Public Works for the regular importation of such data into the ORMVAT data base. The Oum Er Rbia river flow data is available in computer format from the Administration de Hydraulique (AH), a division of the DRH in Beni Mellal. Data for the Bin El Ouidane dam flows will come from the DRH in Rabat. Statistical analysis of inflows into the Bin El Ouidane dam will serve as a basis for a review of the operating rules for the dam and power plant at Afourer taking into account the new constraints imposed by water supplies to canal T2 for ORMVAH as part of the "corrected manifest of Bin El Ouidane" between ORMVAT, ORMVAH and ONE.

Activities under Element 3 will focus on the development and active use of a permanent monitoring system and database of groundwater fluctuations and water quality and the drainage system efficiency in the Tadla perimeter. In Project Years 1 and 2, the institutional contractor will work with the SGRID to establish the groundwater and drainage monitoring network. A minimum of 100 permanent sample points will be established to monitor water table fluctuations. SGRID personnel will insure that these sample points are established in a manner that will complement the 56 points currently being monitored within the sub-perimeters by the DRH in Beni Mellal. It is of paramount importance that close collaboration and information sharing occur between the SGRID and the DRH.

Two other activities under Element 3 will focus on monitoring soil modification and water quality in the sub-perimeters. The first activity will establish permanent sampling points for collecting soils, water quality and agro-chemical residue data during Project Years 1 and 2. It is assumed that the analyses will be done to determine the presence of a minimum of 5 toxic substances selected and prioritized in conjunction with the ORMVAT Service de Production Agricole (SPA), agro-industries operating in the area, and the Ministry of Health's Service Hygiene (SH) in Beni Mellal.

The second activity will integrate these data into the real-time management process of the SGRID. Results from the soil and water quality monitoring will be part of the ORMVAT

GIS. These data when viewed with other overlays of real-time farming practices -- i.e., current crop areas and their agro-chemical demands -- and surface and groundwater water use will enhance the decision making capabilities of the SGRID managers.

It is extremely important that water quality and pollution information reach the local population. To help accomplish this, the project will work through the ORMVAT Service de Vulgarisation et Organisation Professionnel (SVOP) to develop an information network with the regional institutions concerned with these issues. The action-oriented groups most likely to be included are the DRH, in concert with the Office National de l'Eau Potable (ONEP) and the extension agents of the SH in Beni Mellal.

4. Private Sector Firms, Professional Associations and Other Support Agencies

a. Private Sector Firms

Element 2 will work within the context of a systematic program of consultation and reporting. Planning, implementation, evaluation and dissemination of results for the activities in Element 2 will be centered in the SPA, which under the PAGI 2/SIG restructuring plan is soon to be converted into the Service des Etudes Agro-Economiques (SEAE). To facilitate work within the ORMVAT and with the private sector, a small working committee will be constituted with the participation of ORMVAT staff from the SEHA, the SGRID, the SVOP and the private sector representatives relevant to each activity undertaken.

Starting in Project Year 1, a detailed work plan will be drawn up by the working committee and presented at a workshop. Participants at the workshop will include: members of the Element 2 working committee; representatives who have been selected at the CMV level by farmers; private sector agribusiness people selected for their interests in the perimeter; professional association and cooperative representatives; and representatives of other concerned institutions within the GOM and the donor community. Starting in Project Year 2, these annual workshops will include a presentation of Element 2 accomplishments to date vis-a-vis work plan objectives. These workshops will provide the major forum for a general flow of information and feedback. In addition to its information dissemination function, it is anticipated that the dialogue generated will serve as a vehicle to catalyze cooperation between the project and the participant representatives for the following year's work.

As work under Element 2 proceeds, results are generated and recommendations are formulated, other fora will be used for dissemination. Working with the SVOP and private sector groups -- i.e. input suppliers, cooperatives, etc. -- these will include demonstrations of improved technical packages in farmers fields, farmer field days, and group-specific training sessions. This last activity is seen as especially important for informing the private sector of potential clients and business opportunities.

Information and recommendations with respect to discrete innovations and/or technical packages being proposed for specific farmer groups will be summarized as technical reference sheets -- Referentiels Techniques (RT). These sheets, as well as any other occasional bulletins generated by Project Element 2, will be circulated to all concerned parties -- i.e., farmers, private sector firms, professional associations, cooperatives -- in French and Arabic. In addition to the means for disseminating information outlined above, Element 2 will also seek to participate in radio broadcasts of agricultural information if current plans for regional agricultural radio programming materialize.

All Elements will procure of goods and services from the private sector. Element 2 will identify market opportunities in input, equipment, and service supply. Element 3 will provide short-term technical assistance to work with farmers, cooperatives, professional associations, and private firms proper techniques to use and precautions to take in supply, storage, use and disposal of agro-chemicals. Both the project chief of party and the agricultural economist will work with the private sector as ORMVAT disengages and major input and service suppliers -- i.e., the SONACOS, the two sugar beet mills (SUBM and SUNAT) and the sugar refinery (SUTA) -- are privatized over the next few years. They, with short-term assistance under Element 4, will help identify and define options for these and other transitions ranging from service contracts with private firms, to cooperative or association take-over of supply and custom services, to expansion of existing company operations in the Tadla and new start-up operations.

Increasing private sector investment in production and value-added agro-industry will be done by provision of project short-term consulting assistance to develop feasibility studies, business plans, or provide limited start-up assistance on a 50/50 cost shared basis. Element 4 assistance will be oriented primarily toward these crops and related activities falling outside the horticultural sectors. Project staff will orient investors in horticultural crop services, production, and processing to the MAP.

b. Professional Associations

Morocco has a long history of professional associations -- i.e., Associations Interprofessionelles. These organizations borrow from models created in Europe, where there are often close ties and a continuum of interest among the individual, company, regulatory agency, ministry, research and educational participants. In Morocco, professional associations have benefitted from a public interest charter. This charter identifies their public responsibilities to support programs in the national interest, while granting them a large measure of operating autonomy. While they are required to communicate and coordinate with public agencies, their directors do not have to be civil servants, nor are their day-to-day operations or financial management subject to a priori supervision by public agency staff, as is the case with most cooperatives.

There are four professional associations representing producers in the Tadla: the Association des Betteraviers du Tadla (ABT), Association des Eleveurs du Tadla (AET),

Association des Maraichers du Tadla (AMT) and Association des Producteurs de Coton (ACT). There is some doubt about the representivity of these associations, despite the fact that they can mobilize significant resources, because the names of certain local personages appear frequently in the hierarchies of all four associations. With the support of local authorities, these people have accumulated both technical resources and political power. Farmers in general, however, remain passive through lack of information and lack of association efforts to mobilize them.

The associations do not provide high quality technical expertise. Each association is burdened with unnecessarily high administrative costs. They would do well to share a secretarial pool as they share the building in Beni Mellal. Associations often incur costs for unnecessary expenses due to poor managerial decision-making.

The essential roles envisaged for professional associations vis-a-vis project activities are to disseminate information about technical packages and crop recommendations, to participate and backstop project activities and research, as feasible, and to support the interests of their memberships during the period of ORMVAT disengagement.

The project will work primarily with the professional association which appears to have the greatest potential for affecting the efficiency of soil and water resources in and around the perimeter -- i.e., the AET. This association currently plays a role in organizing the importation and distribution of purebred cattle. In the future, it may also assume a role as manager of the dairy cattle artificial insemination program when it is transferred from the ORMVAT to the private sector.

c. Other Support Agencies

The project, under the anticipated implementation schedule, will start implementation fully two years ahead of the World Bank PAGI 2 and PSDAGI. This means that the project will be generating important results and initiating pilot activities well before World Bank project activities come on line. The present planning in the MARA and at the ORMVAT is to use the USAID project information and results to more precisely target the PAGI 2 and PSDAGI activities, both in Tadla and, as relevant, in the other eight ORMVAs. For this reason, the USAID design team has worked in close collaboration with GOM representatives at both the ORMVA and MARA levels to ensure -- to the maximum extent possible -- that all elements of the USAID project are not only fully compatible with PAGI 2 and PSDAGI as designed to date, but will also be contribute to the future planning and implementation of those activities after 1993.

There are two study projects operating in the ORMVA Tadla perimeter at present. One is jointly sponsored by the International Irrigation Management Institute (IIMI), the Service de l'Experimentation de l'Hydraulique Agricole (SEHA) in the Direction de l'Equipement Rural (DER) of MARA, and ORMVAT. The other is a collaborative study sponsored by Wye College and the Institut Agronomique et Veterinaire Hassan II (IAV).

USAID design team members had several discussions with the IIMI country representative about this project and means of coordinating activities in Tadla. Every effort will be made in project implementation to collaborate on field activities and to share information and field trial results.

The Morocco project director for the Wye College study was the co-team leader of this project design team and his presence on the team ensured that anticipated project activities would be compatible with -- and not duplicative of -- Wye College activities.

5. Cooperatives and Irrigation Associations

a. Cooperatives

Cooperatives are not new to the Tadla area, but the cooperative movement has become progressively more important during the past two decades. There are presently about 94 cooperative branches in the area. They are active in about one-half of the perimeter and have memberships representing about one-third of all farms. The ORMVAT provides management assistance for these cooperatives through appointed Directors of Cooperatives. This section describes 4 types of cooperatives, with 74 branches, which are or may in the future be relevant to implementation of project activities.

(1). Multi-Purpose Cooperatives

At present, 47 multi-purpose dairy cooperative branches, with a total membership of 10,172 farm families, are active in the perimeter. Despite a rapid expansion in their early years of existence, this cooperative movement appears to have stagnated recently for two reasons:

- Within a potential clientele of 24,300 livestock producers -- including sheep-herders -- present membership of 10,172 seems to indicate a level of saturation has been reached; and

- These cooperatives have appeared content to focus most of their efforts on their dairy enterprises, even in the face of declining subsidies from the GOM. Most have demonstrated little imagination or initiative in attempting to diversify their activities and/or take advantage of the new opportunities posed by ORMVAT's withdrawal from commercial activities, despite the fact that most have a reliable financial base for such expansion.

There are exceptional cases -- i.e., the Harchiya Cooperative -- where a cooperative has acquired its own premises, contributed to social projects, supported pilgrimages for members, constructed a school, electrified of a hamlet, created a short-term credit fund, launched a cooperative store, or installed a potable water system. However, productive investments to enlarge a cooperative's range of commercial activities and/or services for members are very rare.

This lack of initiative can be explained in part by the low quality of managerial support offered by ORMVAT personnel in the past. Cooperative directors have had only modest training in cooperative planning and management, which has not prepared them adequately to assume their managerial roles. In any cases, they have been inundated in routine paperwork and have not been encouraged to act as much more than clerical staff for their members. Finally, these managers are too few in number and too over-burdened with managing several cooperatives with different structures and objectives.

Under the previous system, cooperative members were not called upon to participate actively in cooperative planning and management. This lack of stimulation and participation has obviously had negative consequences. Moreover, when cooperatives have exceeded certain levels in geographical and social terms, they appear to have had problems with factionalism. Within closely knit in-groups, however, where members have a clear vision of their own interests and potential, some dairy cooperatives have proven very dynamic, setting both social and economic goals and establishing very coherent internal regulation. Properly situated and supported, such cooperatives appear to present real potential.

Project Element 4, therefore, will attempt to assist selected dairy cooperatives to improving their internal management and developing a new and multi-purpose approach to servicing their memberships. This choice was made because of all the existing cooperatives in the Tadla area, these cooperatives appear to have the greatest immediate potential to change current operating practices and affect resource use productivity. They alone have major business enterprises -- i.e., dairy production and milk marketing -- which provide regular cash flows throughout the year and have enabled them to accumulate relatively large capital holdings. Some have even diversified their sources of income beyond their dairy enterprises -- i.e., into agricultural input sales, fuel sales, and custom machinery operations -- and are beginning to reduce their dependency on ORMVAT facilities and management services. Moreover, the constituting decree for these cooperatives permits to engage in a wide variety of input and service supply, production, marketing and processing activities. The cooperatives may also own capital and shares in agriculturally-related companies.

(2). Agrarian Reform Cooperatives

There are 23 Agrarian Reform cooperatives in the Tadla area. They have 523 members on farms with a total area of 3,625 hectares. Under terms of the Law for Agricultural Investment of 1966, members obtained access to irrigated land in exchange for their mandatory participation in an agrarian reform service cooperative. Members come from different social strata. As far as can be determined, the members have no binding kinship, lineage or tribal relationships between them. Some members had never farmed before getting access to cropland within the perimeter through affiliation with a cooperative. The directors of these cooperatives are appointed by the ORMVAT.

Performance varies greatly between these cooperatives. A limited number seem to have developed a real dynamic in supporting their activities, gathering resources, and building

social and education infrastructure -- e.g., Cooperative Laayoune. Others have remained moribund since their creation, unable even to undertake the efforts in group purchases of agricultural inputs, in provision of credit to members, or in common sales of produce. Moreover, the functional relationships between these cooperatives and the local Professional Associations -- i.e., the ABT, ACT and AET -- remain to be developed.

The general impression is that these cooperatives at present are not in a position to play a major role in project activities in the unforeseeable future.

(3). Agricultural Equipment Cooperatives

There are 9 of these cooperatives in Tadla, with 108 member-farmers on about 703 hectares. They are plagued with a number of problems related to both the reasons for their creation and their current stage of development.

First, there is a widespread belief in the area that farmer-members created these "cooperatives" simply to take advantage of special government programs available to cooperatives -- i.e., access to preferred credit status, as well as subsidies for the purchase of agricultural equipment -- without any sense of a cooperative ethic.

Second, while the small size of many farms in the perimeter provides an incentive for farmers to cooperate in the purchase and operation of agricultural machinery, these particular cooperatives have had great difficulty in managing allocation of acquired machinery among member farms within the time constraints for effective plowing, tillage, harvesting and other agricultural operations.

Third, the existing cooperatives suffer from the lack of a complete range of machinery and their operations are often ineffective due to a lack of spare-parts, fuel and oil, and general management expertise. They are chronically short of operational funds and often dissolve as effective entities when a tractor breaks down or other machinery needs to be replaced.

Fourth, the attractiveness of these cooperatives to members is declining in the face of competition from aggressive private sector agents providing cheaper and more timely custom machinery services and as GOM moves to reduce subsidies on agricultural inputs.

Again, these cooperatives do not appear to be good candidates for significant involvement in project activities.

(4). Purchasing Cooperatives

There are 5 of these cooperatives within the perimeter, with 148 members on 5,614 hectares. Their very limited number makes it difficult to provide any analysis of their organizational constraints or a prognosis of their future potential. Nevertheless, it is evident that the ORMVAT, in its previous role of purveyor of farm inputs, did not encourage the

emergence of this type of cooperative and, as a result, these cooperatives have limited themselves to group bulk purchases of diesel fuel. Their potential for the future remains to be investigated.

b. Irrigation Associations

The organization of water users into groups responsible for the maintenance of irrigation systems is not a new idea in Morocco. Traditional systems for community management of water rights in the small and medium-scale perimeters have developed under a highly complex traditional water law and delicately adjusted water management methods. The organization of the ASAP under the Law of 1924 fixed water rights and privileges in the Tadla perimeter. Other less formal and more empirical groupings of water users have also existed in Tadla from time to time.

The ASAPs in Tadla and elsewhere in Morocco were instituted by the Dahir of June 15, 1924. They were groups of agricultural landholders -- often colonialists -- having intent to create irrigation infrastructure, either in the public interest or for development of personal property. Since Independence and with the transfer of these properties to Moroccans, the ASAP idea has fallen into decline. One ASAP, however, has endured in Tadla but it has engendered considerable mistrust among its farm neighbors, due to abuses by some of its members and the undermining of its earlier objectives.

In 1971, the ORMVAT mangement attempted to organize farmers in blocks around the tertiary canals, with the objective of electing representatives who could serve as spokespersons in discussion water management issues with ORMVAT staff. Those elected would have been in charge of allocating the irrigation water available to each block. This effort was envisaged primarily as a means to relieve the ORMVAT of the responsibility of this task and not as a vehicle to manage the affairs and problems of the water-user blocks -- i.e., vandalism and theft of water. This effort seems to have worked for about one year but was gradually abandoned thereafter -- except in the CMV 526, which involved a block of collective land controlled by a closely-related community of water users.

Since the law requiring Irrigation Associations in LSIs was promulgated, the process of organizing these groups has been underway. As of October 1991, three Irrigation Associations had been organized in the ORMVAT perimeter -- i.e., at Al Massira, a former ASAP; at Al Ittihad in CMV 526; and at An Najah in CMV 501. Of these, only Al Massira is currently functional. The other two Associations -- i.e., Al Ittihad and An Najah -- are still in the process of electing their officers and disseminating organizational information to potential members.

Irrigation Associations have a tightly-defined charter which appears to exclude any diversification into income-generating activities. They are presently focused exclusively on water management and canal maintenance activities. The associations are seen by all parties principally as means of shifting the operational and maintenance expenses for the tertiary

canals from the ORMVAT to local farmers. The technical analysis in Annex F Part 4 suggests that the ORMVAT's intent is to rehabilitate the tertiary network before it is turned over to the nascent Irrigation Associations but this plan may be stymied in the Beni-Amir sub-perimeter due to present uncertainties about amount and costs of rehabilitation required. PAGI 2 activities in Tadla as elsewhere will support the development of Irrigation Associations and the costs of rehabilitating the tertiary canals. Element 1 of this project will provide much of the information on flow measurements and water handling techniques needed to adjust system functions in accordance with farmer requirements. It is recommended, however, that ORMVAT proceed slowly with the Irrigation Association campaign to permit course corrections as needed in organizing the associations and developing management practices.

The Irrigation Associations are not intended to be state-run bureaucracies. They are expected to be farmer-run organizations. Towards this end, the project will help train the presidents and board members of the associations in the bookkeeping and financial management practices, plus organizational goal and program planning techniques. In addition, a small amount of short-term technical assistance will be made available to the associations, the ORMVAT and local water commissions to evaluate the financial obligations of the association, determine whether it is in the association's best interests to seek discounts available on water charges, and how best they can participate in representing farmer interests in the negotiations on crops eligible for surface system water deliveries.

E. Environmental Analysis

The project is a natural resource conservation initiative for the ORMVAT irrigation perimeter in Morocco. If successful, it is anticipated that the project will result in positive net effects on the region's natural and physical environment. The major interventions planned for the project specifically address key issues of water and soil management in Tadla -- i.e., water quality, particularly as it relates to salinity, nitrates and other agro-chemical pollutants; and the proper storage, use and disposal of agro-chemicals.

Information collected within the groundwater management and drainage component will allow water system managers to make more informed decisions about the conjunctive use of surface and groundwater leading to decreased incidence of waterlogging -- which is already a serious problem in many areas of the perimeter. On-farm demonstrations and pilot activities focus on water management, land-leveling techniques and more appropriate crop tillage practices aimed at sustained soil resource management.

Long-term monitoring of soil decomposition and water quality will assist resource managers in making more informed decisions, particularly when put in the context of other project Elements. For example, the GIS installation planned for this project provides a tool that will help determine high environmental risk areas and advise farmers about agricultural practices they can undertake to reduce these risks over the long-term. Finally, the project will develop recommendations on ways to improve agro-chemical storage, use/application

and disposal practices in the area. This information will be communicated through on-farm demonstrations, annual workshops, existing extension channels and development of a "pollution information network" which will link area institutions dealing with water quality and other environmental issues.

In addition to these direct benefits for the long-term sustainability of local environmental resources, numerous indirect positive impacts will also result. Most notable among these is the decrease in pollutants entering the Oued Oum Er Rbia watershed at the Tadla perimeter and mitigation of adverse downstream impacts on the human, livestock, fish and plant populations. This is critically important because the river serves as the source of irrigation water for the ORMVAD irrigated perimeter and as a source of potable and industrial water for Casablanca before it empties into the ocean at El Jadida.

Finally, because the surface and groundwater resources serve as the primary water sources for the population living in Tadla, decreases in levels of pollution are extremely important to public health and welfare. If successful, project activities will reduce the health hazards currently associated with water from these sources.

F. Social Soundness Analysis

The social soundness analysis is organized around three distinct but related aspects. The first is the compatibility of the project with the socio-cultural environment in which it is to be introduced -- i.e., its socio-cultural feasibility. The second is the likelihood that the new practices or institutions introduced among the initial project target population(s) will be diffused among other groups -- i.e., the potential spread effects. And, third, the social impacts or distributions of benefits and burdens among different groups, both within the initial project population(s) and beyond.

1. Socio-Cultural Feasibility

a. Who Lives Where?

The ORMVAT currently has irrigation water delivery and/or agricultural extension responsibilities for farm families on 325,067 hectares of agricultural and grazing land in the Tadla plain. According to the most recent information (ORMVAT, 1991), there are 27,916 farm families in the Beni-Amir and Beni-Moussa irrigation sub-perimeters. During the 1989/1990 summer and winter seasons, they planted crops on 114,334 hectares. In addition to farming community in the irrigation perimeter, there are 26,646 farm families in the area outside the two irrigation sub-perimeters, but within the total ORMVAT area. They have rainfed crop and livestock enterprises on the remaining 210,773 hectares.

The ORMVAT area comprises portions of the Provinces of Beni Mellal and Azilal, with 13 rural communes and the 5 major towns of Fkih Ben Salah, Souk Sebt, Beni Mellal, Ouaouizerth, and Bzou. The total population of the ORMVAT area is estimated to be

424,000, of which 318,000 are classified as rural inhabitants and 106,000 are urba dwellers. If all rural inhabitants were also enumerated as members of farm families withi the ORMVAT, then the average size of a rural family would be approximately 6 person The overall population density was 118 persons per square kilometer in the Tadla at the las population census.

According to statistics from the Ministry of Health office in Beni Mellal, the population i the ORMVAT is quite young, with 42.8 percent being less than 14 years of age, 20. percent being between 15 and 24, 17.1 percent between 25 and 39, 13 percent between 4 and 59, and 6.6 percent being over 60 years of age.

For reasons of forced displacement during the colonial period and in and out-migration since then, the farming population of the ORMVAT perimeter is quite heterogeneous. Prio to initiation of irrigated agricultural activities in the early 1930s, the dominant triba confederations on the Tadla plain were the Banu Amir and the Banu Moussa. These peoples, due to their soldier -- Guich -- status vis-a-vis the Moroccan ruler, had collective access and usufruct rights to the land on both sides of the Oum Er Rbia river.

With irrigation in the Beni-Amir sub-perimeter, the tribal confederations lost many of their land use rights and were effectively excluded from much of the irrigated area through colonial decree and private "land sales" to outsiders -- colonialist and Moroccan. In the 1990s, however, the tribal confederations still have influence in the ORMVAT, with the eastern and western fractions of the Banu Amir tribal confederation having their headquarters in Fkih Ben Salah on the right bank of the Oum Er Rbia river and the several major groups of the Banu Moussa having their center in Souk Sebt on the left bank. Only in parts of CMVs 507 and 509 do members of the Banu Moussa inhabit the right bank of the river. Both confederations descend from the Hilali Arab invasion of Morocco in the 12th century and both were given collective lands in the Tadla by the Almohade Dynasty.

Most of the population of the perimeter is said to be of Arab origin but, in the eastern part of the perimeter against the foothills of the Middle Atlas mountains in Azilal Province, three CMVs -- i.e., 525, 529 and 532 -- have largely Berber populations. Most of the inhabitants are from the Ait Atta tribal fraction; but, close to Beni Mellal, there is a significant population of Berbers of the Ait Rbaa fraction.

Ethnicity is a mediating factor which has determined administrative jurisdictions within the Tadla -- i.e., there are rough correlations between tribal/fractional distributions and the delineation of Cercle/Commune boundaries -- and affected patterns of association and cooperation.

b. How Are They Organized?

The core operational objectives of the project are to, first, evaluate and then affect changes

by participants in the management of resources -- primarily water and land -- in Tadla in the context of a more open Moroccan economy. In this regard, it is essential to have or to develop an understanding of who the landowners and agricultural operators are within the Tadla irrigated perimeter and how they organize their activities. This is so because owners and operators of land in the perimeter are -- in matters concerning them -- simultaneously interlocutors with the State and direct actors in resource management.

Any meaningful discussion of resource allocations within the Tadla must start from a very detailed base of current information about property ownership and actual management of agricultural enterprises and household activities. Unfortunately, at present, this is the area of greatest weakness in the existing literature. Detailed farm-level information of the kind needed to assess and recommend changes in resource allocations is simply lacking for the Tadla perimeter and, while the reasons for this lack can be explained, the deficiency could not be remedied in the course of the project design exercise. The only alternative was to design a series of diagnostic studies into project implementation and this has been done for all 4 Elements of the project.

The information problem at present stems essentially from the approach adopted by the GOM over the past three decades toward agricultural enterprises in all of the nine large-scale Moroccan irrigation perimeters. During that period, the practical reality was that the Moroccan government was not overly concerned about how farm families actually organized themselves because the central thrust of irrigation policy was to narrow -- and, to the extent possible, eliminate entirely -- the range of possible management options open for farmer decision-making. In a very real sense, the Moroccan government sought to intervene so massively in the technical, economic and social operations of the large-scale irrigation perimeters that critical resource allocation decisions were essentially taken by the State on behalf of the farming community, not in collaboration with it or by the farmers themselves.

The operative irrigation model assumed an ideal type of operation in which:

- A farm unit of, at least, five hectares was to be maintained as the minimum economic unit for a Moroccan farm family and sub-division below this size by either sale or successional division was prohibited by the law;

- A unified farm plot was to be operated as a single enterprise, and mandatory land consolidation of parcels was implemented to reassemble properties in a geometric layout;

- A balanced mixed farming operation was to be maintained, where crop and livestock enterprises were closely integrated; and

- A stable farming operation was to be managed by the owner or under a regulated term lease.

Under the operative model, the government did almost everything in the large-scale perimeters. It conceived, constructed, operated and maintained the on-site and off-site infrastructure used in irrigated production. It chose the crop rotations for the farmers and imposed crop and irrigation techniques on them. It distributed irrigation water on a regulated seasonal schedule and established the unit price for this water. It granted agricultural credit through public financial institutions and bought, transported and processed the crops for fixed prices. And, finally, through agents at the processing plants, it deducted farmers' credit reimbursements from the crop payments due to them before they received net payments.

The "model" experiment of the last three decades explains in large measure why there is currently such a paucity of detailed farm-level information. Most "farm-level" information recorded at the ORMVAT through the 1980s reports on "actual" agricultural production for the "major" crops vis-a-vis the plan targets for the 26 CMVs in the perimeter, accompanied by explanations as to why targets were or, more often, were not attained.

The same type of informational deficiencies apply to questions of land ownership and tenure in the perimeter. It is evident in discussions with ORMVAT staff that government land titling agencies do not always know precisely how many rightful owners there actually are for any given farm parcel, although nominal ownership is usually ascribed to one owner. On the 94 percent of the land which is privately owned -- nearly always in joint ownership -- government officials are often unaware of how each property is actually sub-divided among co-inheritors and who among these individuals and other non-owners actually works the land.

In the case of irrigated land, this lack of precise information is detrimental for a number of reasons. First, after consolidation, the overall layout of plots within an irrigation block -- with its geometric precision and alignment -- gives a false impression of orderliness when in reality agricultural production enterprises may be scattered among several parcels. Second, the ownership and management functions with respect to any particular field or crop enterprise actually be divided among several different persons making agricultural innovation difficult. And, third, technical operations within the perimeter are still based in large measure on the facile assumptions of complete respect for the system's original development model -- i.e., minimum size of properties, plot operations which respect certain cropping patterns and rotations, etc. -- even though everyone acknowledges informally that the underlying organization of plots and farm resource allocation patterns are not and effectively cannot be respected.

Despite the undeniable technical successes Moroccan engineers have attained in capturing and controlling water deliveries in the ORMVAT perimeter, the overall large-scale perimeter model bears little resemblance to what is actually happening in the perimeter and therefore rarely attain its stated objectives. This is so in many instances because the theoretical layout and operations of plots within a block does not correspond at all with the realities of farm-level operations. Farm operations are very often smaller than anticipated

by the model -- i.e., surveys show that the average farm holding has only 4.26 hectares and 47.5 percent of all farms have less than the minimum 5 hectares. The sub-division and amalgamation of plots, by covert private sale and because of inheritance laws, continues apace. Moreover, actual field operations are not always perpendicular within a block as anticipated by the model and many fields are planted to more than one crop in violation of the anticipated rotation. For all these reasons, the anticipated scheduling of water deliveries to farms based on fixed crop rotations and the water requirements of specific crops under specific cultivation techniques cannot be respected in reality. And, to their credit, ORMVAT system managers have finally recognized this fact and started to modify the water delivery system to accommodate the needs of the farmers but many more modifications are needed -- as detailed in the description of Element 1 activities -- before the system can be fully responsive.

The system described above pertains most directly to the 71 percent of the perimeter land -- i.e., the 68,787 physical hectares -- in 21,396 parcels controlled under private ownership. The variances from the irrigation model are even difficult complicated on the 14,818 hectares and 963 parcels -- 15 percent of the total -- of state land operated by parastatal enterprises, experiment stations and agrarian reform cooperatives and the 13,704 hectares of land in 486 parcels operated as collective or habous lands. In the former case, the majority of the land is operated in large blocks under a unified management and in the latter the land is often leased out to large investment companies for pivot irrigation using water from boreholes. In neither case does actual land management and resource allocations correspond with the theoretical irrigation model.

All of the above, explains, in some measure, why there is not a great deal of useful information available on farm-level organization and why the generation of such information early in the project is of critical importance to the success of project activities. Equally important, the discussion shows why working in Tadla will be such an interesting and stimulating undertaking in the 1990s. GOM decisions taken at the end of the 1980s to revamp the most fundamental elements of its policy toward the large-scale irrigation perimeters will inevitably lead to truly massive reorientations in ORMVAT and GOM thinking and to much improved prospects for meaningful interactions with farmers and other representatives of the private sector. The project Elements have been designed specifically to assist with this reorientation process and to make the policy changes concrete realities in Tadla.

c. Allocation of Time

So little is known about how farm families in Tadla presently make their resource allocation decisions that speculation on how they might respond to project activities over the next seven years might appear somewhat specious. However, judging by the changing patterns in crop production and agricultural practices recorded in the 1980s, one can already conclude that Tadla farmers are highly knowledgeable about and responsive to economic opportunities and technological innovations -- i.e., paprika peppers as a new crop or use

of well water in conjunctive use with water from the gravity system -- they perceive to be in their own interest. Conversely, experiences in the perimeter have shown that farmers will actively resist external attempts to impose changes -- i.e., replacement of the traditional robta irrigation system with furrow and siphon systems, increasing cotton cultivation during the summer season, imposition of fixed crop rotations -- where they believe technical and/or economic conditions do not justify such changes.

Beyond adoption choices based strictly on the objective characteristics of the process or technology in question, there are certain factors which may affect the responsiveness of certain farm groups within the perimeter to innovation. Farm size and the relative degree of dependence on farm production for family subsistence clearly varies widely within the perimeter. Almost one-half of all farms in the perimeter control less than five hectares of irrigable land and many people have expressed the belief that, as farm size in hectares declines below this size, the farm family's dependence on farm production for subsistence needs increases to the point where such families have an inherently lower capacity to respond to economic changes or to adopt new technologies.

This type of statement can certainly be formulated as a valid hypothesis for testing under the project's Element 2 intensive farm management study but it is far from a proven fact. The conventional wisdom on this issue could easily be proven wrong if, for example, intensive diagnostic efforts documented that families on very small farms receive large inflows of funds from family members working in off-farm employment and were willing and able to use some of these funds for modernizing farm enterprises and/or relieve pressures to grow subsistence crops. In these situations, families on small farms might actually prove to be less risk averse than those on larger holdings.

Moreover, in irrigated areas with a large range of possible crop and livestock enterprises operating under open market conditions, there is often no reliable correlation between size of land holdings per se and the size and/or profitability of the farm business. Not only is it not true that larger farms necessarily have higher net farm revenues and, hence, profitability than smaller farms, it has often been found that the opposite case is true -- i.e., because of the constraints they face, families on smaller farms operate their enterprises more intensively, allocate their resources more efficiently, and grow higher percentages of high value crops in rotation than on larger ones. Suspicions of this sort are certainly relevant in Tadla, where virtually every technician and extension agent interviewed was of the opinion that the largest farms, run by public and parastatal agencies and/or under collective arrangements, were the least efficient allocators of resources in the perimeter and the most unprofitable in terms of enterprises undertaken.

Further to this point, interviews, particularly with government officials, often uncover very specific views on gender roles in agricultural enterprises and participants often proceed from these statements to assumptions about how males and females benefit differentially from on-farm enterprises. Women are often said to benefit most from livestock enterprises -- particularly dairy enterprises -- and less from crop enterprises. Further, because most

ORMVAT extension agents are male and tend to directly relate more to male farmers as the ascribed "heads of household", it is usually assumed that women necessarily have diminished -- or even no -- roles in farm family decisions on resource allocations.

These stereotypes are reinforced in many discussions with expatriates by facile assumptions about how Islamic societies function in comparison to "western" societies. Often with the added assumption that Islamic inheritance laws necessarily lead to directly to the fractionalization of land holdings to the point where farms become too small to be viable economic units. Such comments of course carry with them the implicit assumption that Islamic societies are, by their nature, so rigid that they have not developed any alternative mechanisms for dealing with these fundamental problems.

All this is by way of reiterating the fundamental need for intensive work at the farm-level to understand the roles of all family members in decision-making and for flexibility in determining what specific interventions will be designed, tested and disseminated at this level. It also reinforces the project design decision to mainline all project activities in the initial stages of project implementation. At present, project activities are seen by the team to be sufficiently gender-neutral and broad in scope to offer equal opportunities to all potential participants. However, if and when gender discrimination is documented as a specific factor in denying group access to project activities and/or specific activities are shown to favor certain participants unfairly over others, enough flexibility has been built into the processes for designing and implementing project activities to allow substantial reorientations in approaches and resource allocations.

d. Motivation

Farmers and other groups in Tadla will respond to the incentives provided by GOM policy changes and project activities to the extent they perceive benefits for themselves from the changes and activities. Conversely, they will respond to the extent that they see negative consequences to inaction on their parts. This is important in the current situation because various actors are responding to positive and negative stimuli in differing degrees.

For example, farmers in Tadla are already changing their specific crop enterprises and rotations and on-farm practices in response to both positive incentives -- e.g., the emergence of the paprika pepper opportunity -- and goads to greater efficiency -- i.e., elimination of government subsidies on inputs and fixed prices on certain outputs, ORMVAT/parastatal withdrawals from commercial activities. There is no reason to believe that the same mix of positive and negative incentives will not affect farmer responses to the technological and institutional innovations proposed under the project.

At the ORMVAT-level, staff are -- and will increasing be -- reacting to both positive and negative incentives. It is clear, for example, that pressures from the national level are increasing for the ORMVAs to accelerate their disengagement from commercial activities and to develop innovative methods for involving farmers and other economic actors in

decision-making about water deliveries and agricultural extension needs. At the same time all ORMVA staff are feeling the spur toward improved performance, in the Tadla case, they are also looking forward to the technical assistance, training, new equipment and methods, etc. to be provided under the project as positive incentives for upgrading their individual and collective capacities, changing outdated work habits, and revamping unsuitable ORMVAT/client relationships.

Private commercial entrepreneurs and firms will participate in the Tadla economic transition to the extent they can identify and profit from new business opportunities. The project will seek to work with these economic actors to jointly test and disseminate new agricultural technologies for farmers, evaluate new market opportunities, and train staff in improved business management.

e. Minimum Participator Profiles

Activities in this project cover such a broad range that it is extremely difficult to define a minimum participator profile that would apply in all cases. With respect to on-farm activities, the initial assumption used was that full-time farm families having between 3 to 10 hectares of irrigable land would be the primary beneficiary group. This appears to be the group most likely to have already been affected by the policy changes the GOM has made -- i.e., subsidy reductions, market liberalization, withdrawal of ORMVAT commercial services -- and most likely to benefit from improved water deliveries and other innovations under the project.

The major unknown with respect to farms having less than 3 hectares is the origin and status of financial and other resource flows to and within the households. If it can be verified that these families receive significant amounts of money from off-farm sources and can secure farm labor on demand, it is possible that they may be highly responsive to new opportunities -- particularly with respect to more economic use of agricultural inputs and initiation of new crop enterprises. They would also appear to be the operations most in need for private custom services for mechanical operations like plowing, secondary tillage, and harvesting. Conversely, they are probably not good candidates for adoption of custom micro-irrigation systems and/or installation of more efficient pumping equipment to facilitate the conjunctive use of ground and gravity water.

At the upper end of the farm size classifications, most of the land in question is held and/or operated by public and parastatal agencies or in collective arrangements. In the former case, more reliable access to irrigation water will probably be the most effective way of influencing a supply response. Beyond that step, these farms have sufficient access to credit, input supplies, and technical consultants to plan and implement changes in farming operations without extensive support from the project. Whether or not they will make such changes -- after water deliveries improve -- has more to do with what they perceive to be their "moral" responsibilities vis-a-vis the government than it does to lack of resources. Because this "moral contract" philosophy plays such a large role in the decision-making of

these agencies, they may end up as the main Tadla producers of sugar beets and cotton long after the smaller, private farms have shifted their enterprises toward more profitable crops.

With respect to the lands under collective arrangements, there appear to be two different approaches. One is to continue the current process of establishing long-term leases with private companies to develop and manage the collective land using water from boreholes and capital-intensive pivot irrigation technology in return for some benefit sharing arrangement with collective members. The other is to find ways of effectively privatizing the land holdings and giving titles to individual farm families.

In the first instance, the large private pivot operations are effectively beyond the influence of most of the interventions planned for the project. In the second, the process is already converting institutions like the agrarian reform cooperatives into less restricted associations of farm families, each with title to their land. In this status, the households in the cooperatives may not be very different from other private land owners in their responsiveness to the project.

Finally, with respect to the environmental activities under Element 3, there appear to be no minimum requirements for participant participation. Since all parties in the perimeter appear to contribute to the existing pollution and resource misuse problems observed, all should have, at least, the potential to contribute to the process of mitigating -- and, in some case, eliminating -- the problems. And, project activities are designed to generate recommendations for improved environmental management at all levels in the perimeter.

f. Matching Participators and the Project

While the vast majority of Moroccans in Tadla will benefit in some measure from project activities, some groups have the potential to benefit more than others. The major beneficiaries have been identified above and in Section 3 of this Annex and in the Economic Analysis (Annex H).

Two groups which stand to benefit indirectly from project activities are seasonal migrants who come into the area to participate in agricultural activities and the populations living downstream from the Tadla. The first group may derive significant employment benefits over a larger portion of each agricultural year as cropping patterns shift toward more labor-intensive crop enterprises. The second group will benefit primarily from project activities which affect the quantities and quality of water available for use downstream.

A certain number of individuals within the perimeter will definitely not benefit from the project and may be adversely affected by the broad policy changes initiated by the GOM and supported by the project. These include employees of public and parastatal agencies within the perimeter -- i.e., sugar mills, cotton ginneries, input suppliers operating under government contracts, certain ORMVAT staff -- whose essential functions will be reduced and/or eliminated in the disengagement process. Many of these people, because they possess

valuable skills and experience, may in fact find employment in the private sector or in other government positions but all will experience job dislocations and possibly loss of status in the transition period.

g. Obstacles to Progress

There do not appear to be any insurmountable obstacles to progress for the project as designed. But, there definitely are sensitive issues to be monitored and resolved during project implementation. These revolve around the interrelated problems of a legacy of paternalism, problems with the "industrial" crops, and problems in assessing the benefits and costs involved in the GOM's disengagement/decentralization process.

Since 1986, the GOM has embarked on a process of economic policy change, it has already significantly affected power relationships in the Tadla. It must be recognized that this process has been -- and will continue to be -- politically and economically painful for many stakeholders in the previous system. Moreover, the psychological transition from old to new working relationships between ORMVAT staff, farmers and representatives of the private sector is far from over and has been disturbing for many participants.

In a very real sense, both groups find themselves caught between a comfortable and established system of privileges and responsibilities that is disappearing and a new economic system in which their roles, if any, are uncertain or ill-defined. One measure of the effectiveness of the government's economic reorientation efforts to date is that so many groups in Tadla feel uncomfortable in the face of the changes, but this is cold comfort for those who stand to lose real power -- mainly government officials, managers and staff of public and parastatal agencies -- or for those who must manage the transition process so as to avoid serious dislocations in the rapidly changing environment.

In Tadla, there is a constellation of stakeholders whose positions and power are intimately tied to continuance of the local sugar beet and cotton industries. In the past, government attempts to promote production of these two crops have led to development of significant infrastructure and employment and, as important, have altered economic relationships between farmers and the government officials managing these industries. Economic liberalization and the disengagement process have struck at the heart of these relationships. They have broken the essential linkages that shaped the control relationships and, simultaneously, saddled the government with the costs of infrastructure and institutions whose value is declining with each passing year.

As a consequence, it is not surprising at this stage that many of the stakeholders in the old system are the first to raise arguments against the changes underway and make paternalistic statements about the alleged benefits of a declining system for farmers and other groups in Tadla. Many of these comments, although perhaps voiced for the wrong reasons, address real problems that remain unresolved. For example, how can the government handle the transition if it has to effectively write off investments over several decades in the sugar beet

and cotton industries? Or, what will be the real balance of political and employment gains from new agricultural enterprises in Tadla versus losses from old industries? And, finally, how will the transition to a new set of political and economic relationships be handled so as to avoid adverse consequences for major constituent groups?

The underlying struggle to resolve these issues affects fundamental political and economic relationships at all levels in Tadla -- as elsewhere in the country. And, because the project seeks to assist in the process, it will inevitably be affected by it. The prospect of delays in realizing significant progress -- particularly with respect to Elements 2 and 4 -- cannot be discounted. And, only time will tell how strong is the resolve of the government in actually implementing the policy changes it has already announced.

h. Communications Strategies

The rationale for the GOM's irrigation model in the past was to impose a comprehensive technical package of irrigation management and agronomic practices on farmers. Most of the difficulties encountered in this approach can be attributed to three basic flaws in the system. First, communication patterns with farmers either individually through the extension mechanisms or in groups through the organizations the GOM created -- i.e., cooperatives, professional associations, etc. -- were one-way. They served only to communicate government decisions and demands to the farmers without recognizing farmers as legitimate participants in a decision-making process and failed completely to take into account the constraints under which farmers had to operate in the perimeter. Second, the model precluded any effective role for other private sector actors, except as contractors in state-run operations. And, finally, the whole system ran on a set of false economic signals devised by the government and communicated to farmers through a closed market system.

Disengagement will permit farmers and technicians far greater latitude and provide real incentives for both groups to actively foster new economic opportunities within the perimeter and adoption of improved irrigation/cropping practices. The activities designed under project Element 2 will identify critical constraints in farm-level resource allocation and specify pilot interventions which will be tested on-farm to alleviate these constraints. An examination of existing dissemination mechanisms, both formal and informal, suggests they are appropriate vehicles for disseminating results of project efforts. Their effectiveness has been compromised largely by previous restrictive policies. Mechanisms for disseminating project results have been described in the Implementation Plan and this analysis sees no real constraints to their success, if they are carried out in the new spirit of partnership and liberalization.

2. Spread Effects: The Diffusion of Innovations

In a formal structural sense, the primary responsibilities for evaluating the results of project activities and disseminating them within the irrigation sub-sector will lie with government officials in the ORMVAT and the MARA. In the present network of nine

ORMVAs, each is geographically-defined and faces a different constellation of problems. Each has different methods of addressing its problems, employs different types of irrigation and agricultural technology, and interacts with different client groups.

Since the team necessarily confined its design activities to the ORMVAT, it is difficult to assess the potential relevance of any single project intervention to the other ORMVAs at this time. Presently, it would appear that technical system and farm-level activities in Tadla will have their greatest relevance to those parts of the other ORMVAs where gravity irrigation is practiced. If effective methods are developed in Tadla to manage the conjunctive use of ground and gravity system water, this would be another area of potential relevance. And, of course, work with more effective use of agricultural inputs for specific crops may have important carryover effects in other ORMVAs.

But, beyond the technical aspects of the project, it would appear that project efforts to develop and implement new working relationships between ORMVAT staff, farmers, and other representatives of the private sector would hold out the greatest possibilities for diffusion and adoption in the other ORMVAs. Prospects in this regard will be strengthened by the working relationships which have been established with the MARA/World Bank projects. These projects, after 1993, will be working with all of the nine ORMVAs on redefining operational roles and improving ORMVA management practices. To the extent that project activities in Tadla generate findings, recommendations and innovations applicable to the problems in the other ORMVAs, it has already been agreed that the projects will work together in disseminating results within the network.

In addition to the ORMVA network, results from the environmental activities under Element 3 will be disseminated through the network of agencies established during project implementation. In addition to MARA, the network will have participation from agency staffs from the Ministries of Public Works and Health.

Within the project itself, a number mechanisms are envisaged at the regional and national levels to disseminate project results and to discuss common problems. First, the project, in collaboration with the SVOP of the ORMVAT will produce and distribute technical papers in French and Arabic to all interested parties. Second, if a regional radio network for agricultural news and commentary is established, the project will supply materials for broadcast. Third, a number of regional and national workshops and seminars will be supported by the project as a forum for discussions and dissemination of project results. And, finally, standard agricultural extension techniques -- farmer field days, observational tours, audio-visual presentations, etc. -- will be used in Tadla.

3. Social Consequences and Benefit Incidence

a. Access to Resources and Opportunities

The entire purpose of the project is to broaden access to and participation in decision-

making about resources and opportunities in the Tadla for farmers and other private sector participants. The activities of the project seek to actively support that GOM's twin policies of public agency disengagement from commercial enterprises and reorientation of the ORMVAT toward wholly service activities in water delivery and agricultural extension. It will also work with local institutions -- cooperatives, professional associations, irrigation associations, etc. -- to strengthen their capacities to participate to greater degrees in the economic and political life of the community.

As the GOM's policy changes are implemented in Tadla, farmers will be given much greater responsibility and capacity to run their own farm enterprises in response to the constraints and open market economic signals they are facing. A much greater percentage of agricultural and commercial activity will be in the hands of private sector entrepreneurs and firms. Markets will be operating free of the government-imposed price and quantity distortions of the past -- i.e., taxes, subsidies, credit rationing, water allocations.

All these changes should result in significantly greater net incomes for farm families and increased market shares for private businesses in input supply, provision of agricultural services, commodity processing, and product marketing.

b. Employment Effects

Project activities per se in the Tadla will probably have only minor impacts on regional employment because the activities have been deliberately designed to work with existing institutions and retrain their personnel to assume new responsibilities. However, the project is intended to assist the GOM in turning national policy decisions into concrete realities at the regional level. If this process proceeds as planned, there will inevitably be very major changes in both employment patterns and the productivity of labor in irrigated agriculture in Tadla.

Employment patterns will change as a result of the GOM's decision to foster participation from farmers and other private sector actors in the regional development process. As the result of the ORMVAT disengagement and the liberalization of markets and perimeter operating procedures, farmers have begun to reallocate the resources under their control to new crop enterprises -- i.e., paprika peppers, other vegetables and fruit -- and away from lower value crops -- i.e., sugar beets and cotton. These crops are both more labor-intensive to produce and process and more profitable per unit of labor invested.

The project is aimed at assisting farmers in furthering this process in the 1990s by increasing access to and the reliability of critical agricultural resource delivery systems. It will also develop, test and disseminate farm-level innovations which will further increase the productivity of existing labor and create new opportunities for on-farm employment of both skilled and unskilled labor. In addition, the new on-farm innovations will create market demands for new goods and services from the private sector -- i.e., needs for new enterprise inputs, consulting services, equipment maintenance, commodity processing, and

marketing.

Finally, because of the presence of many small farm units in Tadla with limited capital resources and the more general need to create employment opportunities in the Moroccan economy, the project activities have been deliberately oriented toward introducing agricultural innovations which will increase both labor and land intensities. Work on water delivery systems will allow farmers to work their land more intensively. Introduction of innovations in crop tillage and use of inputs -- i.e., seed, fertilizers, and other agro-chemicals -- will increase both land and labor productivities while actually lowering capital costs per unit of output. And, deemphasis of activities with agricultural machinery will avoid problems of labor displacement in agricultural enterprises.

c. Rural Displacement, Migration and Urbanization

The objective of this section of course is not to recount the history of the Tadla irrigation systems from the 1930s to the present but it seems useful to remind the reader that the plain has been the site of rural population displacements, labor in-migrations and out-migrations for a long time. These occurrences have been triggered by many factors over time -- government policies, conditions elsewhere in Morocco and outside it, and the development of very valuable irrigated land in the midst of an area subject to periodic and severe droughts.

There are consequences of these factors in Tadla in the 1990s. The first is, as discussed above, that the farming community in the Tadla perimeter displays a high degree of heterogeneity. It is a complex mosaic of peoples from the tribes -- i.e., the Beni-Amir and Beni-Moussa -- and specific clans -- i.e., the Chorfa and Oulad Abdalla -- occupying the land before the 1930s and "outsiders" who have acquired access to the land since that time.

The second is that, because irrigated land is by its nature limited and alternative economic opportunities are available elsewhere, there is a continuing pattern of out-migration, primarily by young people, in search of temporary or permanent employment in other parts of Morocco and in Europe. Some of the participants in this out-migration are said to regularly send portions of their earnings back to family members in Tadla and these in-flows may in part explain the apparent paradox of relatively large Moroccan families "surviving" on very small parcels of irrigated land within the perimeter. In this regard, it is reported that transfer of money into the Tadla region from migrant workers in 1989 amounted to approximately 50 percent of farm families' off-farm revenues, but 80.4 percent of these revenues for farms of less than 2 hectares, and 91.4 percent for farm families having access to 2 to 5 hectares (A. Ftouhi. 1989. "Les Revenus des Agriculteurs dans le Perimetre Irrigue du Tadla.". IAV, Rabat, Maroc. pp. 30 and 89).

The third is that irrigated crop enterprises have generated a continuing demand for seasonal farm labor in-migrations. Although present information on these in-migrations is limited, it appears that much of the seasonal movement involves unskilled female laborers

from areas immediately adjacent to the perimeter -- i.e., from highland areas of Azilal province -- and from other areas of the country.

In this complex picture and long history of in and out-migrations, it is very difficult to predict a priori how project activities might ultimately affect net flows. It is evident that improved reliability in irrigation water deliveries, relaxation of prior restrictions on fixed crop rotations, and the anticipated shifts to higher value agricultural enterprises in Tadla will make access to irrigated land a much more valuable asset. Adoption of certain types of agricultural machinery and irrigation techniques will also place premiums on accumulation of blocks of land that are sufficiently large to support the costs of capital investments and modernization. But no clear picture emerges as to whether these changes will result in actual displacements of farm families largely through changes in ownership of private land within the perimeter or whether these families will retain ownership of the land but allow it to be managed in larger blocks under cost/revenue sharing arrangements.

The major factors which determine these migration patterns in the future are largely beyond the purview of the project. However, in designing project activities great care was taken to, first, install internal mechanisms -- i.e., the various diagnostic studies, the effort to develop an accurate typology of farm units, and the permanent monitoring and evaluation unit -- to develop a much better understanding as to what is actually happening to specific groups within the perimeter. And, second, to deliberately introduce agricultural and institutional innovations which, at least in part, will be neutral with respect to scale of individual farm operations -- i.e., more reliable water deliveries to all farms; concentration on better use of seeds, fertilizers and agro-chemicals, which inputs are low cost per unit of coverage and investment; and assistance to the private sector to lower unit transaction costs to the purchaser through more competitive market conditions.

With respect to in-migration of farm labor, it again appears evident that conditions which engender farm-level shifts to higher value crop and livestock enterprises will also increase local demands for seasonal -- and, probably, permanent -- farm labor. Increased net farm revenues from these enterprises will also provide the resources and powerful incentives to retain skilled farm labor at higher levels of daily wages and other benefits.

Finally, regarding urbanization effects, the project activities in themselves are anticipated to have no significant effects on the rate of urbanization within the perimeter. Improved business prospects for a variety of private sector input supply, service, processing and marketing enterprises may result in their growth in the small towns in and around the perimeter but most of this growth is expected to come from expansion of existing commercial enterprises. The major impacts on the urban populations in Tadla are expected to come from project activities in the environmental field. If successful, the activities will inevitably lead to significant improvements in the quality of life of these populations through pollution abatement and a lowering of environmental risks. These benefits also have potential for extension to other urban populations in Morocco -- particularly the

Casablanca metropolis -- to the extent that pollution abatement activities in Tadla affect changes in the quality of water flowing back into the Oum Er Rbia river and to downstream water filtration plants.

d. Changes in Power and Participation

The project will help empower farmers in the perimeter to participate in decision-making by strengthening the capacity of the groups in which they participate -- i.e., private sector firms, farmer groups, professional associations, cooperatives and Irrigation Associations. Project activities will support private sector actors at all levels to progressively fill the vacuum left by ORMVAT disengagement from commercial enterprises and provide mechanisms for farmers, technicians and others to discuss water management problems in the perimeter and to transfer greater responsibilities for water and soil management to farmers.

This water management effort will start both at the primary/secondary system level through Element 1 activities and at the tertiary and quaternary levels and with respect to conjunctive use of surface and groundwater in Elements 2 and 3.

Prior to 1986, the ORMVAT, working from directives sent from MARA, set hectarage and production levels for certain "industrial" crops, which were chiefly cotton in summer and sugar beets in winter. Multi-year crop rotations were then "fixed" around these crops. Field cultivation and irrigation techniques were essentially dictated by the technical constraints of the physical irrigation system and the water distribution amounts and schedules. Finally, the farmers operated in a government system of fixed output price schedules, inputs and agricultural credit tied to certain crops, and closed processing and marketing channels for their agricultural commodities.

In practice, farmers did not always respect the ORMVAT irrigation/crop rotation systems as designed by technicians and engineers. They grew crops out of the prescribed rotation. They installed traditional robta irrigation techniques on land supposedly dedicated to the more "modern" border and furrow systems supplied by siphons. Recently, they have adopted new crops like paprika peppers, in conflict with cotton as a summer crop.

This highly constraining system is now being relaxed as a result of GOM agricultural policy changes starting in 1986. The government has adopted a policy of disengagement and, as a result, ORMVAT, among many other agencies, has been instructed to comply. It is now progressively pulling out of all commercial agricultural activities in the perimeters. The ORMVAT plans to turn operations and maintenance management of the tertiary and quaternary canals over to the Irrigation Associations, which have yet to become viable and sustainable entities. The Associations will play a number of key roles: they are expected to control allocations in the tertiary system; work with ORMVAT hydraulic system managers to determine seasonal water allocation plans; develop weekly delivery schedules; and handle the maintenance of lower level canals and drainage ditches.

Achieving reliable water supply through Element 1 is critical to the success of the sustainability of irrigation user groups. At the same time, Irrigation Associations are potentially important factor to Element 1 because success of the technical improvements to the water management system depends on how flexible it is in the future with respect to the quantities and timing of water deliveries and how it is managed at the farm-level.

Recent GOM policy changes have put severe pressures on both the ORMVAT and the private sector. ORMVAT staff will need to become client-responsive, while the professional associations, cooperatives, Irrigation Associations and private firms will need to be developed into entities which can represent the interests of their members. A new balance in decision-making between the public and private sectors will have to emerge, and the project should not underestimate the difficulties involved in this process.

Through the diagnostic study and the monitoring and evaluation efforts, the project will collect information on the development of the Irrigation Associations. This information will be used to review and revise project efforts to support this brokering of power between the ORMVAT and the private sector entities.

The project seeks also to strengthen a variety of other private sector organizations, including multi-service cooperatives, professional associations, and others because their organization is consistent with local social groupings and because people receive immediate financial benefits from their activities. Members of these cooperatives have demonstrated their control over resources and ability to devise strategies to overcome inadequacies of market goods and services. Planned project inputs should further develop their decision-making efforts.

VI. CONDITIONS AND COVENANTS

The Project Agreement should contain one covenant to ensure the GOM plays a consistent role in promoting, facilitating and coordinating World Bank and other donor activities in the irrigation sub-sector.

VII. EVALUATION AND AUDIT ARRANGEMENTS

External project evaluations will be conducted at the end of the third and sixth years of implementation. The principal objective of the mid-term evaluation will be to assess progress and problems in project implementation and to make detailed recommendations for mid-term corrections in implementation as appropriate. The final project evaluation will be designed to appraise the impacts of the project. The final evaluation will be scheduled to afford sufficient time prior to the Project Activity Completion Date (PACD) to properly assess project accomplishments and to disseminate information on promising results in a structured manner.

The specific audit requirements for the project will be determined by USAID and the Regional Inspector General's Office at a later date, as discussed in Section II.D.

Adequate project funds have been budgeted for the evaluation and audit requirements -- i.e., two project evaluations at $ 150,000 each and two project audits at $ 75,000 each.

PROJECT PAPER ANNEXES

ANNEX A

PID APPROVAL MESSAGE AND PD 71 DETERMINATION

ACTION: AID-3 INFO: DCM ECON/5

INFO COPY

LOC: 357 000
23 JUL 91 0742
CN: 43575
CHRG: AID
DIST: AID 608-0213

VZCZCRA0496EA0343
PP RUFERA
DE RUEHC #0553/01 2231751
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FM SECSTATE WASHDC
TO AMEMBASSY RABAT PRIORITY 4611
BT
UNCLAS SECTION 01 OF 02 STATE 239553

AIDAC

ACTION : ANR

DUE DATE: 07/25

INFO : DIR. DDIR. PROG. PHR TRNG CHRON - RF

E.O. 12356: N/A
TAGS:
SUBJECT: WATER AND SOIL RESOURCES CONSERVATION (608-0213) GUIDANCE CABLE

1. SUMMARY: THE PROJECT REVIEW COMMITTEE (PRC) MET JUNE 27, 1991 TO REVIEW THE SUBJECT PROJECT IDENTIFICATION DOCUMENT (PID). BASED ON THIS REVIEW, THE DAA(NE)/ENE HEREBY APPROVES PID AND DELEGATES AUTHORITY TO THE MISSION TO DEVELOP AND APPROVE THE PROJECT PAPER FOR FY 92 OBLIGATION. THE MAIN ISSUES RAISED DURING THE REVIEW FOCUSED ON ALTERNATE WATER USES, SUSTAINABILITY, DONOR COORDINATION, AND PROJECT REPLICATION. GUIDANCE ON THESE ISSUES AND OTHER CONCERNS DISCUSSED DURING THE REVIEW ARE OUTLINED BELOW. END SUMMARY.

2. PROJECT OVERVIEW: THE PRC COMMENDED THE MISSION FOR DEVELOPING A SOUND PROJECT, ESPECIALLY GIVEN THE DESIGN HISTORY OF THIS PROJECT AND THE COMPLEXITIES SURROUNDING WATER ISSUES AND IRRIGATION SYSTEM MANAGEMENT IN MOROCCO. MISSION REPRESENTATIVES DENNIS CHANDLER, DIRECTOR AND ERIC LOKEN, PROJECT OFFICER MADE A DETAILED AND COMPREHENSIVE PRESENTATION OF THE PROJECT TO THE PRC. ISSUES DISCUSSED DURING THE REVIEW AND GUIDANCE FOR PP DEVELOPMENT ARE PROVIDED BELOW:

3. ALTERNATE WATER USES: THE PID NOTES THAT THE INCREASING DEMAND (IMPLICITLY INCREASED COMPETITION) FOR WATER FROM ALL USERS IN THE RIVER BASIN, INCLUDING NON-AGRICULTURAL USERS IN DOWNSTREAM AREAS, IS AN INCREASINGLY ACUTE PROBLEM. YET THE PID CONSIDERS ONLY ONE POTENTIAL BENEFICIARY OF WATER SAVINGS GAINED THROUGH PROJECT-PROMOTED INCREASED IRRIGATION EFFICIENCIES. THE PRC QUESTIONED WHETHER CONSIDERATION SHOULD BE GIVEN TO FREEING UP WATER RESOURCES FOR ALTERNATE USES INSTEAD OF INVESTING IN ADDITIONAL IRRIGATION FACILITIES FOR QUOTE SAVED UNQUOTE WATER. AS EXPLAINED BY THE MISSION REPRESENTATIVE, THE PROPOSED USES FOR SAVED WATER INDICATED IN THE PID'S PRELIMINARY ECONOMIC ANALYSIS ARE BASED ON THE CURRENT MOST ECONOMICALLY VALUABLE USES OF THIS WATER AS DETERMINED THROUGH THE CURRENT BASIN WATER USE/ALLOCATION MASTER PLAN, WHICH IS AN INTEGRATED PLANNING DOCUMENT COVERING ALL POTENTIAL USES FOR BASIN

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WATER SUPPLIES. IN ADDITION, AS THE BENEFICIARY SYSTEM FOR THESE PROJECTED WATER SAVINGS IS ALSO RESPONSIBLE FOR PROVIDING A PORTION OF THE URBAN SUPPLIES FOR THE CITY OF MARRAKECH, THE PROJECT WILL AT LEAST INDIRECTLY BE ASSISTING IN ALLEVIATING POTENTIAL SHORTAGES IN THIS USE AREA AS WELL. NEVERTHELESS, THE MISSION AGREED THAT THIS IMPORTANT TOPIC WOULD BE CAREFULLY EXAMINED DURING PROJECT EVALUATIONS TO ENSURE THAT WATER SAVINGS GAINED THROUGH THE PROJECT ARE, IN FACT, PUT TO THE BEST POTENTIAL USES.

4. SUSTAINABILITY: THE PID DOES NOT APPEAR TO PROVIDE SUFFICIENT INFORMATION ON HOW VOLUNTARY ORGANIZATIONS INVOLVED IN WATER MANAGEMENT AND INFRASTRUCTURE MAINTENANCE WILL ACHIEVE FINANCIAL SUSTAINABILITY AFTER THE PROJECT IS COMPLETED. CONCERN WAS ALSO VOICED ABOUT THE SUSTAINABILITY OF COMPLEX HYDRAULIC MODEL OF THE TYPE BEING PROPOSED IN THE PID TO BE IMPLEMENTED BY ORMVAT, THE IRRIGATION AUTHORITY RESPONSIBLE FOR THE PROJECT. THE MISSION REPRESENTATIVE INDICATED TO THE PRC THAT FINANCIAL SUSTAINABILITY IS NOT AS MUCH OF AN ISSUE AS THE NEED FOR EFFECTIVE AND SUSTAINABLE SOCIO-ORGANIZATIONAL MECHANISMS FOR PROMOTING ENHANCED NON-GOVERNMENTAL PARTICIPATION IN PERIMETER MANAGEMENT. THE PP DESIGN ANALYSIS SHOULD PROVIDE SUFFICIENT EXPERTISE TO ENSURE THAT CRITICAL PROJECT ORGANIZATIONAL AND FINANCIAL SUSTAINABILITY ISSUES ARE THOROUGHLY ADDRESSED.

5. DONOR COORDINATION: THE PRC NOTED THE CONSIDERABLE ONGOING IBRD PROGRAM ACTIVITIES IN AGRICULTURE AND

IRRIGATION IN MOROCCO, AND THE RELATIVELY GREAT POTENTIAL FOR EFFECTIVE COLLABORATION (AND, CONVERSELY, OVERLAP) BETWEEN THESE ACTIVITIES AND THE USAID PROJECT. DURING PP DESIGN, THE RELATIONSHIP BETWEEN THESE TWO DONOR-ASSISTED EFFORTS SHOULD BE CAREFULLY ASSESSED TO DETERMINE EXACTLY HOW THESE ACTIVITIESHVUVGST EFFECTIVELY WORK TOGETHER TO IMPROVE SECTORAL PERFORMANCE. IN THIS REGARD, THE DESIGN TEAM MIGHT LOOK AT WEAT SUCCESS THE WORLD BANK HAS HAD WITH PAGI I, AND HOW USAID PROJECT WILL BEST SERVE TO COMPLEMENT CONTINUING WORLD BANK EFFORTS IN THIS AREA, I.E., NATIONAL VS. REGIONAL-SPECIFIC DEMONSTRATION OF IMPROVED SECTORAL POLICIES.

6. PROJECT REPLICATION: GIVEN THE STATED OBJECTIVE OF SUBSEQUENT REPLICATION OF PROMISING PROJECT RESULTS IN OTHER GEOGRAPHIC REGIONS AND IRRIGATION SYSTEMS IN MOROCCO, SOME ATTENTION NEEDS TO BE FOCUSED ON HOW WATER SYSTEM IMPROVEMENTS ACHIEVED IN THE TADLA PERIMETER WILL BE SPREAD TO OTHER LARGE-SCALE IRRIGATION SYSTEMS IN THE
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B) PARTICIPANT TRAINING: THE PROJECT SHOULD ATTEMPT TO THE GREATEST EXTENT POSSIBLE TO MAXIMIZE PRIVATE SECTOR TRAINING OPPORTUNITIES, AND THE USE OF HISTORICALLY BLACK COLLEGES AND UNIVERSITIES IN PROJECT-FINANCED PARTICIPANT TRAINING ACTIVITIES.

C) HOST-COUNTRY CONTRIBUTION: ALTHOUGH THE PROJECT APPEARS TO BE IN ACCORDANCE WITH REQUIREMENTS CONCERNING HOST-COUNTRY CONTRIBUTIONS, THE DESIGN COMMITTEE SHOULD KEEP ABREAST OF POSSIBLE EMERGING NEW GUIDANCE ON THIS ISSUE.

D) LESSONS LEARNED: THE PP DESIGN SHOULD CAREFULLY EXAMINE THE RESULTS OF PAST A.I.D. PROGRAMS IN IRRIGATION SYSTEMS MODELLING AND MANAGEMENT TO BENEFIT FROM THE WEALTH OF AGENCY EXPERIENCE IN THIS DEVELOPMENT AREA. WE SUGGEST THE MISSION WORK WITH PPC/CDIE AND THE ISFAN PROJECT TO COMPLETE A SEARCH OF RELEVANT INFORMATION ON THESE TOPICS.

HEREBY APPROVES THE PID AND DELEGATES TO THE MISSION PP APPROVAL AUTHORITY PURSUANT TO THE GUIDANCE PROVIDED ABOVE. ONCE AGAIN, THE MISSION IS COMMENDED FOR A JOB WELL DONE.

11. AGRICULTURE POLICY. APPROVALS REQUIRED BY PD 71 HAVE BEEN OBTAINED. COPIES OF SIGNED ACTION MEMORANDUM HAVE BEEN POUCHED TO MISSION. EAGLEBURGER
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COUNTRY. IN PARTICULAR, WHAT SPECIFIC DISSEMINATION MECHANISMS WILL BE DEVELOPED AND IMPLEMENTED UNDER THE PROJECT TO ENSURE THAT BETTER WATER MANAGEMENT TECHNOLOGIES ARE EFFECTIVELY TRANSFERRED TO OTHER SYSTEM OPERATORS AND WATER USERS THROUGHOUT MOROCCO. THIS DISSEMINATION PROGRAM SHOULD BE FULLY DESCRIBED IN THE PROJECT PAPER.

7. ENVIRONMENT: THE PROJECT INCLUDES A SUBSTANTIAL EFFORT TO ASSESS AND IMPROVE THE ENVIRONMENTAL SUSTAINABILITY OF TADLA PERIMETER WATER AND SOIL RESOURCES MANAGEMENT. HOWEVER, AID/W IS CONCERNED THAT INCREASED WATER AVAILABILITY AND DIFFERENT AND MORE INTENSIVE CROPPING SYSTEMS COULD RESULT IN INCREASED ON-FARM EROSION AND AGRO-CHEMICAL USE AND RUNOFF, AND INCREASED AGRO-PROCESSING WASTEWATER DISCHARGES, WHICH WOULD NEGATIVELY IMPACT DOWNSTREAM RESOURCES AND USERS. FOR THIS REASON, PP DESIGN SHOULD CAREFULLY EXAMINE (A): WHAT MEASURES CAN BE INCORPORATED INTO THE PILOT DEMONSTRATION PROGRAM TO PROMOTE ENVIRONMENTALLY SOUND AND SUSTAINABLE ON-FARM AGRICULTURAL PRACTICES IN PERIMETER AREAS, SUCH AS INTEGRATED PEST MANAGEMENT TECHNIQUES, IMPROVED LAND PREPARATION AND MANAGEMENT TECHNIQUES, PROPER LEVELS AND TYPES OF AGRO-CHEMICAL USE, ETC.; AND, (B) HOW BEST TO ENSURE THAT ENVIRONMENTAL QUALITY CONCERNS ARE PROPERLY INCORPORATED INTO THE PLANNED PERIMETER MONITORING PROGRAM. AN ENVIRONMENTAL EXAMINATION OF THE PROJECT SHOULD BE SUBMITTED TO THE BUREAU ENVIRONMENTAL OFFICER FOR APPROVAL WHEN THE PROJECT IS READY FOR AUTHORIZATION.

8. CROP MIX AND MARKET PRICE: WITH THE EXCEPTION OF SUGAR BEETS AND, TO A LESSER EXTENT, WHEAT, IT APPEARS THAT THE CROPS GROWN IN THE PROJECT TARGET PERIMETER ARE RELATIVELY FREE OF MARKET-DISTORTING INFLUENCES. NEVERTHELESS, IN CONSULTATION WITH THE IBRD, THE PROJECT SHOULD EXAMINE WHAT TYPES OF ANALYSES OR OTHER INTERVENTIONS COULD BE PURSUED TO FURTHER PROMOTE THE SHIFT IN PRODUCTION TO HIGHER-VALUE CROPS IN PERIMETER AREAS, E.G., COMPARATIVE STUDIES REGARDING THE RELATIVE PROFITABILITY AND OPPORTUNITY COSTS OF PRODUCTION OF SUGAR BEETS/WHEAT VS. OTHER, MORE ECONOMIC CROPS AND/OR CROPPING SYSTEMS.

9. IN ADDITION TO THE ABOVE ISSUES, THE FOLLOWING CONCERNS WERE RAISED FOR MISSION CONSIDERATION:

A) PERFORMANCE INDICATORS, PROJECT MONITORING AND EVALUATION: THE PP DESIGN SHOULD CLEARLY DEFINE PROJECT MONITORING SYSTEMS AND HOW THE PROJECT INSTITUTIONAL CONTRACTOR AND COUNTERPART ORGANIZATIONS WILL PROVIDE THE INFORMATION NEEDED FOR EFFECTIVE PROJECT MONITORING AND EVALUATION. IN ADDITION, CAREFUL ATTENTION SHOULD BE DEVOTED TO DEVELOPING AN APPROPRIATE AND COST-EFFECTIVE PROJECT IMPACT MONITORING AND EVALUATION PROGRAM WHICH EFFECTIVELY DEMONSTRATES PROJECT PERFORMANCE IN THE ACHIEVEMENT OF ORIGINAL DESIGN OBJECTIVES, AND ITS EFFECTIVE CONTRIBUTION TOWARDS THE MISSION'S OVERALL COUNTRY STRATEGY OBJECTIVES.

ANNEX B

LOGICIAL FRAMEWORK

LOGICAL FRAMEWORK

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Project Goal: To promote more efficient economic and environmentally sustainable management and use of Morocco's water and soil resources	1. Improved water and soil resources conservation and production practices 2. Increased private sector participation in water and soil resources allocation, management and use 3. Enhanced environmental sustainability of water and soil resources management and use in Morocco	Research results Internal and external evaluation reports GOM agricultural and water supply statistics National export statistics and trade reports Project annual and quarterly reports	GOM maintains favorable agricultural sector policies and implements them over the life of the project Positive project results are replicable in other large-scale irrigation perimeters
Project Purpose: To increase the efficiency, economic yield and environmental sustainability of water and soil resources management and use in the upper Oum Er Rbia river basin of Morocco	**End of Project Status (EOPS):** 1. Improved water and soil resources management policy framework and implementation 2. Improved regional water and soil resources conservation and production processes 3. Increased private regional participation in water and soil resources allocation, management and use 4. Cost savings and increased net farm incomes through better allocation of water and other resources at the farm-level affecting both the mix of crops grown and their yields 5. Cost savings to the GOM from disengagement of ORMVAT from commercial activities and more efficient execution of its reduced operational manadate; and 6. Cost savings through more efficient private sector agri-business activities in the Tadla plain	Evaluation reports Project research results Project monitoring and evaluation reports Annual work plans and project status reports Records of the ORMVAT permanent agro-economic survey unit and the Cellule de Suivi Records of multi-service cooperatives, professional associations and participating private sector firms ORMVAT Annual Activity Reports	

Project Outputs: **Element 1** 1. Improve the delivery of irrigation water to be efficient, reliable, flexible, and timely through: ♦ A more comprehensive understanding of the capabilities and limitations of the hydraulic systems in the perimeters; ♦ Flexible system operating capabilities and procedures which are responsive to farmer's needs and evolve with cropping systems; ♦ Improved overall system water delivery efficiencies; ♦ Near real-time measurement of crop water requirements and climatic variability within the perimeters; ♦ A micro-computer network, linking databases in system operation, system management, weather and groundwater levels for more timely system management decisions and responses; and ♦ Improved timeliness in water management decisions with an associated improvement in the ORMVAT's ability to respond to farmer's irrigation needs in a flexible and timely manner. 2. Increase the availability of critical management information to farmers, processors, and other public and private agricultural interests in the region through: ♦ Daily weather data available to farmers, processors and other private sector actors on a near real-time basis for improved decisions on all agricultural operations related to weather;	**Element 1** 1. Establishment and use of an integrated computer-based water management system within SGRID 2. Formulation and implementation of a detailed water delivery policy and operational criteria and procedures for each sub-perimeter 3. Increased flexibility of water deliveries as reflected in increased surface water use efficiencies 4. Increased operational efficiency of the system as evidenced by substantial reductions in return water flows 5. Increased farmer involvement in the seasonal irrigation planning process and the water delivery process	Evaluation reports Project research results Project monitoring and evaluation reports Annual work plans and project status reports Records of the ORMVAT permanent agro-economic survey unit and the Cellule de Suivi Records of multi-service cooperatives, professional associations and participating private sector firms ORMVAT Annual Activity Reports Direct field observations by external evaluators Interviews with farmers, farmer groups, and leaders in cooperatives, professional associations and private sector firms Enumeration of physical assets Review of producer delivery and payment records at local agro-industrial enterprises for produce and at ORMVAT for irrigation water Review of seasonal and annual maps produced by the project GIS	Timing and quality of inputs are to specifications Relatively normal regional weather conditions throughout the life of the project Private agribusiness sector responds to enhanced regional investment opportunities Farmers are responsive to improved commercial opportunities and able to reallocate resources under their control effectively ORMVAT maintains progress in disengagement and restructuring of its functions

♦ An improved understanding by farmers of the capabilities and limitations of the water delivery system and how these affect their enterprise decisions 3. Improved knowledge base for use in the irrigation planning process, resulting in increased system productivity from improved planning decisions through: ♦ The development of an up-to-date hydrologic data base and the expertise necessary to analyze and make application to the irrigation planning process ♦ An improved definition and understanding of actual cropping and land-use patterns by the ORMVAT and how the elements are evolving			
<u>Element 2</u> 1. An improved definition and understanding of actual cropping, land use and tenure patterns and how they are evolving 2. An improved understanding by farmers of the Tadla water delivery system and how these relate to and affect their enterprise resource allocation decisions 3. An improved understanding by the ORMVAT of farmers' decision-making processes and enhanced Office capability to be more responsive to their clients' requirements 4. An understanding of constraints on the hydraulic system and economic efficiency at the farm-level 5. A series of tested pilot activities for dissemination to alleviate constraints to water use efficiencies and economic performance at the farm-level	<u>Element 2</u> 1. Use by farmers of improved irrigation strategies leading to better timeliness in enterprise operations and increased net farm income 2. Use by farmers of improved water application methods leading to greater field efficiencies 3. Modification of cropping patterns toward higher value crops and more intensive crop rotations 4. Greater efficiency in technical coefficients between crop output and units of chemical fertilizers and agricultural chemicals applied 5. Efficient integration of groundwater resources into overall water use at the farm-level		

6. Improved water delivery efficiencies to farm and improved water application use efficiencies at the farm-level **Element 3** 1. A more complete understanding of water balance and drainage system efficiencies in the Tadla perimeter 2. A groundwater model integrated with the near real-time management of surface water 3. Improved management of groundwater resources and soil decomposition -- salinity -- problems 4. A more comprehensive understanding of water and soil quality related to agro-chemical use in the Tadla perimeter 5. An information exchange network to enhance awareness of critical water and soil pollution levels 6. A set of recommendations for agro-chemical storage, handling, use and disposal in the Tadla perimeter 7. Improved management in control of water quality problems **Element 4** 1. A deeper understanding of operative commodity filieres at all stages -- i.e., production, processing and marketing 2. Increased participation of the private sector in provision of key agricultural inputs and services, agricultural production enterprises, agro-industrial processing and marketing of agricultural products	**Element 3** 1. Integration and use of water balance data and the groundwater model into the SGRID management process regarding conjunctive use of surface and groundwater resources 2. Better overall control of groundwater levels and decreased incidence of waterlogging 3. Integration of water quality data into the groundwater model and the use of this information in the ORMVAT's soil and water resources real-time management process 4. Establishment of an informational exchange network to improve awareness of pollution levels in the region, including development of means to take joint action to mitigate the impact of these pollutants on human and livestock populations 5. Decreases in the quantities of agro-chemical residues detected in the water table and perimeter drain system by the end of Project Year 7 **Element 4** 1. Assumption of book-keeping responsibilities for cooperative business activities by cooperative staff or members 2. Development of investment plans for cooperative resources which include clear goals for membership service and prioritization of commercial activities 3. Increased receipts from sales of cooperative products and services		

3. Increased ability of the multi-service cooperatives to manage their production and service activities, develop marketing and financial strategies for their products and services, and begin their transformation to durable enterprise-based cooperatives 4. Strengthened professional associations providing greater value for assessments levied on producers' products, particularly in mobilizing financial and technical resources for members 5. Irrigation Association board members trained in basic management skills 6. Increased private sector supply of key agricultural inputs and services 7. Expanded private agri-business investment in production and value-added agro-industry	4. Decreased costs in milk sales and in economat, seed and input supply and other cooperatives service areas 5. Development of new cooperative enterprise business volume and reserve accumulation		
Project Inputs:	**Illustrative AID Budget:**	**Means of Verification:**	**Important Assumptions:**
Long-Term Technical Assistance	$ 3,625,000	Project Financial Records	Projected funds are provided
Short-Term Technical Assistance	3,468,000	USAID Controller Records	
Project Office Support	1,530,000		
Equipment and Supplies	2,304,000	External Audits	
Training	1,481,000		
Internal Monitoring and Evaluation Unit	300,000	Supplier Invoices and Bills of Lading	
External Evaluations	300,000		
External Audits	150,000	PIO/Cs and PIO/Ts	
Contingencies	660,000		
Inflation	1,759,000	Direct AID Contract with Institutional Contractor/Sub-Contractors	
Total AID Project Costs	$ 15,577,000		

ANNEX C

STATUTORY CHECKLIST

[Section to be completed by USAID]

ANNEX D

GOVERNMENT OF MOROCCO REQUEST FOR ASSISTANCE

[Section to be completed by USAID]

ANNEX E

FAA, SECTION 611 (e) CERTIFICATIONS

[Section to be completed by USAID]

ANNEX F

ANNEX F

TECHNICAL ANALYSES

I. Element 1 -- System Water Control and Management

The canal systems of ORMVAT are vital links for conducting a valuable water resource to the farmers within the irrigation perimeter. The physical irrigation system was installed to operate under a specified crop rotation. Policy changes calling for the liberalization of the crop rotation require corresponding changes in the management of irrigation water distribution. In the project context of conserving the resource and increasing productivity, this analysis proceeds in three steps: discussion of the physical and operational characteristics of the existing system; the demands imposed on the system by policy changes; and how project interventions address new system demands.

A. Findings -- Physical and Operational Characteristics of the Existing System

1. Perimeter Description

The perimeter is divided into two hydraulically separate sub-perimeters by the Oum Er Rbia river -- see area maps in the Report Preface. The Beni-Amir sub-perimeter is located on the right bank and entails about 27,000 hectares irrigated from the Oum Er Rbia river via the Kasba Tadla diversion dam which was constructed in 1929. The reservoir has an operating storage of about 120,000 cubic meters and provides water to the irrigated sub-perimeter through a canal along the left bank of the river connected to a small regulating reservoir of 100,000 cubic meters at Kasba Zidania about 20 kilometer downstream of the dam. Water discharges from this reservoir either through a small hydroelectric plant or into a siphon under the Oum Er Rbia river and thence into the main irrigation canal with a maximum capacity of 14 cubic meters per second. During summer months, river flows may drop below principle canal capacity, especially in light of recent upstream water use developments at Dchor El Oued. These capacity constraints place distribution managers in between the expectations of water users and the realities of limited and uncertain water supplies. Water from this source has a salinity of from 1.2 to 1.6 grams per liter and carries enough silt to completely fill the Kasba Zidania reservoir in about four months. These water characteristics pose significant maintenance challenges -- sedimentation and corrosion -- for the canal operators and restrict the selection of crops within the sub-perimeter. This sub-perimeter is the oldest Grande Hydraulic sub-perimeter in Morocco and was developed between 1938 and 1940. Rehabilitation efforts were begun in the early 1970s, and a possible expansion of 6,000 hectares is presently being studied.

The Beni-Moussa sub-perimeter is located on the left bank of the Oum Er Rbia river and covers about 70,000 hectares of irrigated land with water from the Bin El Ouidane dam on the Oued El Abid in Azilal province. This dam was completed in 1954 and, with a height of 132.5 meters, was the highest dam in Africa at the time of its completion. It has a total

storage capacity of 1,500 million cubic meters with a regulated storage of 1,100 million cubic meters. Of this, 720 million cubic meters are allocated to the Beni Moussa sub-perimeter and 235 million cubic meters will be allotted to the lower Tessaout perimeter in ORMVAH upon the completion of the T2 transit canal in the next few years. This will impose new constraints on the water supply from the Bin El Ouidane dam. The hydro-electric plant associated with the dam has a maximum capacity of 135 megawatts, with a mean annual production of 200 million kilowatt hours. The irrigation works were completed in 1974. Water for the Beni-Moussa irrigation sub-perimeter is supplied from a compensating dam at Ait Ouarda immediately downstream of the Bin El Ouidane dam and then passes through a tunnel 10.5 kilometers long to the second hydro-electric plant at Afourer. This latter plant has a maximum capacity of 86 megawatts with a mean annual production of 400 million kilowatt hours. Water from the hydro-electric plant at Afourer discharges directly into the two main canals -- "GM" and "D" -- of the sub-perimeter. The upper reaches of both main canals serve as in-line storage reservoirs with a capacity of 300,000 cubic meters allowing evening peak hydro-electric generation needs to be met while supplying the relatively constant irrigation system demands. The principal hydraulic infrastructure for the two large-scale sub-perimeters, in addition to those mentioned above, include 200 kilometers of main canal, 360 kilometers of primary and secondary canals and 1,800 kilometers of tertiary canals in addition to many more kilometers of unlined field ditches -- or quaternary canals. Drainage is provided by a network of surface drains totaling 1,700 kilometers in length.

The principle crops produced in the ORMVAT perimeter are cotton, sugar beets, cereals, forage, vegetables, citrus and olives. There has recently been a private initiative introducing paprika peppers, which are processed locally. Minor acreages of maize, soybeans and roses demonstrate the possible diversity of crops which the region can support.

Approximately 28,000 individual farms are contained within the perimeter. Farm size varies considerably, with 82 percent of the farms less than 5 hectares comprising 41 percent of the total area, and 2 percent of the farms more than 20 hectares covering 27 percent of the total area. The ability of water distribution managers to respond to farmers' requests is stressed by the sheer number of farmers and is compounded by the diversity of farm sizes and types.

2. The Irrigation Water Distribution Design

The irrigation systems of ORMVAT were designed to meet the crop water requirements of specified crop rotation patterns through continuous flow day-and-night irrigation during peak periods. Canals and turnout structures sized to meet this peak demand are the structural elements of the existing system. The patterns, as specified under the Trame A and Trame B design specifications, reflect the effort of the designers to provide a means of meeting national production goals with efficient and equitable water distribution while accommodating large variations in individual land ownership patterns (Ait Kadi, 1986).

Trame B calls for the layout of each irrigation block of about 30 hectares with farmer land holdings running across the layout of quaternary canals. These canals supply water not to the farm holdings but to a field containing one crop and extending across the farmer land holdings parallel to the quaternary canal. Water then is supplied not to individual farm holdings, but to a crop in a block -- all of which is planted along a single quaternary, eliminating excess water losses from filling many quaternaries to irrigate the same crop and field area -- see Annex F Part 1 Figures 1 and 2. Canal spacing is set based on soil permeability and slope to provide good application efficiencies under border and furrow irrigation. Distribution system scheduling based on the fixed cropping pattern is concerned not with farmer requests, but the crop rotation in the block. Water is allocated not to farms but to the crop. This rational layout has experienced problems mostly related to the violation of the fundamental assumption that farmers would cooperatively maintain the same crop along each quaternary and that all farmers would agree to receive water at the same time for these fields. With the variation from this rational crop layout, delivering water based on the standard crop rotation cannot be justified and other methods of irrigation water ordering were developed. In Tadla, this takes the form of a paperwork-intensive system of farmer water ordering and control, using a form MV-I for water ordering and a form MV-II for arranging the gate settings.

3. Hydraulic Characteristics of the Canal Network

Physical control of the irrigation water distribution system is accomplished through the use of upstream control. All canal control structures are designed to maintain a relatively constant upstream water level regardless of the flow rate through the structure. Water offtakes, therefore, are designed to deliver standard flow rates over this limited range of water levels. Operationally, this means that water released at the canal head is not held in reserve. If inflows and outflows are not balanced, water either passes through the system -- flooding either farmers and/or drains -- or is diverted only to upstream users. Balancing of system inflows and outflows requires the advance scheduling of system flows.

The control structures used in the Tadla irrigation distribution system to maintain constant upstream water levels are long-crested weirs and Vanne Amil automatic level control gates. Flow rates through the turnouts are controlled using Modules a Masque constant flow distributors of a mixed-weir and orifice-type, which result in a small range of flow rate variation when upstream water levels are within the range of the gate operation.

The main canals in the system are concrete lined and trapezoidal in shape. The smaller canals in the system are semi-circular and mounted on concrete support piers. Some sections may be elevated as much as 2 to 3 meters to maintain sufficient elevation to cross low areas and provide sufficient head for irrigation of areas downstream. Maintenance of this type of canal system requires replacement of broken canal sections, supports and seals, although visual checks on canal leaks are greatly facilitated. Canal leaks or overflow can result in settling in support piers and resultant changes in canal slope. Field access is maintained by using large numbers of inverted siphons, generally at the same location as

[INSERT ANNEX F PART 1 FIGURE 1 HERE]

[INSERT ANNEX F PART 1 FIGURE 2 HERE]

the turnout gates. When waters contain high sediment loads, plugging of these siphons can be a significant problem.

4. Administration of Irrigation Water Distribution

Irrigation water distribution is under the direction of the Service de Gestion de Reseau de l'Irrigation et de la Drainage (SGRID). The head of SGRID answers directly to the director of ORMVAT. SGRID is charged with operation and maintenance of the irrigation and drainage infrastructure, the control of groundwater pumping development, water pricing and all water rights-related issues.

The SGRID organizational structure consists of three major bureaus at the headquarters -- maintenance, irrigation techniques and operation. The Bureau of Irrigation Techniques is charged with the monitoring of soil and groundwater evolution and field testing of irrigation techniques and practices. The Operations Bureau is in charge of working out general operating plans for the irrigation network, organizing the distribution of water based on the needs expressed by the CMVs and participating in the identification of water rights and measures for their expropriation. This operational mandate also includes the collection and use of accurate water distribution statistics for improving the distribution of water in the future.

Field level implementation is carried out by three sub-divisions -- Beni-Amir, east Beni-Moussa and west Beni-Moussa -- in particular, the scheduling irrigation water distribution. Sub-divisions are areas of the perimeter which are, in general, within the same hydraulic branch or branches. This is as opposed to the CMVs which may cross hydraulic system boundaries. Each sub-division is responsible for providing water for approximately 8,000 individual farm units on approximately 33,000 hectares.

Sub-division structure divides the canal system hydraulically under the control of three head Aiguadiers and a head of canal for managing flows in the main canal. Irrigation scheduling operations are performed by Aiguadiers, under the supervision of a head Aiguadier for a canal secondary branch. Actual distribution operations are performed by the Gardes Vanne for principle canals, under the direction of the head of canal, and by the Agents de Distribution within secondaries and tertiaries, under the direction of the head Aiguadiers. Water distribution schedules as implemented are used by an ORMVAT billing office as the basis for water charges.

5. Organizational Control of Irrigation Water Distribution

Under the fixed cropping rotation specified in the design, the water distribution policy was set based on the design documents. Advance system schedules, necessary for proper management of upstream regulated systems, could easily be set based on the rotation of crops and standard system flow rates.

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Implementation of this fixed rotation was perturbed by farmer deviation from the prescribed patterns. As a result, in ORMVAT, the schedule of gate settings is determined using a method of ordering water which requires requests to be made the week before water is to be delivered. The system of water ordering implemented by the MV-I form groups farmers by tertiary canal. Water orders are arranged by an aiguadier who is responsible on the average for 500 farmers.

Before a period of severe water shortages in 1981 to 1983, allocation was based on farmer requests for water up to available system capacity. This period of water stress within the system stimulated a policy change for water allocation based on a more rational method defined by: registered cropped area for each farmer, estimated crop water use and available water supply. This water distribution policy has continued to be used in times of adequate water supplies.

The registered cropped area for each farmer is collected at the beginning of each cropping season from each CMV. The area registered by each farmer is used for the purpose of obtaining seeds, fertilizers and agro-chemical supplies. Crops for which water will be allocated are limited to the approved crops specified under the design crop rotation patterns. A maximum area for each crop is used by the CMV so that during peak periods, the time of flow per hectare is limited by the design canal network capacity.

Estimated crop water use, a stochastic parameter, is estimated on a weekly basis at the head of management level. When reported data from Ouled Gnaou experimental station is available, the Blaney-Criddle formula based on local experimental data can be used. Some of the feel for this is reinforced by the feedback received from farmers to the Aiguadiers and Subdivisionaire. For example, if water needs were underestimated, requests for complementary or supplementary irrigation would be up on a general basis as farmers saw water stress in their crops.

The length of the water rotation is set based on the average readily available water holding capacity of the soil and average crop water use for the total sub-division. In Beni-Amir, this is valid until water supply limitations are experienced.

The water allocated to a farmer is then calculated by the Aiguadier as the registered area times the determined crop water demand times the number of days in the rotation. The amount is then increased to account for the distribution efficiency. An efficiency of 70 percent is the recommended value, but personnel realize 50 percent is a more realistic number. For alfalfa, a reduction is made in all allocations to account for lower water use in the part of a field which has been recently harvested. This is translated from a volume to a number of hours at the standard flow rate of 30 liters per second. The order of rotation among farmers served by the same outlet is then determined and each farmer starts and stops at the times set. Normally, the rotation is from the farmer nearest to the outlet to the farmer most distant from it so that the earth canal is filled progressively and the last farmer does not have to fill the entire canal with water for his turn. It is in the

rotation that the Aiguadier has room for flexibility, sometimes allowing a longer rotation for an outlet since all gate changes must be made between 8 and 18 hours. All schedules are then reviewed by the Chef Aiguadier for approval and the farmer issued a water order -- bon -- which he signs, indicating not only acknowledgement of the time, but an agreement to pay for that given amount of water.

Three types of adjustments can be made to this allocation amount with approval of the subdivisionaire. First, in the case where it is documented that water is not delivered to the farmer in the quantity agreed, for example a chute d'un element or bouchage de siphon where flow is interrupted and this is confirmed by a water distribution agent -- aiguadier -- in a repair request, the farmer will be granted compensation at no extra charge to complete his allocation. This is done as soon as there is water in the secondary by either altering the end of week schedule or including it in the beginning of the next week. Secondly, farmers who find that the water allocated was not sufficient to irrigate their entire cropped area, but cannot document that the water supplied is less than the amount indicated in the water order can, request complementary water. Consideration is given to whether other farmers are experiencing the same problem, in that if you give to one, you will be obliged to give to all. This water is added to the amount of the water order for billing. Third, a farmer can request supplemental water, which is in a sense unjustified additional water. From the perspective of the Aiguadier and Subdivisionaire, complementary and supplementary water are the same thing.

Available water supply is an especially important factor for the Beni-Amir sub-perimeter when river flows are below demand. For Beni-Moussa, annual allocation from the dam is set at 720 million cubic meters. There is a strong dependence in both cases on the system design and fixed cropping patterns as the last word in allocation. No planning mode exists to allow a variable cropping pattern or select an optimal pattern based on available water. For Beni-Amir, when the system capacity or expected water supply will not meet demand, the number of days in the rotation is lengthened until supply and demand match as calculated on the MV-I. In essence, the standard rotation allocation amount is used but the rotation is lengthened resulting in periods when tertiary canals are closed. Another method would be to reduce the water supplied to each farmer using the standard rotation. The Subdivisionaire indicated that he preferred to lengthen the period between rotations since water losses would be less than water losses for more frequent irrigations with a smaller amount.

Distribution of the water allocation is worked out on the MV II form, accumulating the tertiary outlet flows from the MVI, and using these tertiary sums to determine secondary channel flow and adding water to account for losses in the secondary canals. No consideration is given to the dynamic hydraulic system characteristics such as time required for upstream flow adjustments to travel downstream. Gates down to the tertiary level are only adjusted from 8 AM to 6 AM by the distribution agents. Main canal offtakes are watched by agents who live at a house next to the offtake. They could be adjusted at night but probably are not. Aiguadiers are praised for arranging their rotations so that the flow of water into secondaries is relatively constant. Regulation of the principle canal is done by

observing water levels at the offtake for the canal median, and the offtake for secondary 17. Radio communication is maintained between these two gates and the main canal intake located just before the main siphon under the river. Comments were made that it is necessary to maintain some spill to know that the system is delivering full water to the last outlet. This is also used as the cushion from which compensation can be extracted. Complementary irrigation may be fit into the end of the week when, in general, total demand is declining.

The water supply limitations of Beni-Amir sub-perimeter force the use of several real-time management practices to insure that water is distributed equally throughout the system. When supply is falling within the week, secondary canals may be cut for 24 hours, delaying all irrigations on those secondaries, to adjust supply to demand. This delay is rotated among secondaries until it is not necessary -- i.e., the supply flow stabilizes or a new week begins and adjustments are made in the whole system. When supply is rising, complementary water can be given more freely.

The incorporation of rainfall in management is done using the local observations of the Aiguadiers for local events. Widespread and seasonal rainfall may result in complete cutting of the canal flow. No indication is given of a rainfall measurement network being used as a basis for these decisions. Rather, observation and interaction with the farmers appears to be the basis for such decisions. Responsiveness of the managers to farmer requests to not receive water after rainfall events depends on the timing of the rainfall. If the irrigation schedule for the week has been set and is in progress, the tendency is to force farmers to take the agreed upon delivery and pay for water which they will not use, rather than make changes in the predetermined schedule.

B. Analysis -- Demands Imposed on the System by Policy Changes

The policy changes calling for the liberalization of the fixed-rotation type of cropping pattern opens farmers to receive water for a larger variety of crops and the managers of ORMVAT water distribution to recognize the variety of crops and cropping patterns being practiced in the ORMVAT irrigation perimeter. Responding to these cropping patterns in a way that promotes the wise use of the limited water resource requires consideration of the following factors:

- The feasibility of irrigation water delivery to meet crop water demands can no longer be assumed;
- Crops requiring a flexible water delivery schedule for high productivity are grown by farmers;
- The demand for water will increase, increasing tension in the water distribution system;

- Distribution system managers will be expected to meet the water demands of the farmers, not of the fixed crop rotation.

Meeting these changes in a wise manner is best described as a demand for efficiency, flexibility, reliability and timeliness in irrigation water delivery.

Water distribution efficiency in an irrigation water conveyance system is a measure of the proportion of water released into the system which is delivered to the outlets for use by the crops. In an upstream controlled system, operational losses are directly related to the ability of the operators to balance the flow of water in the canals in a dynamic manner based on an understanding of the dynamic response of the canal to the release of water. In a system as complex as Tadla, computationally limited techniques of regulation can only seek to maintain the system as near as possible to steady-state conditions or run the risk of severe efficiency penalties and even damage to system components. Increased ability to model dynamic operational conditions can result in safe and efficient operation of the system in a dynamic -- i.e., flexible -- manner. From the point of view of the agency operating the canal, losses incurred at the farm level are beyond the scope of their control. Field losses, however, can be minimized through on-farm actions if the canal system is operated in a flexible, reliable and timely manner and will be increased if it is not.

Flexibility in irrigation water distribution means that varying water demand patterns can be accommodated and that adjustments to a changing demand pattern can be made on short notice. Water demand and supply are defined at the outlet level by flow rate, duration and time of water delivery. In the upstream controlled systems of the Tadla, flexibility is limited by the flow dynamics of the canal system, the abilities of the system controllers to understand and use these properties in system control, the ability to communicate changes in scheduled gate operations to gate operators on short notice, and the ability of system operators to anticipate flow changes in the system. Anticipation is crucial since changes made at the head of the canal may take one or two days to reach the lower reaches. Information management and analysis which will allow more effective short-term planning is crucial to anticipation of changing conditions and enhanced abilities to make short-notice changes in delivery schedules that are essential for implementing decisions which will result in higher system efficiencies.

The setting of a water delivery schedule in an upstream controlled system becomes a water delivery contract when this schedule is communicated to farmers. Reliability is the fulfillment of this water delivery contract in terms of flow rate and duration at the time agreed upon. Given that no consideration has been given to flow dynamics in present system operation, modeling should also result in considerable increases in reliability as flow lag times are considered in setting gate operation schedules.

Timeliness is included to insure that flexibility and reliability do not overlook the essential fact that water arrives when the plants need it. In Tadla, distribution system capacity constraints may limit the timeliness of water under certain water demand patterns. The

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integration of this factor into the irrigation planning process will result in better meeting of crop water needs in a timely manner for higher production.

1. System Planning

The existing canal network has flow limitations as indicated by the criteria used to design the peak capacities. Changes in cropping patterns may result in water demands in excess of canal capacity at any level of the canal system. This results in constraints on flexibility, reliability and timeliness once the cropping pattern has been set. While the liberalization will result in farmer choice of crops, these flow limits still exist and need to be addressed.

Water supply limitations can also occur at a system level. In the Beni-Amir sub-perimeter, river flows may descend below crop water demand in the most crucial period of cotton growth. In the Beni-Moussa sub-perimeter, reservoir supplies may be limited so that the total allocation of water accorded to the ORMVAT may not be available. Pre-season planning should address both of these supply issues and balance the risk of loss of productivity from shortages with the risk of loss of productivity from limited water demand cropping patterns. With liberalization, this may involve the provision of information to farm-level decision-makers as opposed to central decision-making.

2. System Scheduling

In order to increase distribution efficiency and to insure that water is distributed throughout the system, it is necessary to use a system of arranged water delivery where a schedule of gate settings is determined in advance. This schedule takes into account the flow dynamics of the system and the ability of the system operators to make the necessary adjustments in distributing water released into the canal head to meet water demands in the system. It is characteristic of this distribution method that the system is operated by the irrigation distribution agency to insure that the gate operation schedule is followed.

The time required to develop a water delivery schedule has a significant impact on the quality of water delivery. With the present system, weather data from the previous week is being used to determine water deliveries for the following week. This lag time can result in significant changes in farmers needs for water from the time of ordering to the time of receiving water. Attempts to make large changes in system schedules -- flexibility -- can result in poor balancing of flows in the system reducing efficiency and/or reliability. Poor predictions of water needs within the system can also have in the same effects.

When changes need to be made in system flows on short notice due to canal breaks or plugging, rainfall or changes in farmer water demand, operational losses of water will occur and/or farmers will not receive needed water at the proper time. Short-term changes in the water distribution pattern change the flows required after water has been released in the head of the system and losses can only minimized if the water can be utilized on short notice by users in another part of the system. Present scheduling techniques require that

farmers notify the Aiguadier. Modifications are then made and checked by the head Aiguadier and Subdivisionaire for the effect on main system flows, a water order is issued and any changes in gate settings are communicated to the distribution agents. Approval of the changes is dependent on the Subdivisionaire's evaluation of system ability to respond to the change. This is the reason for arranging a small water cushion in the form of system discharge to the drains.

A rapid evaluation of required system changes and hydraulic limitations will result in better decisions with less water loss and more flexible response to farmers. Decisions will not be made as much to preserve the steady flow of the system, as in the case where farmer requests to not receive water already ordered are denied, but to reduce the loss of water from the system. Measurements of the water being lost will provide incentive to avoid the distribution and billing of water to farmers who no longer need and will not use the water delivered to them. Flexible response will also minimize delays in the delivery of water to meet critical water demands for increased productivity with efficient water delivery in a timely manner.

The dynamic hydraulic characteristics of an upstream controlled water distribution system also greatly influence the quality of irrigation water delivery. Systems are most easily operated in a rigid mode, with all flows adjusted until the system achieves a steady state. Changing flow rates within the system for flexible operation with a minimal loss of efficiency requires an understanding of the lag times required for flow adjustments to proceed down the canal. If changes in flow require upstream and downstream changes to keep the flows in the system balanced, upstream changes must be made in advance of the downstream changes. In the case of flow increases, opening both gates at the same time will deprive downstream water users of water until the upstream change reaches the downstream gate. When flows are decreased, excess water will be spilled from the system until the upstream change travels downstream. Multiple changes result in flow patterns which are not easily assessed. Hydraulic modeling will be necessary to deal with the possible complex interactions resulting from increasing system flexibility.

C. Recommendations -- How Project Interventions Address System Demands and Limitations

In the context of physical system limitations and present operating procedures, addressing demands for quality irrigation water delivery -- i.e., efficiency, flexibility, reliability and timeliness in distribution system operation -- is based on the following principles.

1. Operational Policy

Changes in any major element of current operational policy requires the reformulation of operational policy and general operating criteria which system operators -- ORMVAT/-SGRID and/or Irrigation Associations -- must take into account in determining detailed operational procedures. Diagnostic analysis is a basic tool for assessing existing procedures

and the role of all the actors involved. Cursory evaluations based on informal interviews with some of the actors involved are not a sufficient tool for system diagnosis. Involving actors from all levels in the evaluation process will result in the discovery of how the system actually works as opposed to how each actor would like the system to work. It will provide a basis from which policy changes can best be made.

Policy changes will also necessarily reflect the availability of the improved database and ability of system operators to use the information and operations analysis capabilities. GIS organization and analysis of soils, crops, groundwater, farming systems and other possible future data will lead to policies which incorporate spatial variations in these factors, eliminating the consistent inaccuracies related to using spatially-lumped data in policy formulation.

Present policies supporting rigid system operation rules and allowing for inefficiency as necessary for system operation will be changed. The ability to model system operations will lead to formulation of policies based on the dynamic capabilities of the system. Flexibility and efficiency will be balanced in a modeling environment, and short-term supply and demand predictions will be included as operational criteria.

Reduced time requirements for operational procedures, particularly water ordering and setting of the gate operation schedules, will be reflected in a policy of accommodating farmer requests on a more timely basis -- i.e., a service orientation. The present system of water ordering requires excessive paper work by the Aiguadiers, who in essence take water orders, set the time and duration of water delivery for every farm, calculate the flow of water in all tertiaries, secondaries and primaries and, in the process, try to maintain steady flow rates in primary and secondary canals. A policy of making short-term adjustments will be possible through the use of computers.

2. Operating Plans

Quality irrigation delivery is necessarily preceded by the preparation of the annual and seasonal operating plans. Good estimations of water supply and crop water demand derived from the cropping pattern or a set of precisely defined water allocation principles increase the feasibility of quality delivery. The development of databases in hydrology, climate, cropping patterns, and soil properties are aimed at providing information to aid the planning process. Ultimately, it is farmers who set the cropping pattern and whose informed participation in the planning process will provide the best possibility of defining a feasible cropping pattern and allocation process. These databases will also provide a valuable tool for aiding farmers in assessing their enterprise decisions and will be made accessible through the use of the presentation capabilities of the GIS system.

Database developments necessarily require efficient means of data collection and tools which make the data collected readily available for analysis. Computerized systems provide this advantage when developed, maintained and managed by well-trained personnel. Equipment

must be matched to the required tasks and training in hardware maintenance and software use included. The result will be up-to-date information bases and easily accessible decision information. Decision-makers will then be able to integrate factors such as soil property variability or cropping pattern and farm size correlations which previously were inaccessible due to information lags and limited computational ability. The integration of these elements into the planning process is illustrated in Annex F Part 1 Figure 3.

3. Operational Procedures

Quality operation of a system with upstream control requires the preparation of a specific set of procedures to operate the head works, the conveyance and delivery systems. This requires an understanding of the actual hydraulic happenings in the system since all control events, except accidents, are specifically caused by system operators.

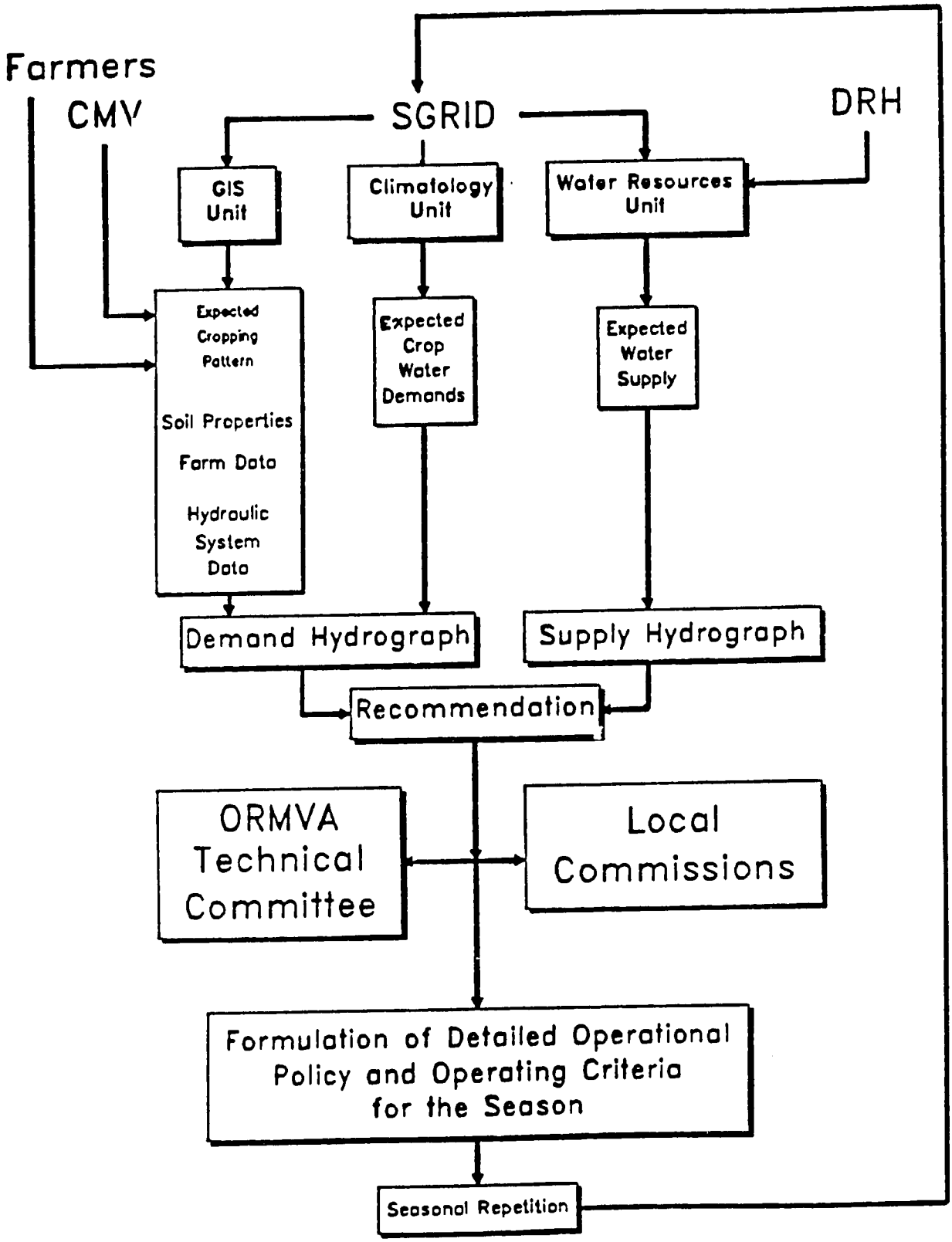
Hydraulic modeling, along with field calibration of the hydraulic system, provides a feasible way of determining system operational possibilities. Procedures will no longer be defined in terms of maintaining steady-state conditions but with dynamic operation and control for maximum efficiency, flexibility, reliability and timeliness. Operational patterns will be tested and optimized based on these quality criteria. Real-time operation of the models will result in field-tested results and higher confidence in model-based decisions.

The gate scheduling process is also a key element in defining operational procedures, especially in making the system flexible and efficient. The present system requires a large amount of repetitive paperwork by the very people who are the interface between ORMVAT and the users of system water. Computerization of this process will increase flexibility and free the Aiguadiers to monitor system operation and to dialogue with the farmers. A computerized system will replace the function of the MV-I and MV-II forms and provide a simple way of generating the notices given to farmers of the water they will receive.

Ultimately, reliability is not measured by good intentions but by actual delivery performance. Development of procedures to monitor the actual water distribution in the system will indicate if the system is performing according to the operational plan, give feedback for improvements in gate setting procedures, and indicate needed adjustment of the water delivery schedule. Real-time measurements of the system at crucial points will make adjustments of operations to reduce losses possible on a timely basis. The operation and feedback process is illustrated in Annex F Part 1 Figure 4.

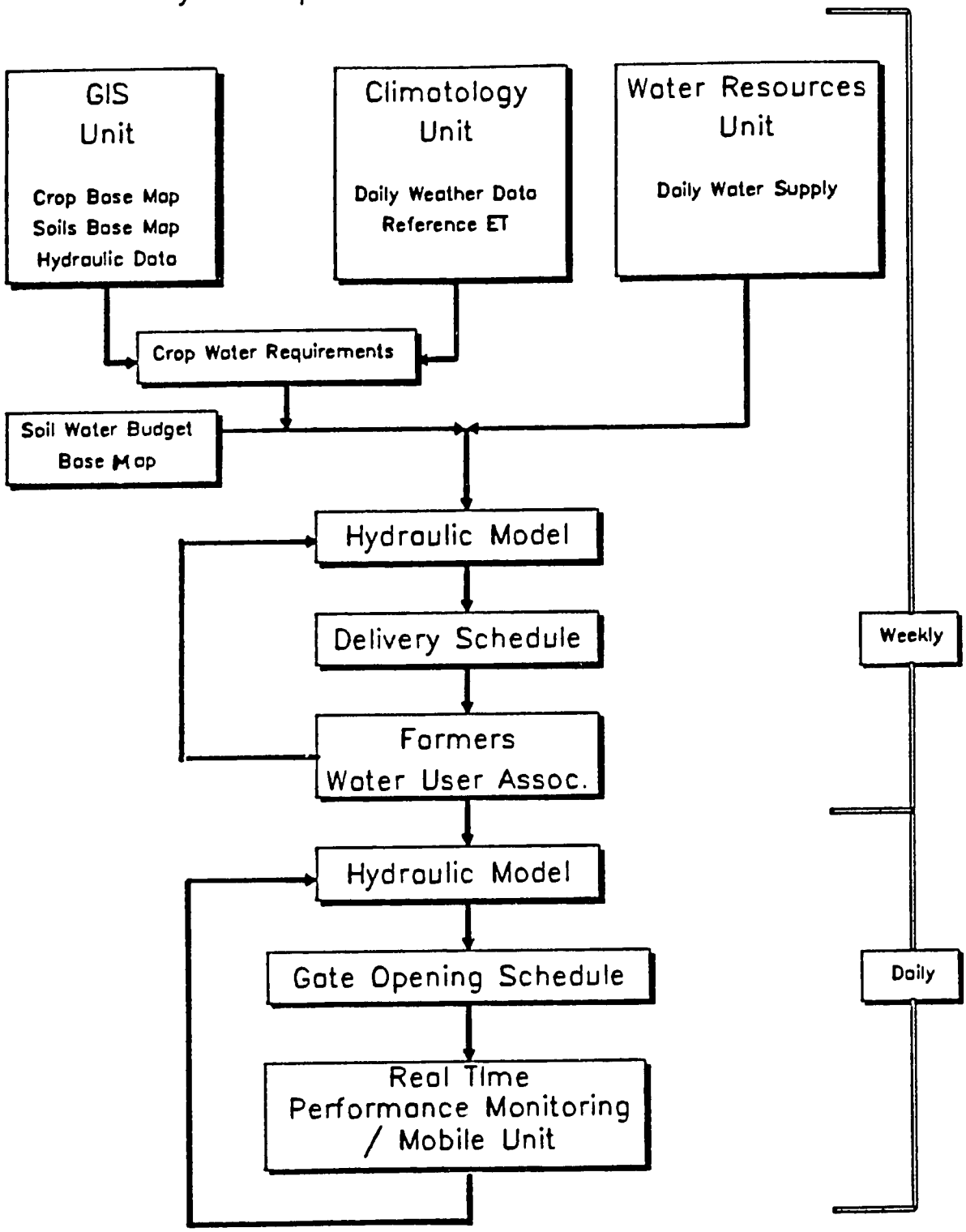
Crucial points within the system, determined in discussions with ORMVAT personnel, by consideration of the network layout and by site visits, are described below and shown in Annex F Part 1 Figure 5.

Annex F Part 1 Figure 3
The Seasonal Planning Process

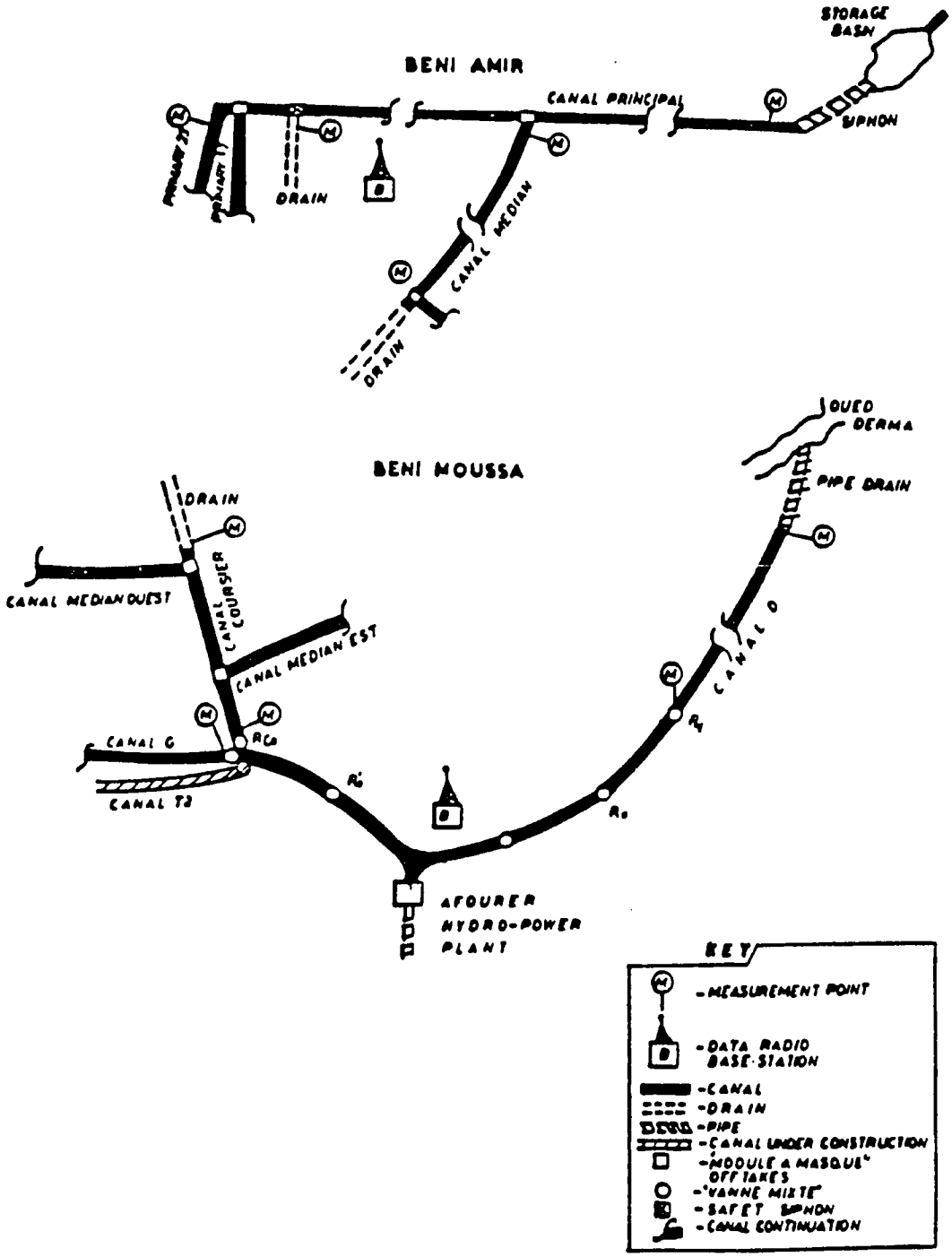


Annex F Part 1 Figure 4

System Operation and Feedback Process



Annex F Part 1 Figure 5
Real Time Flow Measurement Points



Along the single principal canal in the Beni-Amir system, installation of automated flow measuring structures and/or instrumentation of existing structures are recommended for five locations in the system. These locations are:

- At the outlet of the siphon at Zidania. Installation of a "Replogle" type broad crested weir with automated water level recorder and radio data transmitter.

- At the head of Canal Median. Installation of a "Replogle" type broad crested weir with automated water level recorder and radio data transmitter.

- At the end of Canal Median where it spills into the Bir Ouargedanne drain. Installation of a sharp-crested V-Notch weir in a box at the exit of the two pipe outlets of the spillway with an automated water level indicator and radio transmitter.

- At the head of Offtake 23. Installation of a "Replogle" type broad-crested weir with an automated water level recorder connected to a data-logger and radio transmitter shared with the installation at the "security" siphon outflow (below).

- At the outflow of the "security" siphon just upstream of the end of the principle canal. Installation of a "Replogle" type broad-crested weir with an automated water level recorder connected to the data-logger and radio transmitter shared with the station on Offtake 23.

Along the two principal canals of the Beni-Moussa perimeter, five points of measurement are recommended to define the flows in the system. These points are:

- At regulator "R-1" on canal "D". Installation of an automated water surface level indicator in the existing stilling well for the downstream control of the vanne mixte. This indicator should be linked to a data logger and a radio transmitter. This installation will also require calibration of the gate by canal cross-section with a propeller meter and integration of velocity distribution just downstream of the gate. This gate is located at Station de Pompage Timoulilut.

- At the termination of canal "D". A Duckbill weir is being installed at this point to provide a long broad-crested weir which can be instrumented with an automated water level recorder and calibrated to provide real-time measurement of flow spilled into the Oum Er Rbia river.

- At the point along canal "GM" where it splits into canal "G" and canal coursier. A vanne mixte at this point which is identical to the one at location "R-1" in canal "D" which controls flow into canal "G". Thus, this flow can be measured by installation of an automated water level recorder in the downstream stilling-well and downstream calibration of the gate using canal cross-section and velocity distribution by propeller meter. This recorder will be linked to a data logger and radio transmitter

shared with the measuring system at the head of canal coursier.

- The head of canal coursier is actually two trapezoidal canals. At a point sufficiently downstream from the diversion from "GM", it is recommended that a "Replogle" type broad-crested weir be installed in each canal with automated water level recorders linked to a data logger and radio transmitter shared by the recorder located in canal "G". At the end of canal coursier where a new duckbill weir is being installed, install a "Replogle" type broad-crested weir just downstream of this structure and instrument it with an automated water level recorder linked to a radio transmitter.

The actual system status, as evaluated by the mobile monitoring units, will provide additional truthing of the quality of irrigation distribution as evaluated by the hydraulic model coupled with the gate schedule and real-time system measurements. These units will necessarily be equipped with the ability to calibrate any existing structure within the irrigation network and will also make measurements of systems flows for comparison with the real-time system status provided by the hydraulic model.

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II. Element 2 -- On-Farm Resource Management and Innovation

A. Introduction

Project Element 1 activities are designed to develop a comprehensive understanding of the hydraulics and hydrology of the ORMVAT irrigation system and to use this knowledge in the design and implementation of a more responsive system-wide water management system. Project Element 3 will be concerned with the environmental impacts which irrigated agriculture has had and is having on soil and water resources. And, Project Element 4 will address the potential for an expanded private sector role in the Tadla perimeter.

However, the potential for innovation and development in the agricultural economy of the Tadla perimeter will not be fully realized without an intimate link with and responsiveness to the evolving situation at the farm level. The activities designed under Project Element 2 are designed to integrate all Project Elements at the farm-level.

To bring forth a more productive and sustainable economy, the project must establish clear priorities and focus its attention on problems which have a high potential for responding to improved management. In this context, three activities are fundamental.

First, ORMVAT managers must begin to operate a water delivery system that is much more oriented to the needs of the client-farmers in the sub-perimeters. Second, they must start to factor in water quality and soil resource preservation considerations in their management decisions. And, third, farmers as participants in the Tadla irrigation system must have a much better understanding of the technical capacities and managerial constraints of that system and their implications for farm-level enterprises and resource allocation patterns. The key point is the neither ORMVAT managers nor client-farmers will be able to make efficient resource allocation decisions without, first, having comprehensive and reliable information on the workings of the whole perimeter system and, second, having a structured and continuous dialogue on system operations in the context of a common and accurate base of knowledge.

The four activities under Project Element 2 are designed to, first, find out what is presently occurring at the farm-level in the ORMVAT in terms of the owner/manager/household decision-making process(es) for selecting and managing crop, livestock and off-farm enterprises, allocating available resources -- i.e., land, labor, capital and managerial expertise -- to these enterprises in attainment of household objectives, and selecting which techniques to adopt and which inputs to purchase over time. And, second, to help local decision-makers to assess what is technically, financially, economically, environmentally and socially possible in the future.

Detailed farm-level knowledge is critical to the dialogue process. This is so because even brief tours through the sub-perimeters leave one with two strong impressions. The first is that the actual farming practices, crop rotations and resource allocation patterns bear little

or no resemblance to the almost Cartesian precision of the crop rotations anticipated when the ORMVAT irrigation systems were designed. The second is that the farming systems are quite heterogeneous both between the sub-perimeters and within each of them. This means that one cannot talk about or relate to farm households in Tadla as if they were one homogeneous population. One must assist in defining the interests, motivations and capacities of each sub-population before accurate assessments can be made of future potentials.

For all of the discussion in the Moroccan irrigation literature about the benefits of the Trame A and Trame B irrigation systems -- or variants thereof -- it appears evident that farmers, at least on the Tadla perimeter, have succeeded in modifying the original rigid engineering approach to irrigation to meet their own technical and socio-economic objectives and resource constraints. Recognition of this basic fact is central to being able to design successful interventions at the system and farm levels in Tadla. It is also clear that the managers at ORMVAT, while possessing much factual information about the perimeter, have less than adequate knowledge of the motivations and objectives of the farm households in the perimeter or of the probable directions agricultural enterprises will take under conditions of a more liberal and market-oriented economy.

On one level, farm management information will be important to the development of the system-wide hydraulic management model, because it will determine if and how the system can be operated to more adequately respond to changing demands of the water users. Since farm enterprises have evolved considerably since the Tadla system was originally designed and constructed, the ORMVAT needs to know how these enterprises are currently constituted, how they actually function as decision-making units, what farmers perceive as their scarce resource(s) and what constraints they face, and, finally, what they see as their prospects for the future in the changing economic environment.

In sum, the managers at the ORMVAT need to know their clients much more intimately than they appear to now if they are to be successful in discharging the more focused water delivery management and soil/water resource stewardship mandate which they will have in the medium-term.

In addition to addressing the immediate informational requirements of the ORMVAT, Element 2 will also actively seek to broaden the knowledge base of the farm community as to what is technically possible and economically feasible within the Tadla perimeter. This element would address the reverse of the problem described above - i.e., it would instruct farmers as the technical constraints imposed upon their farming operations by the physical and managerial realities inherent in the Tadla hydraulic system as designed. The objective would be to present farmers with practical information as to how far they can stretch the capabilities of the Tadla irrigation system in their attempts to better adapt their farm enterprises to new market forces. The central premise being that successful farmers as entrepreneurs need increasingly detailed and precise information on all aspects of the economic environment in which they must operate if they are to make sound resource

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allocation decisions.

At a third level of interaction, it is envisaged that the results from the activities under Element 2 would be regularly and broadly disseminated through local cooperatives, professional organizations, and private sector input suppliers and output buyers. Moreover, the anticipated pilot field interventions, wherever feasible, will be designed, jointly funded, executed, and evaluated in collaboration with private sector input suppliers and firms promoting development of specialized cropping systems.

Element 2, therefore, will be comprised of four principal activities. They are:

- Developing an accurate and current inventory and typology of all farm enterprises in the Tadla perimeter and conducting an intensive diagnostic study of a representative sample of those farm enterprises (200 to 300 farms) over, at least, two full cropping cycles -- i.e., winter and summer crop rotations over a two year period;

- From the intensive diagnostic studies and other sources, critical constraints in farm-level resource allocations will be identified and pilot interventions will be specified and tested at the farm -- and ORMVAT -- levels to alleviate these constraints. And, then, results of these pilot interventions at the farm-level will be disseminated to farmers, ORMVAT personnel, cooperatives, professional organizations, and private sector firms.

- Assistance to the newly created Agro-Economic Monitoring and Evaluation Studies Service at ORMVAT to develop a permanent local capacity follow up on the two year intensive diagnostic study and to collect and analyze relevant, high quality information on different types of farm households and their operations in the perimeter over time.

- The fourth activity area will be support for a series of assessments of special topics of mutual interest to USAID, ORMVAT and/or other participants in the project. These assessments could include studies of particular agricultural and irrigation policy issues, detailed appraisals of discrete crop production/harvesting/processing/ marketing chains -- i.e., filieres -- assessments of farmers' attitudes toward particular types of innovation, etc..

With respect to the first activity, ORMVAT staff have already amassed a considerable amount of inventory information on the types and distributions of farm enterprises in the Tadla perimeter. The design team has reviewed this information and proposed an initial farm typology for consideration. After detailed review and updating of these inputs and other information, a farm enterprise typology would be developed and used to draw a representative sample of farms to be studied in detail under the intensive diagnostic study. This activity would be completed in the first six months of Project Year 1.

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The intensive diagnostic study will be conducted during the first two full agricultural years after the start of the project. Specifically, the study period would be from the start of first winter crop season in Project Year 2 to the end of the second summer crop season in Project Year 3. The study would be designed in such a way that data collected could be fully processed and analyzed on a season by season basis. Data collected during the first full agricultural year of the project would also constitute a baseline information file to be used by the project monitoring and evaluation unit at subsequent points in the project to quantitatively assess changes in economic activities at the farm level.

The function of the intensive diagnostic study, however, would be to serve as a factual basis for identifying farm-level constraints in resource allocation and specifying pilot interventions to be tested and evaluated to alleviate the constraints over the life of the project. Given the paucity of detailed farm enterprise data from the Tadla perimeter at present, it is impossible to specify a priori and in detail what constraints farmers see as impinging upon their resource allocation decisions or what specific pilot interventions might best address their needs in the medium-term.

From the outsider's perspective, it would appear that farmers might face significant constraints on their supply responsiveness and resource allocation in the following areas:

- The tradeoffs between providing for the subsistence requirements of the extended farm household and being fully responsive to commercial opportunities and market forces;

- Problems posed by the increasing fractionalization of land holdings within the perimeter and the potential divorce of the ownership and management functions in resource allocations;

- Problems involved in matching water deliveries from the system-level with crop requirements and efficient water use at the farm enterprise level;

- Inadequate knowledge of crop production techniques and potential on the one hand and real market possibilities on the other;

- Financial constraints on reorientation of the farm enterprise in the face of new opportunities; and

- Labor constraints with respect to producing, harvesting and marketing higher value crops.

A series of pilot interventions at the farm-level will be designed and implemented on the basis of information available after the first year of the intensive diagnostic study is completed. The interventions in Project Years 2 and 3 are expected to focus primarily on making more efficient the fundamental water/soil relationships at the level of the farmers'

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fields and on demonstrating more efficient conjunctive use of groundwater and water from the gravity system. Other pilot demonstrations will be designed and implemented as more detailed information on farm-level constraints becomes available in the second year of the intensive diagnostic study and, subsequently, from the permanent ORMVAT Agro-economic Studies Service.

In all activities, information generated and recommendations advanced will be thoroughly discussed and debated at a series of annual workshops. Participation in these workshops will be open to all interested parties including ORMVAT personnel, representatives of farmer groups, cooperatives, professional organizations, and private sector input suppliers and output buyers. In addition, the project will work closely with the extension agents, professional organizations, and other interested parties to develop and disseminate both orally and in written form summaries of the information collected with detailed recommendations as appropriate. Field days will be organized for relevant farmer and other groups to visit pilot demonstration sites and discuss with project staff and participating farmers how new interventions could be adopted. This process of dialogue and dissemination will start immediately after Element 2 has become to generate useful information and recommendations and will continue over the life of the project.

B. Preliminary Farm Typology for the Intensive Diagnostic Study Sample Frame

After several field trips and review of the existing literature, the design team proposes consideration of the following farm typology when the intensive diagnostic study sample frame is drawn. We believe that the critical variables which define the ORMVAT farm population for the purposes of the study are as follows:

1. Farm Size in Arable Hectares;
2. Type of Land Tenure;
3. Type of Access to Gravity System Irrigation Water;
4. Capacity of Use Groundwater for Irrigation; and
5. Importance of Livestock Enterprises in the Farming System.

Within these variables, we have attempted to identify the key points of functional distinction between different farming systems in the perimeter as follows:

1. Farm Size in Arable Hectares

   a. 0 to 3 arable hectares
   b. 3 to 20 arable hectares
   c. Greater than 20 arable hectares

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2. Type of Land Tenure

a. Private tenure -- Melk
b. Collective land --
c. Private state land -- Domaine Prive de l'Etat -- i.e., state farms and parastatal companies
d. Land allotted to Cooperatives under Agrarian Reform regulations

3. Type of Access to Gravity System Irrigation Water

a. Priority access by contractual arrangement
b. Normal access -- i.e., farms well-situated in the perimeter with respect to outlet canals
c. Restricted access -- i.e., farms poorly-situated in the perimeter
d. No access to gravity system irrigation water

4. Capacity of Use Groundwater for Irrigation

a. Wells less than 20 meters in depth with good water
b. Wells less than 20 meters in depth with saline water
c. Wells less than 20 meters in depth in areas with drainage problems
d. Wells greater than 20 meters in depth
e. No access to groundwater

5. Importance of Livestock Enterprises in the Farming System

a. High -- i.e., farms with intensive dairy or livestock fattening enterprises and regular commercial sales
b. Low -- i.e., farms with traditional, subsistence livestock enterprises and occasional commercial sales
c. None -- i.e., farms with no livestock enterprises.

C. Cropping Strategies in the Tadla Perimeter

1. Cropping Percentages in the Tadla Perimeter

Cropping percentage refers to the ratio of area of crops grown to the total area available. In the case of the ORMVAT perimeter, where the climate is Mediterranean and where "area available" refers to irrigated land, it would be expected that the cropping percentage would be well above 100 percent. This is because the Tadla perimeter is climatically a winter crop production region. But with irrigation, summer cropping is also possible. Cropping percentage is a measure of the intensity of rotations. Theoretically, a cropping

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percentage of 200 percent could be achieved by growing both a winter annual crop and a summer annual crop on every parcel of land.

A major problem for intensive rotations on the perimeter is the excessive amounts of time during which some crops occupy land. Cotton and paprika peppers are both nine month crops at Tadla. Consequently, they seriously infringe on planting schedules for winter crops. The sugar beet harvest continues well into July. Only 20 percent of the land used for sugar beets is subsequently planted to a summer crop. The introduction of a short season summer crop that could follow sugar beets would have an immediate positive impact on cropping percentage. Over the past several years, there has been an inconclusive effort to use soybeans in this role.

The key crops for calculating cropping percentage are the annual crops, since a perennial crop will always have a cropping percentage of exactly 100 percent unless it is increased by intercropping. When only annual crops are included in the calculation, the cropping percentage reached 146 percent in 1990 -- see Annex F Part 2 Table 1. Given the constraints, this has to be considered a good performance. It indicates that farmers are aggressively managing their resources. It also indicates that perimeter farmers will be quick to exploit opportunities which are presented by the removal of constraints on their performance.

2. Cropping Patterns in the ORMVAT Perimeter

The GOM has liberalized its policy on mandated cropping, thus putting an official end to the Trame A and Trame B cropping patterns. It is anticipated that this policy change will result in a move by farmers to more profitable crops. This judgement is based on the fact that, while these plans had already undergone extensive modification at the farm-level, the fundamental idea of mandating the production of specific crops had been kept in force by means of water allocation policies. Annex F Part 2 Table 2 summarizes the resulting cropping patterns as they currently exist on the ORMVAT perimeter.

Most attention relative to the effect of liberalization on perimeter cropping patterns centers on the possible negative impacts which liberalization might have on the areas planted to the two major government-mandated industrial crops -- i.e., sugar beets and cotton. While this is important, government policies limiting the areas planted to perennial crops -- i.e., olives and citrus -- have also been an important factor in shaping cropping patterns in the perimeter. Based on the high number of applications for permission to plant olives and citrus, it is expected that liberalization will result in a shift to these crops. It is also expected that the area planted to alfalfa will increase as a result of liberalization. Alfalfa is a high-priority perennial crop which has significant potential for improved yields. Current yields vary from 4 tons to 13 tons of dry matter per hectare. Potential yields are about 20 tons of dry matter per hectare (Ameziane et al., 1978; Baya, 1989).

Annex F Part 2 Table 1
Cropping Percentages for the ORMVAT Perimeter
(in thousands of hectares)

	1988	1989	1990
Total Area Irrigated	97.8	97.8	97.8
Total Area of Crops Produced	123.7	128.2	128.2
Cropping Percentage	126	131	131
Total Area Irrigated for Annual Crops	68.4	67.2	66.3
Total Area of Annual Crops Produced	94.3	97.6	96.7
Cropping Percentage for Annual Crops	138	145	146

Note: Data provided by Service de la Production Agricole (ORMVAT, 1991)

These possible changes in the patterns of perennial cropping have important implications for more efficient water use. The only significant use of high efficiency, individualized irrigation systems in Tadla is in citrus production. Alfalfa is the field crop which is most adapted to improved gravity irrigation methods.

Annual cropping patterns are best analyzed on the basis of season -- i.e., as summer annual crops and winter annual crops. Since all annual rainfall comes during the mild winter in Tadla, traditionally it had only a winter cropping season, which is characteristic of agriculture in a Mediterranean climate. A comparison of Annex F Part 2 Table 3 with Annex F Part 2 Table 4 shows that, decades after the introduction of irrigation, winter cropping is still strongly dominant. On average, over the past three cropping seasons, about four times as much land has been planted in major winter crops as has been planted in major summer crops. With irrigation, the summer growing season is superior to the winter growing season in a Mediterranean climate. The fact that the winter growing season has remained dominant at Tadla is an indicator of the effect of the constraints imposed on farmers by mandated farming and restricted availability of irrigation water during the summer growing season.

A further comparison of Annex F Part 2 Tables 3 and 4 shows that there is a high level of stability in the cropping patterns of the major winter crops -- i.e., hard and soft wheats and sugar beets. But there is not any apparent stability in the cropping patterns of the major summer crops -- i.e., cotton is falling, paprika peppers are increasing rapidly, and the area devoted to lesser crops is fluctuating on an annual basis. Both the potential, on a per unit area basis, and the problems of the summer growing season are greater than those of the winter growing season. Consequently, the cropping patterns of the summer growing season are less stable than those of the winter growing season.

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Annex F Part 2 Table 2
Cropping Patterns in the ORMVAT Perimeter

Crop	Area in Thousands of Hectares			Percent Change	
	1988	1989	1990	1989	1990
Annual					
Cereals	46.9	45.4	47.5	- 3.2	+ 4.4
Sugar Beets	19.4	19.6	19.4	+ 1.0	- 1.0
Forages	6.3	8.5	7.1	+ 34.9	- 16.5
Vegetables	9.8	11.2	11.2	+ 15.3	- 1.0
Cotton	11.9	11.5	11.5	- 3.0	0.0
Sub-Total	94.3	97.6	96.7	+ 3.5	- 1.0
Perennial					
Alfalfa	10.3	10.3	10.9	0	+ 5.8
Citrus	6.8	6.9	7.0	+ 1.5	+ 1.4
Olives	11.5	12.6	12.8	+ 8.7	+ 1.6
Other Fruit	0.4	0.4	0.4	0	0
Roses	0.4	0.4	0.4	0	0
Sub-Total	29.4	30.6	31.5	+ 3.9	+ 2.9
Total	123.7	128.2	128.2	+ 3.5	0

Note: Data provided by the Service de la Production Agricole (ORMVAT, 1991)

The winter growing season has unexploited potential for improved efficiency and economic return. In fact, Ameziane et al (1976) saw wheat as "la culture pratiquee dans le perimetre la plus susceptible de voir augmenter ses rendements". The recommendations for use of supplemental irrigation and fertilizer practices are as valid now as they were in 1976. Karama (1985) achieved more than a 50 percent improvement in wheat yields by means of proper timing of supplemental irrigation.

One further comparison between winter annual crop production and summer annual crop production is that the total number of hectares in winter crops has remained stable over the past three years. But the number of hectares in summer annual crops has shown significant increases. It is important to note that this represents an absolute increase in the number of hectares farmed per year -- and thus an improvement in cropping percentage -- and not an increase in hectares devoted to summer annuals at the expense of hectares devoted to winter annuals -- or for that matter, in the number of hectares devoted to perennial crops. Apparently, the increase in the number of wells over the past decade and

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the reduced emphasis on mandated cropping is already leading to increased exploitation o the highly favorable summer growing season.

In the context of summer annual crops, the recent history of cotton and paprika peppe production is the most interesting. Since data for these two crops is available for 1991, i is included in Annex F Part 2 Table 4. The data substantiate the view that of the twc mandated industrial crops -- sugar beets and cotton -- cotton is the most vulnerable to the consequences of liberalization. Cotton is outside the purview of this project but brie mention will be made here of the two most obvious sources of the vulnerability of its statu as a major crop in the Tadla. First and foremost, cotton production in the perimeter is poorly executed. Second, cotton is probably going to face stiff competition from highe value summer crops, with paprika peppers giving the first solid evidence of this trend.

A decline in hectares devoted to cotton is not new. A similar phenomenon occurred in the late 1960s and again in the late 1970s and early 1980s. In each of those instances, cotton production recovered the hectares which had been temporarily lost. This recovery may happen again, but there have been some major changes in the intervening years. Specifically, there has been liberalization and the accompanying probability that there is going to be serious, sustained competition from higher value horticultural crops, as evidenced by the fact that the private sector has made a significant investment in dehydrator plants in the Tadla region.

In order for their potential to be fully exploited, the new dehydrators will need a steady supply of appropriate agricultural commodities. Tomatoes, another summer crop, would be a likely candidate. Steps are now being taken by the private sector to establish a research program which will serve to identify crops and varieties which are promising relative to maximizing the return on the investment in dehydrators. Winter crops will also be needed for the dehydrators, but the first point of impact for expanded production of higher value crops will be on summer annuals.

Annex F Part 2 Table 4 summarizes the very rapid expansion of paprika pepper production over the past four years. Apparently, Tadla has benefitted from an improvement in its competitive position relative to Spain which has been a major paprika pepper producer. A significant amount of the current crop is being trucked to Spain for processing. On the negative side, only about half of the paprika pepper production in Tadla in 1991 is being grown under forward-contracting arrangements and the demand for agricultural commodities such as paprika pepper is notoriously volatile.

Improved irrigation efficiency is favored by current trends in summer annual crop production. The general trend to increased summer crop production, in spite of a limited supply of irrigation water, will necessitate more efficient use of available water. Crops such as paprika peppers and tomatoes are well-adapted to efficient, individualized irrigation methods.

Annex F Part 2 Table 3
Evolution of Cropping Patterns for Selected Major Winter Annual Crops
in the ORMVAT Perimeter

Crop	Area in Thousands of Hectares			Percent Change	
	1988	1989	1990	1989	1990
Soft Wheat	38.4	36.8	37.6	- 4.2	+ 2.2
Hard Wheat	6.9	6.9	7.2	0	+ 4.3
Sugar Beets	19.4	19.6	19.4	+ 1.0	- 1.0
Berseem Clover	1.4	1.3	1.5	- 7.1	+ 15.4
Forage Barley	4.5	6.5	5.1	+ 44.4	- 21.5
Potatoes	1.9	1.5	1.4	- 21.1	- 6.7
Onions	2.1	2.1	2.1	0	0
Total	74.6	74.7	73.3	+ 0.1	- 1.9

Note: Data provided by Service de la Production Agricole (ORMVAT, 1991)

Annex F Part 2 Table 4
Evolution of Cropping Patterns for Selected Major Summer Annual Crops
in the ORMVAT Perimeter

Crop	Area in Thousands of Hectares			Percent Change	
	1988	1989	1990	1989	1990
Cotton	11.9	12.8	11.5	+ 8.0	- 10.2
Maize for Grain	2.1	1.7	2.7	- 19.0	+ 58.8
Maize for Forage	0	0	2.8	0	---
Paprika Peppers	0.4	1.5	2.9	+ 275	+ 93.3
Sesame	0.5	0.9	0.6	+ 80.0	- 33.3
Beans	1.3	1.9	1.2	+ 46.1	- 36.8
Total	14.2	18.8	21.7	+ 32.4	+ 15.4

Note: Cotton area in 1991 was 7,400 hectares, down by 35.7 percent from 1990; paprika pepper area was 6,800 hectares, up 134 percent. Data provided by Service de la Production Agricole (ORMVAT, 1991)

D. Water Management Strategies

1. Crop Water Sources in the Tadla Perimeter

Rainfall, canal water and groundwater are the three sources of water available for cropping in Tadla. The fact that all of the 350 millimeters of annual rainfall comes during the winter assures that winter cropping will be more extensive than summer cropping which has an inadequate water supply as the primary constraint on expansion. Improvement in the responsiveness of the canal water delivery system will reduce losses resulting from inconvenient scheduling and allow for an increased emphasis on timeliness in irrigation applications.

Wells, as the comparatively new water source in the perimeter, are not as yet either understood or exploited as an alternative source of water. The number of wells tapping the shallow perched groundwater under the perimeter doubled to 9,220 over the last decade. In most cases, these wells are a source of flexibility and security for irrigated farming. In other cases, this shallow aquifer is an immediate threat to some soils and may be a long-term threat to others. This problem will be the direct concern of Project Element 3.

The cost of well water is a function of pumping cost and is calculated to be about three times the cost of canal water. Pumping systems used for wells are often inefficient. The cost of well water would be reduced by using more efficient pumps to lift it. Efficient pumping is an important factor for drainage on some land. Project Element 2 will include testing of drainage pumps.

2. Application of Irrigation Water in the ORMVAT Perimeter

The presence of the robta irrigation method and the lack of land leveling, field maintenance and efficient gravity irrigation has been a recurring matter of concern for decades in Tadla. Robta is a system which virtually eliminates the need for an on-going process of field maintenance and leveling. It accomplishes this at a cost in water-use efficiency by using a series of header ditches for a given field, thus reducing the length of each run. While robta is a traditional system, its use is not limited to traditional farms. The system was observed as the primary method of gravity irrigation on large well-financed, high-tech farms, both in and off the Tadla perimeter.

Robta is criticized because using a series of header ditches is wasteful of both land and water. In fact, given the constraints farmers face, robta at its best may be a better application system than the syphon method.

If robta is going to be replaced by more efficient methods of gravity irrigation, the process is going to have to be carefully considered. A possible point of departure would be the use of level ground borders and checks for alfalfa production. Given the fact that alfalfa is a perennial crop, once leveled, the grade of the field would not be disturbed by field

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operations. Since this method is only efficient if large quantities of water are applied quickly, well water could be combined with canal water to cover the field in the shortest possible time. When this method was described to officials in the extension service, it was stated that there are already farmers in the perimeter who are using this method on alfalfa.

Timeliness of water application is another area which should have a high potential for improvement. Irrigation applied at the right stage of crop development can have a high rate of return. This concept is not very important for summer cropping, where a regular cycle of irrigations is necessary to keep a crop alive and growing. But it is very important in the context of supplemental irrigation of winter crops. As illustrated by Annex F Part 2 Table 5 and Annex F Part 2 Table 6, a strategic irrigation or two at critical stages in crop development can have a major impact on wheat yields.

The responsiveness of the canal delivery system to requests for water is of obvious importance to timeliness in water application. If canal water is not available at a particularly critical stage of crop development, the economic return to an irrigation might justify the use of well water.

Improvements in water use efficiency could be realized by the use of individualized irrigation systems. These are expensive and comparatively high technology solutions but they can save a lot of water and are better adapted to the production of many high-value horticultural crops. They are used mainly on citrus in Tadla, but if inadequate water supplies become a major constraint to the expansion of high-value summer annual horticultural crops, these systems may be accepted on a much wider scale. Given the requirements of these systems, wells would be a much more practical source of water for their use than the canal system.

Annex F Part 2 Table 5
Effect of Water Regimes on 1985 Soft Wheat Grain and Straw Yields
in Tons of Dry Matter per Hectare in ORMVAT Perimeter

Crop Yield/ Treatment	R1	R2	R3	R4
Grain	2.0	4.1	4.4	5.9
Straw	2.9	4.7	5.0	6.5

Notes: R1 = Precipitation only: 215.4 millimeters; R2 = One Irrigation: flowering.
R3 = Two irrigations: flowering and grain filling; R4 = Control. No water stress.
Four irrigations: Tillering, stem elongation, flowering, grain filling.

Data from Karama (1985)

Annex F Part 2 Table 6
Effect of Date of Irrigation on Wheat Grain Yield

Type	Plant Growth Stage					Yield in Tons/ Hectare	Percent Change
	ET	TE	EH	HF	FM		
0						1.3	0
1	55	55				2.1	62.2
2		55	55			2.4	92.1
3			55	55		3.3	158.8
4				55	55	2.1	68.5
5		110				2.1	62.3
6			110			2.4	8.6
7				110		2.1	6.5
8					110	1.7	3.4

Note: Based on the Marrakech region. In a simulation, 1973 climatic data were used. Rainfall for 1973 corresponded to median precipitation. (Ben LHamdani, 1991).

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E. Agricultural Chemical Strategies

There is a growing awareness in Morocco of the adverse environmental impacts which can result from intensive irrigated agriculture. Pesticide use on cotton and fertilizer use on sugar beets are invariably the problem areas which are mentioned relative to the ORMVAT perimeter. These crops are focused upon partly because the concern is justified and partly because there is only very limited information and controls on chemical use on other crops.

One of the first project activities will be an attempt to inventory and describe chemical use in the perimeter as a means for setting priorities in this area. Efficient, economic and responsible fertilizer and pesticide use will be a part of all recommended production packages -- see below. The broader issues of safety and pollution will be addressed by Project Element 3.

F. The Development and Promotion of Production Packages

It is anticipated that farm-level improvement in the efficient use of water and other inputs will contribute to the overall economic benefits of this project. The potential for a positive impact is obviously present on the farms of the ORMVAT perimeter. A more responsive canal delivery system and the integration of well water into cropping programs will be the basic elements of production packages within the context of this project. For winter crops, the emphasis will be on the extensive application of timely supplemental irrigation. For summer crops, the emphasis will be on highly efficient irrigation of high-value crops. A perennial crop -- alfalfa -- will probably be used to initiate a first step toward improved gravity irrigation in the perimeter. Other crops, which are likely to be a part of production packages, are wheat, paprika peppers and other vegetables.

The long periods of time required to test and demonstrate improved production technology is the most important problem to be overcome if proposed innovations are going to have a significant impact during the life of the project. Testing of innovations which are essentially new or which appear particularly promising will start in Project Year 2. Testing will be done on farms. This will give farmers the opportunity to evaluate a given technology long before it is officially recommended or rejected.

To the extent possible, testing will be done in cooperation with agribusinesses which have commercial interests in Tadla. This would allow for the promotion of a given technology and required services/inputs/equipment by the private sector long before a formal recommendation would be promulgated as a result of project activities.

III. Element 3 -- Environmental Monitoring and Mitigation

A. Introduction

The Tadla irrigation perimeter is one of the largest and oldest of the modern large irrigation schemes of Morocco. As illustrated in Annex F Part 3 Figure 1, it is composed of two relatively hydraulically independent sub-perimeters:

- The Beni-Amir sub-perimeter on the right bank of the main river, with a total irrigated area of 27,500 hectares, whose water is diverted from the Kasba Tadla diversion dam upstream of the perimeter on the Oum Er Rbia river; and

- The Beni-Moussa sub-perimeter on the left bank, with an irrigated area of 69,500 hectares, whose water is diverted from the large dam of Bin El Ouidane on Oued El Abid. An additional 5,000 hectares are irrigated in small and medium-scale perimeters, and 12,000 hectares are irrigated using groundwater.

Irrigation development in the Tadla area has enhanced the agricultural productivity as well as the diversification of the cropping systems. This has been accomplished through the intensification of the farming activities and the heavy use of the fertilizers and pesticides, especially on the "industrial" crops -- i.e., cotton and sugar beets -- and vegetables. Intensive agro-industry activities have accompanied this agricultural development. These agro-economic developments have also directly affected the growth of a large urban center in the area -- see Annex F Part 3 Figure 1. Those changes can be classified as direct benefits of the Tadla irrigation perimeter in achieving the overall goals of increasing food production, income generation and employment. Accompanying these beneficial changes have been many adverse effects whose impacts might be of significant importance in the long-run, if not addressed appropriately.

The observed environmental impacts discussed in this section are classified into three categories: groundwater and drainage system management, soil modification and water quality, and agro-chemical storage, use and disposal. The first two categories are related to the direct environmental impacts at the irrigated perimeter level; the last category falls into environmental impacts of regional significance.

B. Ground Water and Drainage System Management

Prior to the start of irrigation in Beni-Amir perimeter in 1938, the water table depth varied between 50 meters at upstream locations and 15 meters at downstream sites. Water leakage through earth distribution canals network in conjunction with excess irrigation water uses has resulted in a significant water table rise since 1974. The southwest part of the perimeter has been severely damaged by surface waterlogging problems. The construction of a surface drainage system between 1950 and 1960 helped to reduce this effect, but has not

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[INSERT ANNEX F PART 3 FIGURE 1 HERE

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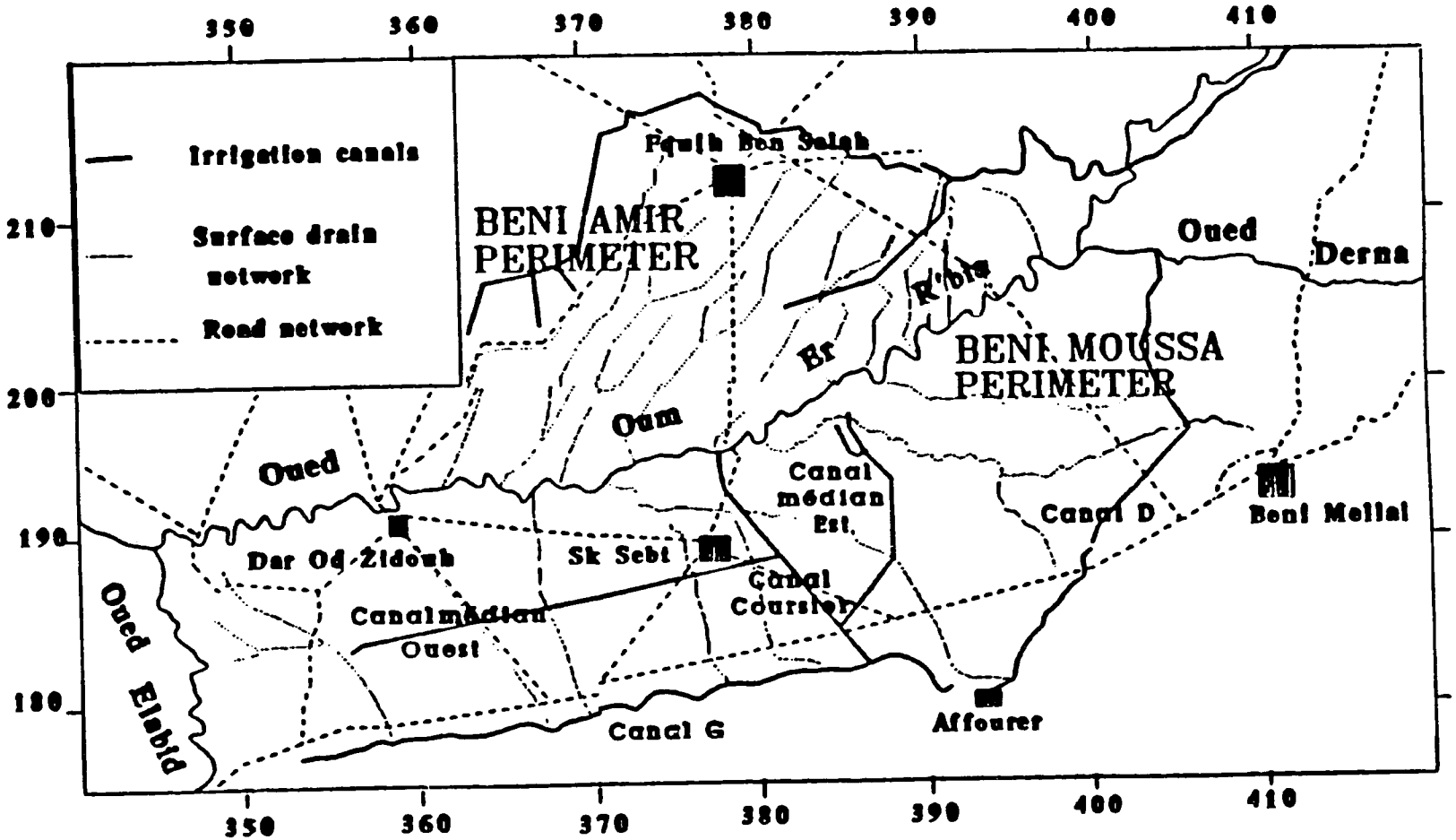
Annex F part 3 figure 1
Tadla Perimeter infrastructure



Source: Debbarh et al, (1991)

eliminated it, as shown by Annex F Part 3 Table 1.

This situation has also been improved by the rehabilitation of the main irrigation transport canals -- e.g., use of cement instead of earth -- started in 1973. The construction of around 145 kilometers of surface drains between 1975 and 1979 has enabled better control of the water table below one meter over the major part of the perimeter and completely eliminated surface waterlogging over 1,990 hectares.

Annex F Part 3 Table 1
Evolution of the Area Affected by Waterlogging, 1950-1969

Year	Month of Observation	Area where Water Table Level is:	
		0-1 meter	1-2 meters
1950	January	3,170 hectares	11,070 hectares
1955	October	6,950 hectares	16,870 hectares
1957	April	7,030 hectares	18,020 hectares
1963	September	1,540 hectares	14,880 hectares
1969	February	3,200 hectares	19,000 hectares

Source: ORMVAT, 1980.

In the Beni-Moussa perimeter, the water table fluctuation varies from the eastern to the western parts of the area separated primarily by the main central canal -- canal coursier. In the eastern part, following the introduction of irrigation in 1954, the water table began to rise at a very rapid rate -- 2 to 3 meters a year -- and reached the soil surface in many areas. It is also worthwhile mentioning that prior to irrigation, waterlogging problems were already known in the area. Many of the waterlogging effects have been solved by the construction of secondary and main drainage outlets and ditches to strengthen the existing natural drains of the Oueds Day, Takerzouzt and El Arich. In addition, a series of 8 pumping stations have been installed in the critical areas of El Arich and Sidi Jabeur, whose transmissivity characteristics are very high -- well discharges at these sites vary from 100 to 250 liters per second. As a result of this organized pumping activity combined with the construction of 4 kilometers of surface drains, the rise of the water table level was slowed down between 1975 and 1980.

In the west Beni-Moussa sub-perimeter, waterlogging problems occurred mainly in the sector of Oulad Zidouh where the water table level was less than 5 meters prior to irrigation. In the absence of a drainage network, the water table began to rise continuously beginning in 1970. Surface drainage works have since been implemented over approximately 1,900 hectares. Annex F Part 3 Table 2 shows that even with the construction of this

drainage system the situation did not improve, and the potential waterlogging area has increased from 3,763 hectares in 1976 to 3,940 hectares in 1979 -- i.e., the area where the water table is located between zero and one meter below the soil surface.

The maximum area with potential waterlogging problems in 1990 was around 20,000 hectares -- 13,000 with water table located at 1.5 meters below soil surface and 7,000 hectares between 1.5 and 2.00 meters. This situation improved significantly during the 1979-1984 drought years -- see Annex F Part 3 Figures 2 to 5 -- due to the combined effects of drought occurrence and the pumping of water from the aquifer by the growing number of privately constructed wells. These wells now number over 9,000 in the Tadla perimeters.

Annex F Part 3 Table 2
Waterlogging Due to the Presence of the Water Table Between 0 and 1 Meter

Sectors	Hectarage Affected by the Aquifer (0-1 meters)	
	1976	1979
Oulad Jabri		30
Khelalta	887	495
Oulad Ayad	348	320
Beni Moussa I	287	568
Beni Moussa II	1,228	1,309
Souk Sept I		36
Oulad Illoul	405	400
Dar Oulad Zidouh	608	782
Total	3,763	3,940

Source: ORMVAT, 1980.

A recent study done by Debbarh et al (1991) has shown that the irrigation return flow is the major factor which figures in the recharge of the Beni-Moussa shallow aquifer -- see Annex F Part 3 Figures 6 to 8. The major sources of outflow are drainage and private well withdrawals -- Annex F Part 3 Figures 9 to 11. The study illustrated that the net water balance is positive for the Beni-Moussa aquifer -- Annex F Part 3 Figure 12 -- during the normal rainy years of 1970 to 1980, and 1986 to 1990. There is, hence, a net increase of the storage volume of the aquifers leading to the multiplication of risky agricultural lands with potential waterlogging and/or drainage and salinity problems. Annex F Part 3 Figure 13 shows an example of the spatial distribution of water table levels in June 1990. The monitoring of these two aquifers is done separately by DRH and SGRID of the ORMVAT. The existing monitoring system is not sufficient. About 56 piezometers and observation wells are measured bimonthly by DRH and a similar number of observation

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Annex F part 3

Fig.2: Well N° 239/36
CMV 532

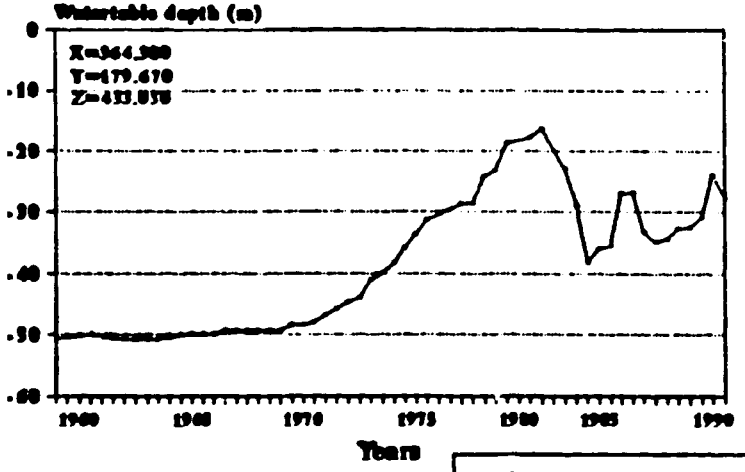
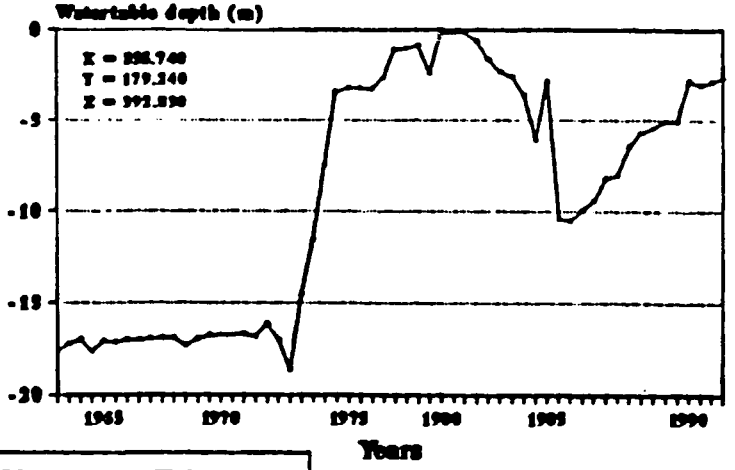


Fig.3: Well N° 248/36
CMV 533



EVOLUTION OF WATERTABLE LEVEL IN BENI MOUSSA PERIMETER

Fig.4: Well N° 638/36
CMV 537

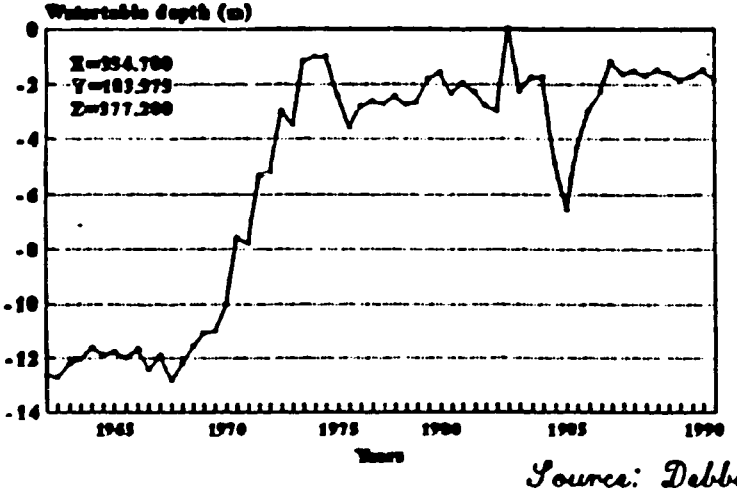
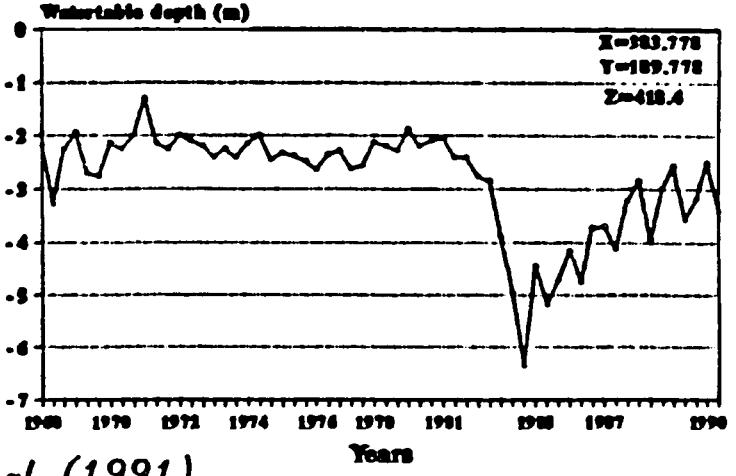
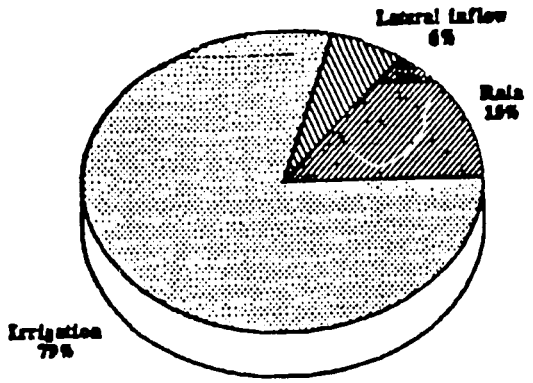


Fig.5: Well N° 153/36
CMV 527

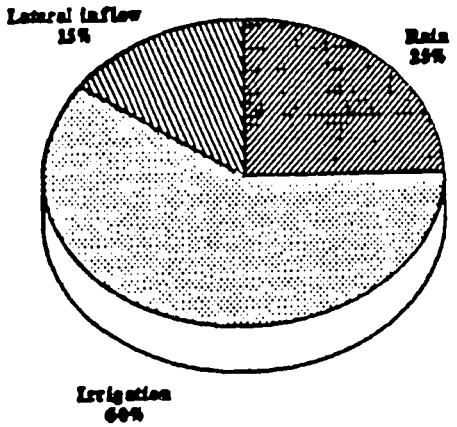


Source: Debbarh et al, (1991)

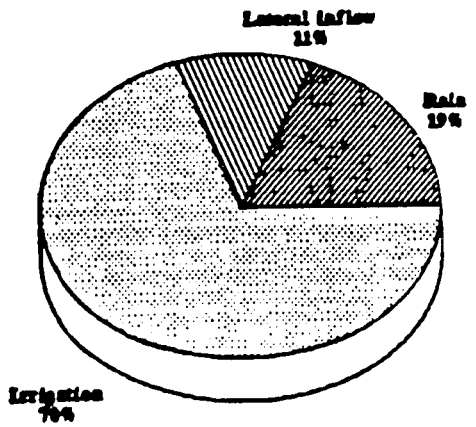
Annex F part 3 Fig. 6: Groundwater recharge components. 1975 to 1980



Annex F part 3 Fig. 7: Groundwater recharge components. 1981 to 1984

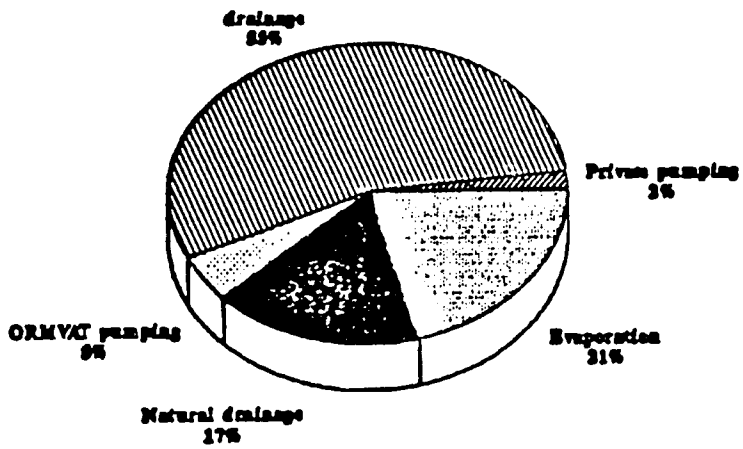


Annex F part 3 Fig. 8: Groundwater recharge components. 1985 to 1990

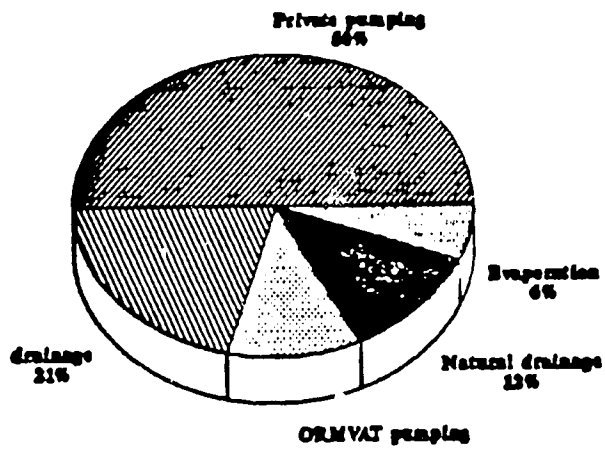


Source: Dobbert et al. (1991)

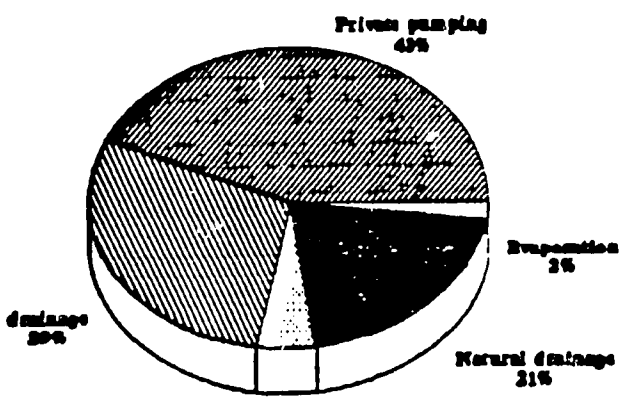
Annex F part 3 Fig. 9: Groundwater withdrawal components. 1975 to 1980



Annex F part 3 Fig. 10: Groundwater withdrawal components. 1981 to 1984



Annex F part 3 Fig. 11: Groundwater withdrawal components. 1985 to 1990



Source: Dubbert et al. (1991)

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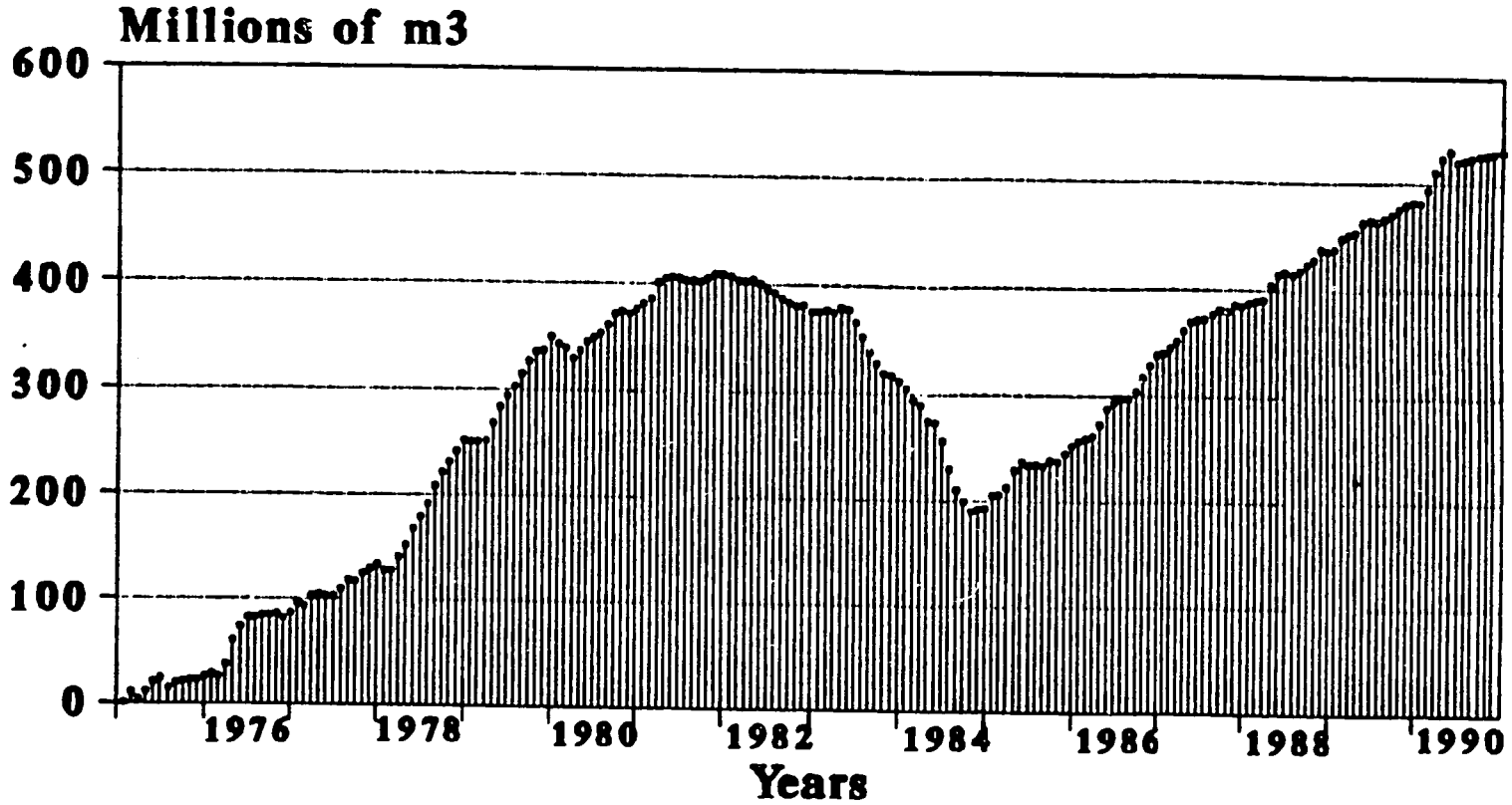
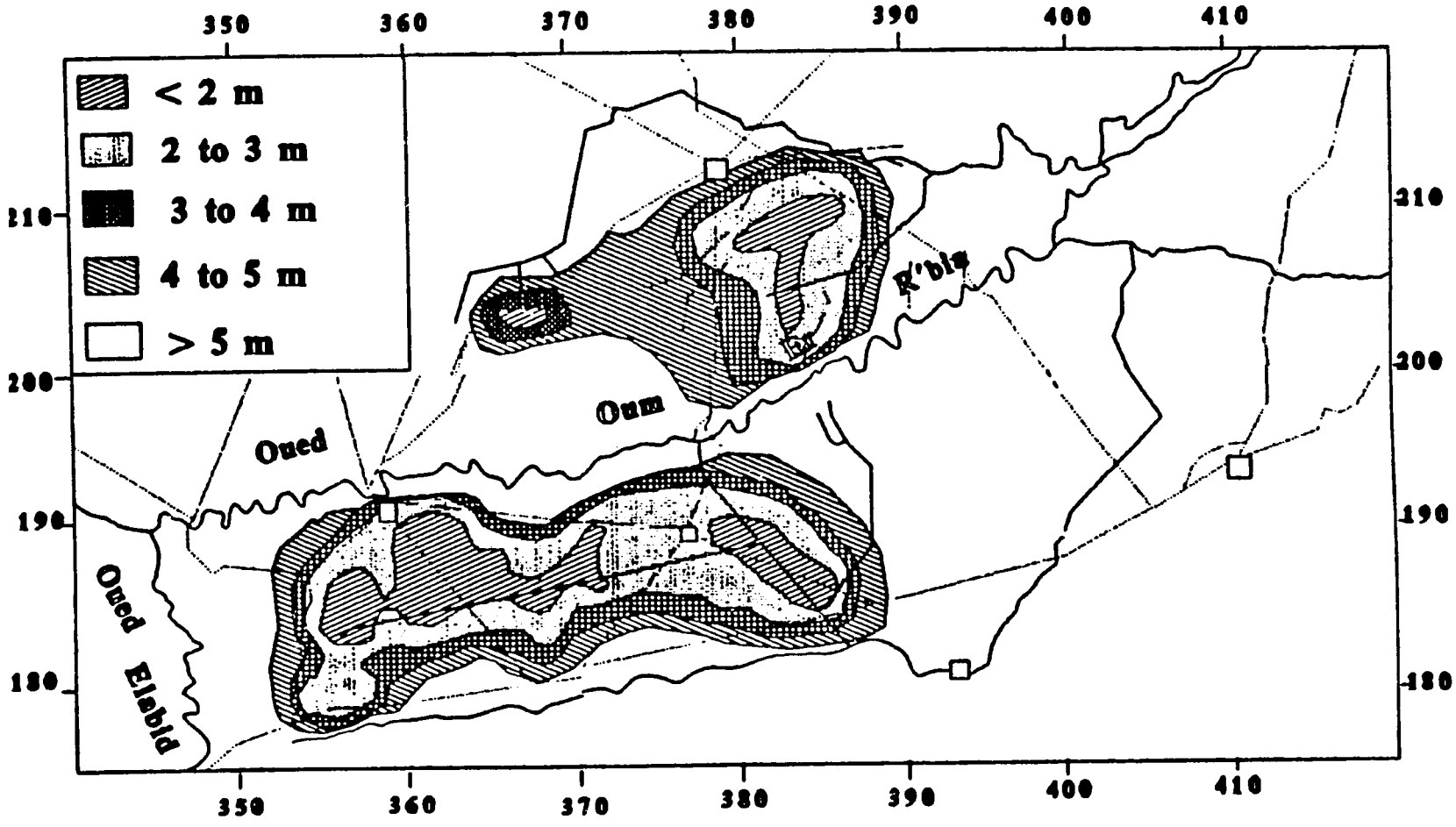
Annex F part 3 Figure 12
Sum of the storage regulation volumes of Beni-Moussa shallow aquifer



Source: Debbarh et al, (1991)

Annex F Part 3 Figure 13
Spatial distribution of watertable level in the Tadla perimeter; June 1990



Source: Debbarh et al, (1991)

wells are measured by SGRID personnel. There is no systematic exchange of information between the two institutions, nor is there any rigorous database to enable the perimeter's managers to get a more complete picture of the dynamics of the groundwater systems of the Tadla area. Comprehensive strategies of integrated surface and groundwater management could be investigated once a database is established and real-time management models are developed.

The drainage system constructed by ORMVAT in the two perimeters is mainly a surface drainage network with a large spacing of 400 to 700 meters between consecutive ditches. The depths of the ditches and the outlets vary between 1.5 to 2.5 meters. Around 1,700 kilometers of drainage ditches and outlets need to be rigorously and continuously maintained. The ORMVAT is currently only able to handle about 200 kilometers a year, most of which are concentrated in the critical areas of west Beni-Moussa. Maintenance is both mechanical -- i.e., a dredging exercise -- and chemical, using one of the following products: Weedazol powder, and Weedazol or Roundup liquid concentration. The insufficient maintenance actions of ORMVAT and the wide spacing of the drainage ditches may be the main constraints to the appropriate functioning of this drainage network. A more rigorous assessment and monitoring of this system would allow for better estimates of its real efficiency and possible ways to improve it. Alternating solutions of various drainage systems, including conjunctive surface and groundwater resources should be investigated in such way that the water table does not pose any serious waterlogging problems for the sustainability of agricultural activities in the Tadla sub-perimeters.

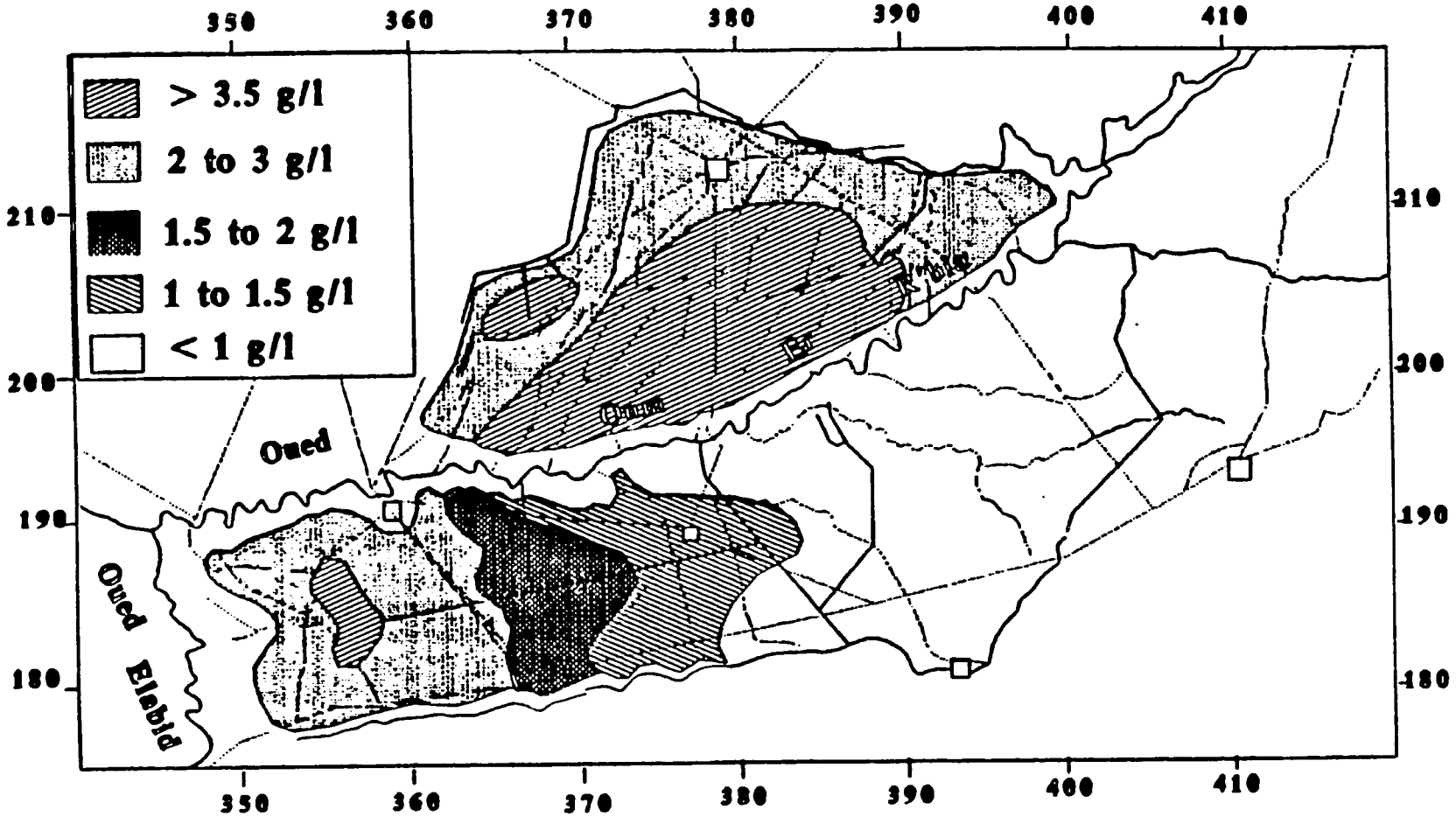
C. Soil Modification and Water Quality

The development of irrigation in the Tadla area has resulted is an intensification and modernization of agricultural farming systems, discussed in Part 2 of this annex, which has led to -- among other factors -- increased use of large amounts of fertilizers, pesticides and other agro-chemicals to increase agricultural productivity. The low return flow from irrigation -- about 50 percent -- to the aquifer contributes to the leaching of salt, nitrates and chemical pollutants from these practices through the relatively high permeable soils of the Tadla.

The salinity of the soils has not yet reached critical values in the two sub-perimeters. The situation may worsen in the future, especially in the areas where irrigation water of high salt content is used -- i.e., the reuse of drainage water by pumping along outlets and ditches, salty groundwater, etc.. There are not enough available data on soil evolution, under irrigation, that would help assess the effective salinization or the negative impacts of irrigation on soils.

Significant salt accumulations have occurred in the shallow aquifer areas of the two sub-perimeters -- where the water table depth is less than 1.5 meters. Maximum concentrations reached so far are around 3.5 grams per liter. Annex F Part 3 Figure 14 illustrates the spatial distribution of the groundwater salt content during the month of July 1991. This is

Annex F part 3 Figure 14
Spatial distribution of groudwater salt contents in the Tadla aquifers, Period of July 3 - 17, 1991



Source: Debbarh et al, (1991)

the result of the combination of soil leaching -- irrigation water with relatively high salt content from Oum Er Rbia river -- and evaporation from shallow water tables in the Beni-Amir sub-perimeter. For the west Beni-Moussa, the high content of salt might be explained by evaporation from the shallow aquifer, and by the salt composition of some geological formations through which water flows and which constitute part of the lateral boundaries of the groundwater reservoir.

The nitrate pollution of the aquifers is directly related to the intensive agricultural activities in the area. In fact, recent investigations by the Direction de la Recherche et de la Planification de l'Eau (El Haiba et al, 1990) have shown that around 4,000 metric tons of nitrates are annually leached and are enriching the water tables. As a consequence, an annual rate of nitrate accumulation of about 5 milligrams per liter has been measured in many observation wells. This has led to the multiplication of large areas with high -- above 50 milligrams per liter -- nitrate concentrations. The highest concentration zones have been located around Fkih ben Salah in the Beni-Amir sub-perimeter and at sites downstream of the Beni-Moussa aquifer. The enrichment of the shallow water tables by nitrates has evolved in parallel with the doses of nitrates used in the agricultural sector. The annual rate of nitrate accumulation has increased from 15 to 30 milligrams per liter in 1981, to 20 to 50 milligrams per liter in 1990. The application of nitrogen for agricultural uses has increased from 64 kilograms per hectare per year to 104 kilograms per hectare per year during the same period.

The agro-industries, including the three sugar factories in the Tadla, also contribute to the enrichment of the aquifers by nitrates and pollutants. An estimated annual amount of 2,000 metric tons of nitrates are discharged with the raw sewage effluent of the SUBM, SUNAT and SUTA factories (El Haiba et al, 1990). Part of this nitrate recharges the aquifer during the transport of the industrial effluent, along the existing drainage system, to the Oum Er Rbia river. The urban centers also contribute, in smaller proportions, to this pollution load.

Water quality is also affected by the raw sewage flowing into the existing drainage system from the urban centers of Tadla perimeters -- Beni-Mellal, Afourer, Dar Oulad Zidouh, Fkih ben Salah and Souk Sebt. Pollution levels are unequally distributed in the two sub-perimeters. Along the main effluent drains -- Beni-Amir canal, G12 and Takerzouzt outlets -- the sewage water of the cities and sugar factories has caused significant localized water pollution as measured in the form of high nitrate and salt contents, important microbiological infestations -- often associated with high water temperature, significant amounts of suspended matter and a low Biological Oxygen Demand consumption rate. Pollution levels along the Oum Er Rbia river, however, are within acceptable Moroccan limits. Hence, the water of the El Massira Dam, downstream from Tadla, does not threaten public health, nor the socio-economic activities of the water users in the Doukkala and Casablanca regions.

The construction of the storage dam at Dechra El Oued -- see the discussion in Annex F Part 1 -- upstream from Kasba Tadla, is likely to exacerbate the pollution problem when water quantities, which contribute to the natural flushing and dilution actions of the Oum

Er Rbia river, are significantly reduced. The increasing level of pollution and decreasing water quality, in combination with water stagnation along the irrigation canals and drainage network, may also contribute to the development of water-related diseases in Beni-Amir. In fact, schistosomiasis, in continuous regression -- 483 infestations in 1986 as opposed to 154 in 1990 -- is mainly located in the Beni-Amir sub-perimeter around the Sidi Aissa and Fkih Ben Salah communes. Other water-borne diseases have also been reported such as malaria and cholera. Other sources of infection might be related to the quality of the source of potable water, which for the rural population, is primarily obtained from private wells in the perimeters.

The monitoring activities of water quality and soil modifications are not systematic and are only partially undertaken by the various local or regional technical departments or services -- SGRID of ORMVAT, DRH, Service d'Hygiene, and the sugar factories. A comprehensive database would enable a better assessment of soil and water salinity, nitrates and chemical pollutants in the perimeters. Such a tool would enhance integrated surface and groundwater management and could help offset some of the negative environmental impacts brought on by irrigation and agricultural activities within the perimeters.

D. Agro-Chemical Storage, Use and Disposal

Agro-chemicals -- i.e., fertilizers, pesticides, herbicides and fungicides -- unless carefully controlled and safely handled and used, can put human and livestock populations seriously at risk. This is in addition to causing long-term, and perhaps irreversible, damage to the region's water, soils, flora and fauna. Water quality, as noted in the discussions above, is already seriously threatened in the Beni-Amir and the Beni-Moussa sub-perimeters, through the combination of fertilizer applications and uncontrolled fluctuations in the perched water tables. The random field observations of the assessment team confirmed the lack of knowledge in the Tadla concerning storage, application and disposal of agro-chemicals. A discussion of the economic and welfare costs associated with environmental pollution in the Tadla can be found in Annex H.

Agro-chemicals are widely used in the two Tadla sub-perimeters, a fact borne out by team discussions with the ORMVAT Service de la Production Agricole (SPA). Although there is little supervision or monitoring of these chemicals in terms of storage, application and disposal, ORMVAT personnel felt that farmers "probably did apply the dosages of the chemical as prescribed because they were expensive to buy". Even if this is the case, little is done -- or in fact known -- about how individual farmers store, prepare and mix, apply and eventually dispose of the agro-chemicals that they do use.

These points were reiterated in discussions with the Direction de la Protection des Vegetaux, des Controles Techniques et de Repression des Fraudes in Rabat. Staff here noted that control was less of a problem for major crops like cotton and sugar beets where the government oversees agro-chemical applications. But for market vegetables, roses, alfalfa, sesame, and the like, no one has any real idea of what is going on. As an example, in the course of

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their field visits, the team observed more than one instance of farmers applying chemicals to their crops -- using backpack sprayers -- with no protective clothing in the heat of the day and under fairly windy conditions. The team also observed the ORMVAT-controlled aerial spraying of cotton fields. Although this was being done primarily in the early morning hours, many of the fields being sprayed were less than one-quarter hectare in size and were often adjacent to irrigation canals, homes and villages.

As the ORMVAT moves through the disengagement process, insuring the safe use of agro-chemicals is apt to become even more problematic and the modicum of control for these chemicals that currently exists will be put more at even greater risk. The sheer volume and types of chemicals now applied are little more than "guesstimates". Cotton fields alone, for example, were treated with more than a dozen different pesticides in the years 1988-1991. As the perimeter farmers produce more crops in response to market demands and as agro-industries participate more in this process, the use of agro-chemicals is liable to increase. This raises major policy issues regarding environmental and public health safeguards on the distribution and use of these materials, not just for the ORMVAT, but for all of Morocco. What, if any, are the points of control for agro-chemicals? And, who will be responsible for monitoring these controls? When environmental damage does occur, or when public health is endangered, what is the assessment process, and who is ultimately responsible for paying the costs?

These are not, obviously, questions that can be answered by the activities proposed for this project. Public awareness about the risks of unsafe handling and use of agro-chemicals -- and water pollution in particular -- is only now beginning in Morocco. In its Environmental Discussion Paper, the World Bank (1990) calls attention to these facts. In preparation for PAGI 2, the Bank specifically provides terms of reference for assessing environmental impacts of the nine ORMVAs (World Bank, 1991). Enhancing this awareness -- especially among the rural populations living in the Tadla perimeters -- is at a level of detail that is beyond the scope of the PAGI 2. It is an area, however, where interventions of this project can contribute to the environmental pollution debate.

It is granted that many of the chemicals used on the two sub-perimeters are relatively safe and environmentally benign, particularly when they are used in a controlled manner. It is also known that the ORMVAT has centralized storage points -- the CMVs -- for agro-chemicals used with major crops and that the Service de Vulgarisation et Organisation Professionelle, with the SPA, provides basic instruction and guidance to farmers on agro-chemical use. The Direction de la Protection des Vegetaux also cooperates with the ORMVAT to analyze and test the agro-chemicals that are to be applied to the major crops. Very little information exists in the ORMVAT about practices associated with agro-chemical storage and disposal. There are no standards established for how these materials should be stored or in what manner they should be destroyed. There is no monitoring system that details where these sites are -- a problem area that will grow as disengagement continues -- or if safety precautions are followed. The team was not able to determine what practices were employed, or precautions taken, concerning the disposal of these materials.

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At the farm-level, the ORMVAT SPA has established guidelines for the use -- dosages -- of agro-chemicals with a host of crops. There is no reliable knowledge, however, on whether farmers adhere to the suggested dosage guidelines, and whether they supplement these agro-chemicals with others that are readily available in the local markets -- the latter's presence strongly suggests that supplements are used.

One of the principal activities of the ORMVAT is the management of water resources, yet it has been only minimally involved with other area institutions that monitor water quality and have a direct interest in environmental pollution. The Direction Regional d'Hydraulique (DRH) and the Office National de l'Eau Potable (ONEP) in the Ministry of Public Works, the Direction des Eaux et Forets et de la Conservation de Sol (DEFCS) in the Ministry of Agriculture and Agriculture Reform, and the Service d'Hygiene in the Ministry of Public Health are the major local government institutions with a stake in these issues. Presently, the ORMVAT only has a working relationship with the Service d'Hygiene in Beni Mellal. The Medecin Chef, in talks with the team, noted that this has been a fruitful collaboration and has had a direct impact on the decreased incidence of water-borne diseases in the area. He also voiced strong concern about how little is known about the toxic effects of agro-chemicals used in the Tadla perimeter on human and livestock health. The Service d'Hygiene, even with its solid network of rural health care workers, does not have the capacity to monitor these types of public health risks.

The DRH, in conjunction with the ONEP, is charged with monitoring the quality of water in the Oum Er Rbia river basin. It currently has established a monitoring system in the Beni- Amir and Beni-Moussa sub-perimeters and along the Oum Er Rbia river at several points in the Tadla perimeter. It has sub-contracted with the Laboratoire Public d'Essais et d'Etude (Centre des Etudes et Recherche sur l'Environnement et la Pollution, 1990a, 1990b, 1991) to conduct analyses of surface and groundwater quality at these monitoring points for a number of chemicals and pollutants against the list of Moroccan water quality standards -- see El Jebbari (1991).

Efforts such as this directed by the DRH provide an excellent example of where regional collaboration and information among the different environmental interest groups could occur. The tasks and functions of each of these groups are often complementary. A regional network designed to foster collaboration and dialogue would be a big step to raising environmental consciousness and help to ensure the sustainability of agro-economic development.

IV. Element 4 -- Private Sector Resource Allocation, Management and Use

The activities in Element 4 have been chosen to support the disengagement of the ORMVAT and other parastatals from commercial activities and the promotion of the private agribusiness sector. Elements 1, 2 and 3 will help create opportunities for cooperatives, professional associations and private companies to supply agricultural inputs and services. Element 4 provides short-term technical assistance and training, with minor material support, to strengthen the private sector capacity to turn opportunities into expanded cooperative, association and company operations. The activities in Element 4 result from a reconnaissance of the organizations which make up the current web of participants in agribusiness -- i.e., parastatals, membership cooperatives and professional associations, companies, and representative bodies such as the Chamber of Agriculture (Beni Mellal) and the Chamber of Commerce and Industry (covering Beni Mellal and Azilal). The major companies are given in the format of a database file integrated with the USAID agribusiness database. A list of input distributors is filed separately. In addition, an examination was made of the likelihood of a private water market being established during the life of this project.

The reconnaissance was intended to identify those organizations and companies which could have a major impact on the flexibility, efficiency and environmental sustainability of use of water and soil resources. The operating assumptions were that impact would be closely tied to broad spatial representation in the perimeter, the financial health as measured by capital reserves and the willingness of banks to extend lines of credit, the presence of an established market or the potential to build one, a charter which permits flexibility in choice of commercial activities and investments, and management capable of undertaking strategic planning and following through with a business plan and its execution.

A. The Agribusiness Landscape

The ORMVAT through its CMVs has broad area coverage and control of key assets. The disengagement process is shifting commercial activities to the non-governmental and private sectors. The commodity-specific parastatals -- COMAPRA in cotton and oilseeds; SUTA, SUBM and SUNAT in sugar -- also have broad coverage and have absorbed substantial parts of the seed and input delivery services and crop transport services from ORMVAT. These industries are strategic ones in the perspective of the Government of Morocco, because they provide export revenue -- e.g., long staple Pima cotton -- provide import substitution and security of the national sugar supply, and provide salaried jobs for skilled and unskilled labor. Even though their charters permit investment in other activities, they have not done so, primarily for financial reasons. While they could have a tremendous impact on water, soil and input use efficiencies, this project does not need to provide direct support to them. The sugar industry is financing its own research and development effort to improve production and plant efficiencies, and all three sugar plants are on the block for privatization. New management will quickly be forced to seek ways to make sugar a more profitable crop for all concerned. The cotton industry is facing similar pressures from

the liberalization of crop rotations. Cotton has lost ground to paprika peppers -- niora -- which crop is now said to be grown on 6,000 to 8,000 hectares, providing a stimulus for COMAPRA to find ways to reduce production costs, improve productivity and return to cotton.

The Societe Nationale de Commercialisation des Semences -- SONACOS -- the state seed parastatal is also being put on the auction block. It currently operates through the region in both dryland and irrigated areas, principally filling orders passed on from ORMVAT, the Direction Provinciale de l'Agriculture (DPA), the Centres de Travaux, and executing the importation of sugar beet and potato seed. Regional volume is about 1,400 to 1,500 metric tons annually. Discussions with its regional staff suggest that whoever takes over SONACOS will radically restructure its operations. The ORMVAT is charging for transport, storage and distribution services which it once provided at no charge. There are now major incentives for establishing wholesaling operations within and outside the perimeter and for contracting for distribution with retailers. Looking only at wheat seed sales, it is likely that SONACOS -- or its purchaser -- will find that its volume will be cut in half, unless the government continues to contract or guaranty seed supply in excess of the seed stock renewal practices of farmers. Here too, the national catalogue system of varietal licensing greatly slows the introduction of new varieties of the major cereal crops and sugar beets.

The parastatal land management companies -- SODEA and SOGETA -- are both reviewing their operations and restructuring their farms. Like other tree crop producers with a predominance of citrus trees, SODEA is hesitating to make new investments in citrus crops until 1993 -- the year in which Spain and Portugal become fully integrated into the Common Agricultural Policy (CAP) of the European Community. SOGETA, with much greater land in annual crops, is diversifying to new crops in the Tadla, and planning to invest in pressurized irrigation systems to boost yields, reduce water loses and dependence on the surface irrigation system, and, they hope, reduce operating costs. SOGETA is tightly bound to national plan objectives of strategic crop production, so they have reduced flexibility in crop choice.

While this management constraint is likely to change over time, neither SODEA, SOGETA, nor land they manage is available for lease or sale, limiting privatization possibilities. However, both parastatals represent markets for input and custom service suppliers, and suppliers of pressurized irrigation systems -- e.g., sprinkler, pivot, trickle irrigation.

Outside of the parastatal sector, there are two major booms occurring in the Tadla. One is the rapid expansion of center pivot irrigation schemes. The second is the rapid expansion of paprika pepper production and processing. The center pivot program is supported by the Ministry of Interior. Pivots are being installed primarily on collective lands on which leases for up to 19 years are negotiated for annual rents equivalent to the value of between five and seven quintals of wheat per hectare. Currently, about 3,500 hectares have been developed for pivot irrigation. About another 5,300 hectares are in various stages of

development by private companies and individuals. Beyond these 8,800 hectares, another 3,000 hectares have been identified as apt for center pivot irrigation. About 13 major investment groups are involved. The installed and planned surface area offers a good opportunity for suppliers of irrigation equipment, pumps and motors, inputs, custom services, and maintenance and repair services. The larger hardware and agricultural equipment stores in Beni Mellal already carry an impressive array of motors and turbine pumps for tubewells.

The paprika pepper growth has been phenomenal over the past three years. Four years ago, there was essentially no paprika pepper production in the Tadla perimeter. Since 1989, the paprika pepper production area has jumped from 400 hectares to somewhere between 6,000 and 8,000 hectares. This crop is tied to an export market for oleoresin and red colorant for food and cosmetics. A dehydration plant treats some peppers in the Tadla before shipment to Larache. A second operation ships field-dried peppers directly to Spain for colorant extraction. The logistics of this operation has spurred the extension of transport services well after the normal peak period of the sugar beet harvest. The success of this operation reflects the broader changes in the agribusiness investment climate, particularly the opening up of ownership of Moroccan companies to foreign participation and the liberalization of the trucking industry.

The major post-harvest packing operations in the Tadla are the Primagrume packing house, and a rudimentary packing operation attached to a new and sophisticated cold storage facility. Much of the tree fruit production in the Tadla is sold as standing crop on the tree and hauled to one of the 23 packing houses operating in the Casablanca area.

In addition there are about 300 traditional olive oil presses -- maasra -- 8 low-capacity rolling stone mill olive oil presses, and a large, but difficult to enumerate, set of buying agents, collectors and accumulators of olives for table olive processing and oil milling from the major plants in El Kelaa, Marrakech, Fes and Meknes.

The modern milk marketing and processing market is primarily defined by Halib Tadla, the former cooperative pasteurization and yoghurt plant which is now managed by the Centrale Laitiere as a pasteurization and milk product distribution center. Other than tetrapack pasteurized milk (about 50,000 liters a day), all other milk (an additional 50,000 to 80,000 liters a day) is shipped to the Centrale Laitiere facilities in Casablanca for processing. The dairy production industry is dominated by the cooperatives, which are run by ORMVAT cooperative directors. A dairy cattle artificial insemination program and bred heifer importation program are also run by ORMVAT. Animal health services are provided by 9 private veterinarians located in the rural communes of the Tadla perimeter.

Horticultural diversification is underway in the Tadla. There is a rose cut flower and rosebush export industry, with strong links to French firms. There are many small producers and packers of onions and potatoes for the national market. And, there are a few producers of table grapes. Small country accumulators buy this production, although the

two major cold storage facilities in the Tadla perimeter also purchase and store potatoes and handle apples produced in the piedmont -- Dir -- at the foot of the Atlas Mountains near Beni Mellal.

Obviously, the production and post-harvest operations create a large market for agricultural input supply, harvesting services -- i.e., combining wheat and manual labor for other crops -- and transportation services. Input supply is in a state of flux. The parastatals still dominate local markets but, with increasing numbers of small and medium-scale distributors -- 53 by current ORMVAT count -- particularly for fertilizer and pesticides.

There are approximately 80 agricultural cooperatives which operate in the Tadla area. These range from the very old Cooperative Marocaine Agricole -- which is the largest single buyer of wheat in the region, but now runs more like a parastatal since the cooperative has lost essentially all of its members -- to small fuel supply cooperatives. The most widespread cooperatives are multi-service cooperatives. These have been built up from a nucleus of dairy collection points and consumer cooperatives since the Plan Laitier was put into effect in the early 1970s. ORMVAT staff now point to 50 cooperatives and 11 private collection centers as a network of economic activity. Dairy operations have remained their core activity but most have developed other substantial business operations. Several have agricultural machinery services, with machinery selected to meet the highest demand periods for mechanization, land preparation and cereal harvesting. Others have a service station for diesel fuel and kerosene supply. Most now play a growing role in the sales of fertilizers, seeds and plant protection chemicals. Because they are organizations made up of farmers, they are very close to point of decision-making about soil and water use. Their central role in the livestock industry brings them even closer to key water and soil issues. Besides the 90,000 head of cattle in the perimeter, there are nearly 500,000 sheep, and tens of thousands of goats. Alfalfa production takes place on 18,000 hectares and is managed both as an input into the local herd and as a valuable forage "exported" from the perimeter. There is one major animal feed plant in the Tadla and another 8 small units. The sugar beet mills produce a substantial quantity of beet pulp for area herds. Several cooperatives have small feed mills but use is low.

The multi-purpose cooperatives have grown to be some of the strongest local organizations on the perimeter. They have arrived at this point with major assistance from the GOM. Initially, dairy operations were almost wholly subsidized by the government. Gradually, the cooperatives began to take on more of the financial cost of their operations, paying the energy costs of refrigerating milk, paying feed costs, obtaining and servicing loans for equipment, constituting revolving funds for procurement of stock for the cooperative store, etc.. Today, their capital and cash flow positions are relatively strong. The strongest cooperatives are already moving out of the CMVs, obtaining land, and building new cooperative complexes. They fulfill most of the conditions sought. However, the cooperatives have a significant weakness in that they are still strongly dependent on the ORMVAT for general management and accounting, business strategy, and the development

of new enterprises.

While there are many associations in the Tadla, there are four of greatest interest to this project. The oldest and strongest is the Association des Producteurs des Agrumes du Maroc (ASPAM). It represents the growers and packers who export the largest export crop of Morocco. While it has always had a strong government presence, it also has the most highly developed technical support operation of any association in the country. It spawned a technical services and laboratory analysis service, which supports the citrus growers but has expanded to include consulting and analytic work for vegetable growers as well. ASPAM and its technical service have a regional office in Beni Mellal. The other three member organizations of direct concern to this project are the Association des Eleveurs du Tadla (AET), the Associations des Cotonniers du Tadla (ACT), and the Association des Betteraviers du Tadla (ABT) -- the livestock, cotton and sugar beet professional associations, respectively. Together with a cooperative union, all three associations are housed in the same office building in Beni Mellal. The building was built as a joint association investment. The common thread in these three associations is that they represent producers who raise what are called "integrated" livestock or crops -- those crops for which there is one principal marketing channel. Each is supported by an automatic levy from the receipts of product delivery. Existing statutes ensure that, when and if the cotton and sugar parastatals are privatized, the levy on production will still be applied, assuring each association of an income to carry out its member representation services. To move beyond the general representational level requires that the associations offer services of financial value to its members. It is expected that the associations will help lead the development of the vertically-integrated industry in the region. Of the four, ASPAM fulfills this role already. The Livestock Producers Association probably has the best chance of delivering value-added services to its members, primarily because the dairy industry provides a year-round cash-flow to producers. The Social Soundness Analysis -- Annex I -- provides more details on how representative these associations are and what the likelihood is that they can assist in the federation of producer cooperatives into larger economic units.

Two things are striking about this picture of the Tadla. The first is the relatively small amount of packinghouses and processing facilities in the fruit, vegetable and olive industry. While many reasons are advanced, the answer seems to boil down to the strength of the companies and packinghouses in Casablanca and the major agro-processing cities of the interior. Much of this strength is financial and is reinforced by banking practices which demand high levels of loan guarantees -- up to three times the loan amount -- for lines of credit and operating capital, creating a high entry cost into the marketplace. The second major point is the size of the input and service markets in the Tadla surface irrigation perimeter and the center pivot extension areas. While much of the input supply is still run through parastatals, the privatization of these should provide the opportunity for restructuring of the industry. Diversification of both crops and irrigation technologies should create a strong demand for new services.

The design team judged that the greatest project impact could be achieved from major investment in the cooperatives and the associations, with smaller project investment in promoting private sector firm activities. The cooperative and association focus will permit the project to quickly move water and soil management technologies from demonstration to broad application. The project will, however, also promote a diversity of private sector supply of inputs and services as individually-owned businesses and corporations are likely to be able to respond to a rapid growth in opportunity most quickly.

B. Concentration on Cooperative and Association Strengthening

Three Element 4 activities focus short-term technical assistance and training on cooperative and association strengthening to improve their management of costs and services, to develop their ability to plan and undertake commercial operations, and to help them develop a strategy for sustainability based on current and new economic activity.

The 50 multi-service cooperatives were selected as targets because:

- They have the best spatial coverage of the perimeter;
- Operate on a cooperative decree, which gives them broad choice of business activity;
- Have dairy production as a major business enterprise, which provides a regular cash flow throughout the year;
- Have a diversified business base, including sales of consumer goods, agricultural input supply, fuel supply and custom machinery services which provide additional year-round cash-flows;
- Have accumulated capital reserves; and
- Because they are targeted for accelerated disengagement by the ORMVAT -- i.e., movement out of or rental of the CMV facilities used as collection, storage and retail space, the transfer of cooperative directors' salaries and accounting costs -- which will rapidly eat into cash flow and capital reserves.

With proper management of the transition to independent, business-based operations, these cooperatives could invest in the input supply and custom service opportunities resulting from Element 2 activities and from the upcoming sale of SONACOS and the two sugar mills and one sugar refinery. Development of good cooperative management skills may also enable these cooperatives to provide cost-shared management services to the other cooperatives in the Tadla who are handicapped by seasonal and/or low cash flows.

Strengthening of the AET was selected because of the large potential impact of its principal activities -- i.e., livestock breed improvement -- on efficiency of water and soil resource use.

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Crossbred dairy cattle produce over 4 times as much milk per lactation as local races. Purebred cattle produce about 1.6 times as much milk per lactation as crossbred animals. The ORMVAT 1986 plan for disengagement targets artificial insemination program as one of the local enterprises targeted for privatization. The artificial insemination program is well-organized in six regular circuits. It performs nearly 20,000 inseminations annually. Transfer of the service will need to be carefully managed to ensure that the same or an increased level of service is provided. A successfully implemented activity will provide a service to members and serve as an example to the other four associations housed in the Beni Mellal association building of how to structure and operate a member-oriented business.

Irrigation Associations are the newest local organizations on the Tadla landscape. They are being asked to take on both management and financial loads which even the ORMVAT has been only partially able to evaluate. They have been mandated from above by a decree which greatly limits their choice of economic operations in return for a 20 percent rebate on member water charges, which is supposed to cover operations and maintenance costs and result in a small profit. Three Irrigation Associations have been constituted and they will start undertaking their responsibilities in 1992. The design options were to concentrate project resources on Irrigation Associations with the intensity of the cooperative effort, or to provide a lower level of assistance while the main system is adjusted to provide more reliable and responsive water supply, a sine qua non for successful local management of water and maintenance of secondary and tertiary canals, seguia and drains. The design choice was to help prepare Irrigation Associations and their partners in water management through management planning, management training, and short-term technical assistance. This action will lay the groundwork for more effective turn-over of the system when this project can help provide reliable water supply and PAGI 2 can provide funding for rehabilitation.

C. Promotion of the Private Sector

In Morocco, disengagement of the state from commercial activities and privatization of parastatal enterprises in the agricultural sector are managed by the state. It is managed in a step-wise fashion to avoid shocks to production and unwanted impacts on consumer prices and employment. The public sector seeks assurances that a transferred operation will continue to run and provide the same or increased services and products. Consequently, there is a tendency to define two policy options for a disengagement process, then to award the transfer of a commercial activity to a group in the form of a tacit or explicit contract which provides advantages to the group or company in return for adherence to national or local plan objectives. Element 4 of the project is designed to broaden the options for transfer of commercial activities run by the state and the creation of new ones. It builds on the work of the first three Elements which will identify input and service requirements, fund new environmental monitoring activities, and demonstrate the market potential for input supply and services which improve resource use on the farm. Element 4 is designed to provide a small quantity of catalyzing technical assistance to help the private sector

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define and evaluate the market potential for expanded or new input supply and services. There are potentially large markets in land leveling, pressurized irrigation systems, mechanically assisted harvesting, and pesticide consulting and application. Seed and fertilizer supply will soon have the potential for major restructuring, providing the opportunity for expanded operations of distributors in the Tadla, whether these are cooperative or corporations. The options of providing credit for these operations was rejected as financing is available from the Caisse Nationale de Credit Agricole (CNCA) through established lending programs.

Banks, agricultural and commercial Chambers, and individual investors have remarked on the relatively low levels of new capital flow into the Tadla for packing and processing. This is partly due to the strength of competing centers for packing and processing in Marrakech, Fes, Meknes, and especially Casablanca. It is also due to the high guaranty requirements imposed by banks for operating capital or lines of credit, and the fact that much private capital flows to the coastal cities or into non-agricultural investments in real estate or commerce. The new examples of capital inflow are center pivot irrigation programs, where state encouragement is very strong, and in paprika pepper production and export. Once again, financing sources are available for center pivots, so no credit activities were considered. New horticultural or other crop development and processing investment appears to require an external investor who also brings a marketplace to a partnership. Element 4 will provide a small amount of technical assistance to develop feasibility studies, business plans and to assist in start-up for projects which fall outside of the horticultural sector. Project technical assistance will direct horticultural opportunities to the USAID MAP, rather than attempting to set up a parallel promotion structure for the Tadla.

D. Water Markets

The Supreme Water Council for Morocco is gradually helping to create conditions for water for all uses to be treated as a public utility. However, given the need for the publicly-operated Tadla perimeter to rework its current operations to permit it to operate more reliably and efficiently, the incipient transition to decentralized operations and maintenance, and the need for time to carry out the overall disengagement process, the feasibility of USAID investments in exploring the potential of a water utility for the Tadla is probably low at this time. The issue should be examined again at the mid-term evaluation when it will be seen if the physical control works of the perimeter are capable of responding to a contract-driven water demand schedule and if users are able to accurately attribute costs and benefits to water supply and secondary and tertiary system operation and maintenance.

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ANNEX G

ANNEX G

Financial Analysis

I. COST ESTIMATE AND FINANCIAL PLAN

A. Cost Estimates and Financial Plan

The total cost of the project is estimated at $ 19.472 million. The project will be supported with contributions from USAID, the participating GOM agencies -- i.e., MARA, DER and ORMVAT -- and the private sector.

1. USAID Contribution

USAID will provide $ 15.577 million in grant funds from the Economic Support Funds (ESF). Projected annual obligations by functional category are shown in Annex G Table 1 below.

2. Projected Contributions from the GOM and the Private Sector

The GOM contribution to the project will be the in-kind costs for provision of technical and administrative personnel, office space and logistical support for project operations. The GOM will also continue salary payments for government employees while they participate in training sponsored under the project. As per standard GOM/USAID procedures, airline tickets and other travel costs for Moroccans participating in external training will be paid by the GOM. The projected GOM contribution to the project is estimated to have a value of $ 3.120 million.

Private sector firms and individuals benefitting directly from project interventions, training and/or technical assistance will contribute to project support costs. This private sector support is anticipated to include payments for airline tickets and other travel costs for employee participants in domestic and external training; salaries and logistical support for personnel working with project specialists on collaborative pollution reduction/-environmental protection activities, export market surveys, and other activities. The projected contribution from the private sector is estimated to have a value of $ 0.775 million

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ANNEX G TABLE 1
INDICATIVE PROJECT BUDGET
(in $ 000)

Cost Item	Fiscal Year 1992	1993	1994	1995	1996	1997	1998	Total Cost
Long-Term Technical Assistance	375	750	750	625	500	375	250	3,625
Short-Term Technical Assistance	493	1,028	673	368	280	450	176	3,468
Office Staff, Operational Expenses and Staff Vehicles	25 100 240	50 75 50	50 75 50	50 75 240	50 50 50	50 50 50	50 50 50	325 475 730
Equipment/Supplies/ Temporary Personnel	815	370	439	217	163	152	148	2,304
Training	20	334	305	234	210	173	205	1,481
Internal Monitoring/ Evaluation Unit	50	40	50	40	50	40	30	300
External Evaluations			150			150		300
External Audits			75			75		150
Contingencies	106	135	131	93	68	79	48	660
Inflation Factor		138	262	296	299	438	326	1,759
Total Cost	2,224	2,970	3,010	2,238	1,720	2,082	1,333	15,577

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B. Methods of Implementation and Financing

The methods of USAID disbursement to be used in this project will include:

1. Direct Payments

USAID may make direct payments to suppliers or contractors for goods and/or services delivered.

2. Reimbursement

Under the reimbursement method of financing, the GOM implementing agency or private contractor will disburse its own funds and be reimbursed by USAID upon submission of appropriate documentation.

Annex G Table 2 summarizes the expected implementation and financing methods for disbursement of USAID funds.

ANNEX G TABLE 2

Type of Expense	Implementation Method	Financing Method
Training	AID Direct Institutional Contract	Reimbursement
Technical Assistance	AID Direct Institutional Contract	Direct Payment
Commodities and Supplies	AID Direct Institutional Contract or Direct Purchase from Supplier	Reimbursement Direct Payment
Evaluation and Audit	AID Direct Contract	Direct Payment

C. Recurrent Costs and Flow of Funds

1. GOM

Recurrent cost obligations incurred by the GOM as a direct result of project activities are expected to be modest. They are estimated to be approximately $ 0.750 million per year in real terms. Given that ORMVAT, the principal GOM agency participant, is progressively divesting itself of the cost of many commercial activities at the same time that its gross revenues are increasing due to higher irrigation water fees and better collection procedures, it should be an excellent position to assume the projected recurrent cost obligations by the end of the project.

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2. Private Sector

No significant recurrent costs are anticipated for private sector firms or individuals as a result of their voluntary participation in the project.

3. USAID

Once funds are obligated for the project, earmarking, commitments and disbursements will follow, depending on the project's pace of activity. Flow of USAID funds will be subject to standard rules and regulations.

All foreign exchange costs under AID direct contracts or project grants will be paid directly by USAID. USAID may make direct payments or reimbursements to suppliers/contractors.

D. Project Audit Requirements

Primary responsibility for audits of USAID projects lies with the Regional Inspector General's Office (RIG). However, in the event that the RIG is unable to carry out direct audit activities, an external auditing firm will be contracted for the purpose. An amount of $ 150,000 will be provided for two non-federal audits. It is anticipated that such reviews will comply in all respects with United States Government requirements for financial and program audits.

G. Standard USAID Project Financial Tables

USAID project financial tables Annex G Table 3 -- Summary Cost Estimate and Financial Plan; Annex G Table 4 -- Costing of Project Outputs/Inputs; and Annex G Table 5 -- Projection of Expenditures by Fiscal Year -- are presented below

ANNEX G TABLE 3

SUMMARY COST ESTIMATE AND FINANCIAL PLAN

(US $ 000)

PROJECT PAPER

Source	AID		Host Country		Other		Total Costs
	FX	LC	FX	LC	FX	LC	
Technical Assistance							
Long-Term	3,625			2,200			5,825
Short-Term	3,468						3,468
Office Staff	325						325
Participant Training							
In-Country	1,100			300			1,400
External	381			100		575	1,056
Commodities and Equipment							
Research and Demonstration Equipment	2,304						2,304
Vehicles	730						730
Office Equipment, Supplies and Operations	475			50			525
Support for Pilot Demonstration Activities				300		200	500
Project Monitoring and Evaluation							
Internal Project Monitoring	300			100			400
External Evaluations	300			35			335
External Audits	150			35			185
Inflation Factor	1,759						1,759
Contingency Factor	660						660
Total Costs	15,577			3,120		775	19,472

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ANNEX G TABLE 4

COSTING OF PROJECT OUTPUTS/INPUTS

(US $ 000)

Project # 608-0213 Morocco Water and Soil Resources Conservation Project

Project Inputs	Element 1 -- Improved System Management	Element 2 -- Improved Farm Enterprise Management	Element 3 -- Environmental Management	Element 4 -- Private Sector Initiatives
AID Appropriated	3,473	2,850	1,556	1,379
Host Country/Government	900	1,195	400	400
Host Country/Private Firms	-	200	-	575
Project Costs Directly Attributable to Elements 1-4	4,373	4,250	1,956	2,354
Total Project Costs Including All Shared Costs				19,472

Note: Shared costs include the USAID expenditures for the following items: long-term chief of party ($ 1,625,000); project office staff ($ 325,000); project office operations ($ 475,000); purchase of project vehicles ($ 730,000); the internal monitoring and evaluation unit ($ 300,000); external evaluations ($ 300,000); external audits ($ 150,000); contigencies ($ 660,000) and inflation ($ 1,759,000). These items total $ 6,324,000. Shared costs projected for the GOM include the following items: project office operations ($50,000); internal project monitoring and evaluation activities ($100,000); contribution to external evaluations and audits ($ 70,000). These items total $ 220,000.

ANNEX G TABLE 5

PROJECTION OF EXPENDITURES BY FISCAL YEAR

(US $ 000)

Fiscal Year	AID	Host Country (Government)	Host Country (Private Firms)	Total Expenditures
FY 1992	2,118	446	111	2,675
FY 1993	2,697	446	111	3,254
FY 1994	2,617	446	111	3,174
FY 1995	1,849	446	111	2,406
FY 1996	1,359	446	111	1,910
FY 1997	1,565	446	111	2,122
FY 1998	959	444	109	1,512
Inflation Factor	1,759	-	-	1,759
Contingency Factor	660	-	-	660
Total	15,577	3,120	775	19,472

ANNEX H

ANNEX H

Economic Analysis

This section of the report presents an economic analysis of the anticipated project interventions with respect to the net benefits from increased water efficiency savings in quantitative terms, and qualitative analyses of the potential supplementary benefits from improvements in factor allocations in agricultural and agro-industrial enterprises and from the environmental component. In the quantitative analysis, the value of the water savings is compared against the anticipated USAID grant investment and the total project cost stream. In the qualitative analyses, the potentials for additional benefits derived from better allocations of the factors of production, shifting to higher value crops at the farm level, more private sector involvement in agribusiness at the regional level, and improved environmental management are discussed.

1. Water Savings Under the Project

A study of irrigation efficiency in ORMVAT funded by the Belgium government (ORMVAT, 1986) determined that canal delivery efficiency in the perimeter was about 80 percent -- i.e., 80 percent of the water entering the head end of the canal was available at farmers' fields -- and that field application efficiencies were 60 to 65 percent -- i.e., 60 to 65 percent of the water applied to the field finds its way to the root zone, where it can be used beneficially by the crop. The overall efficiency of the system, therefore, was estimated between 48 to 52 percent.

Estimates of the field application efficiency and the overall efficiency appear high. Based on team observation of irrigation techniques in the Beni-Moussa and Beni-Amir sub-perimeters, it was estimated that field application efficiencies are more likely to be about 40 percent, with an overall efficiency of 35 to 40 percent.

In addition to estimating efficiencies, the Belgian study determined that 6 percent of the irrigation water entering the head end of the main canals was being lost at the end of the canals due to ORMVAT's inability to manage the perimeter canal system dynamically. This 6 percent loss was recorded in the 80 percent delivery efficiency estimate noted above so that, if all of the 6 percent were to be saved, the delivery efficiency would be increased to 86 percent.

The magnitude of this problem was confirmed during the team visits to ORMVAT. Engineers responsible for canal management indicated that a substantial amount of water was being lost out the end of the canals because the existing system has a long response time before changes in system demand are reflected at the farm level -- i.e., ten days to two weeks.

The ORMVAT Activity Report for 1989 (ORMVAT, 1989 and ORMVAT, 1990) -- the annual ORMVAT Activity Report is issued in two sections, each covering six months -- reports that 710 million cubic meters of water was diverted from Ben El Ouidane dam through the Beni-Moussa irrigation sub-system. Based on this report, it is estimated that an additional 290 million cubic meters of water was diverted via the Kasba Tadla diversion dam from the Oum Er Rbia river through the Beni-Amir irrigation sub-system. Total water diversions for irrigation in the Tadla perimeter from the two sources was, therefore, 1,000 million cubic meters for 1989.

The 1988 and 1990 Activity Reports (ORMVAT, 1988; ORMVAT, 1989; ORMVAT, 1990 and ORMVAT, 1991) provide similar figures for the perimeter. In addition, an ORMVAT brochure (ORMVAT, 1990) indicates that groundwater pumping provides about 160 million cubic meters of water each year in the perimeter -- i.e., 70 million in the Beni-Amir sub-perimeter and 90 million in Beni-Moussa sub-perimeter. This water does not travel in the sub-perimeter canal systems. For this reason, no savings in groundwater efficiency can be derived from improved canal delivery efficiencies. Field application efficiencies, however, can be affected through improved farm-level water and soil management.

The interventions of the project to improve canal management should result in complete elimination of water losses out of the end of the canals. This would result in maximum annual water savings estimated at 60 million cubic meters -- i.e., 6 percent of the 1,000 million cubic meters. Slack further estimates that a significant proportion of these savings could be achieved within two years after initiating implementation of an improved ORMVAT canal management strategy. By the end of Project Year 3, therefore, it is projected that this type of water loss would have been reduced to 4.5 percent of the total and to 3 percent at the end of Project Year 4. Thereafter, water savings would increase linearly so that by the end of Project Year 7 such losses would have been completely eliminated.

These project interventions do not directly address other aspects of the canal delivery efficiency, which account for an additional water loss of 14 percent. However, assuming that 14 percent of the water is lost by leakages and other related causes throughout the system, if improved management results in 60 million cubic meters of water no longer flowing out the end of the system, then the fraction of this amount that was previously lost by leakage would also be saved. Thus, there is a direct savings of 14 percent of 60 million cubic meters -- or another 8.4 million cubic meters of water per year. These savings would be achieved at the same rate as those above -- i.e., 50 percent achieved by the end of Project Year 4 and 100 percent by the end of Project Year 7. Total savings from increased canal delivery efficiencies attributable directly to improved management of ORMVAT perimeter are projected at 68.4 million cubic meters per year by the end of the project.

Water savings will be enhanced by the anticipated PAGI 2 interventions to be financed by the GOM and the World Bank. These interventions are to be directed at rehabilitating sections of the Tadla canal system and reducing losses from canal leakage. While PAGI 2

addresses field application efficiencies directly with infrastructural interventions -- e.g., gated pipe, field leveling, and use of siphon tubes -- the benefits from these improvements cannot be fully realized without the improved knowledge of crop requirements provided by the project intervention with automated meteorologic stations and the improved canal management.

With the project interventions and those of PAGI 2 in place, overall system efficiency in ORMVAT should be increased from 50 percent to about 70 percent -- with canal delivery efficiency at 90 to 95 percent and field application efficiency on the order of 70 percent. Slack believes that with such improvements, it is reasonable to attribute half the projected gain in field application efficiency to the PAGI 2 infrastructure interventions and half to the interventions under the project. However, it is doubtful that the PAGI 2 interventions in and of themselves would achieve any improvements in field application efficiencies.

If, after the projected water savings in the Tadla perimeter, net water flows into the two sub-perimeters remained at the current level of 931.8 million cubic meters per year and the canal delivery efficiency was 90 percent, then the amount of water arriving at the field level would be 836.6 million cubic meters per year. A field application efficiency of 60 percent would then mean that 335 million cubic meters per year -- 40 percent of 836.6 million cubic meter -- would be lost due to inefficiencies in water application at the field level. If this efficiency rate is increased to 70 percent, the loss is reduced to 251 million cubic meters -- i.e., a savings of 84 million cubic meters per year. If one attributes 50 percent of this cost saving to project interventions, then this savings would amount to 42 million cubic meters per year.

These savings, however, are projected over a longer time period than those for canal management savings. Slack estimates that 10 percent of the total could be achieved in Project Year 3 and that this savings would increase linearly to 50 percent of the field level cost savings by the end of the project. One hundred percent of projected savings would be achieved 15 years after Project Year 1, with annual linear increases from years 8 to 15. This longer period is necessary because the process of achieving higher field efficiencies is seen as more evolutionary -- i.e., it will involve a considerable number of changes in the way the ORMVAT and farmers currently interact and it presupposes a certain level of farmer responsiveness to new information.

Finally, the project interventions will save groundwater through improvements in the pumping and field application efficiencies. Given that the current groundwater use amounts to 160 million cubic meters per year and assuming no canal losses are associated with this type of water use, a current field application efficiency of 60 percent implies that 64 million cubic meters of this groundwater are lost to irrigation after being pumped to the field surface. An increase in field application efficiency to 70 percent would reduce this field loss to 48 million cubic meters per year -- i.e., a net savings of 16 million cubic meters per year, with 8 million cubic meters of this savings attributable to project interventions. The rate of achievement of these savings is projected to be the same as that for the field efficiency

savings of canal water above.

Annex H Table 1 presents a summary of projected water savings in millions of cubic meter by year.

2. The Value of Water Savings Compared with the Costs of the Project

The value of the projected water savings in the ORMVAT perimeter depends on how the water saved is actually used. Since experts believe that water has its highest average value per cubic meter in Morocco -- i.e., approximately 0.85 dirhams or $ 0.11 at the current exchange rate per cubic meter -- when used for irrigation purposes, this analysis confines itself to irrigation as the assumed end-use for water saved. However, within this end-use category, ORMVAT system managers would have the option of using in water saved within the Tadla perimeter in two ways: to develop new irrigated lands within the Tadla perimeter -- i.e., extension in the Dir area around Beni Mellal -- or to provide supplementary water allotments to existing irrigated fields.

Our working assumption in this analysis is that the marginal value of water applied on newly irrigated land is significantly higher than that of supplementary water allocated to existing fields. To illustrate this difference in our analysis, we have used 1.10 dirhams or $ 0.139 per cubic meter as the marginal value of water over the range in question when applied to new irrigation areas and 0.70 dirhams or $ 0.089 as the value of water applied to existing fields. Since the Tadla perimeter has approximately 6,000 hectares of land with irrigation potential remaining to be developed, we would postulate that the best use of the water saved would be in developing this area and that this infrastructure could be in place by Project Year 7. Therefore, after Project Year 7, we assume that 60 million cubic meters of the water saved by project interventions is allocated to 6,000 hectares of new irrigation and the remainder is used for supplementary allotments on existing fields. Based on these assumptions, Annex H Table 2 presents the value of projected water savings under the project. Annex H Table 3 presents a comparison of the projected benefits and costs of the project.

In the quantitative analysis, the value of the water savings was compared against the anticipated USAID grant investment in the project ($ 15.476 million) and against the total project cost stream -- i.e., USAID, GOM ($ 3.095 million) and private sector contributions ($ 0.775 million) to the project over seven years. This investment is projected to yield a total of $ 194.6 million in undiscounted benefits from water savings alone over twenty years from project initiation.

To add further reality to these figures, the working assumption was made that the GOM through ORMVAT would incur recurrent costs equivalent to $ 0.750 million per year after Project Year 7 to maintain the level of activities institutionalized by the project. The calculations were repeated taking these recurrent costs into account for Years 8 to 20 in the cost stream.

ANNEX H TABLE 1

YEAR FROM START OF PROJECT	WATER SAVING FROM IMPROVED SYSTEM LEVEL CANAL MANAGEMENT	WATER SAVING FROM IMPROVED FARM LEVEL WATER MANAGEMENT	WATER SAVING FROM IMPROVED GROUND-WATER MANAGE-MENT	TOTAL ANNUAL WATER SAVINGS
1	0	0	0	0
2	0	0	0	0
3	17.1	4.2	0.8	22.10
4	34.2	8.4	1.6	44.20
5	45.6	12.6	2.4	60.60
6	57.0	16.8	3.2	77.00
7	68.4	21.0	4.0	93.40
8	68.4	23.6	4.5	96.50
9	68.4	26.2	5.0	99.60
10	68.4	28.8	5.5	102.70
11	68.4	31.4	6.0	105.80
12	68.4	34.0	6.5	108.90
13	68.4	36.6	7.0	112.00
14	68.4	39.2	7.5	115.10
15	68.4	42.0	8.0	118.40
16	68.4	42.0	8.0	118.40
17	68.4	42.0	8.0	118.40
18	68.4	42.0	8.0	118.40
19	68.4	42.0	8.0	118.40
20	68.4	42.0	8.0	118.40

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ANNEX H TABLE 2

YEAR FROM START OF PROJECT	VALUE OF WATER SAVINGS FROM IMPROVED SYSTEM LEVEL CANAL MANAGEMENT	VALUE OF WATER SAVINGS FROM IMPROVED FARM LEVEL WATER MANAGEMENT	VALUE OF WATER SAVING FROM IMPROVED GROUND-WATER MANAGE-MENT	VALUE OF TOTAL ANNUAL WATER SAVINGS
1	0	0	0	0
2	0	0	0	0
3	1.52	0.37	0.07	1.96
4	3.04	0.75	0.14	3.93
5	4.06	1.12	0.21	5.39
6	5.07	1.50	0.28	6.85
7	6.09	1.87	0.36	8.32
8	9.09	2.10	0.40	11.59
9	9.09	2.33	0.45	11.87
10	9.09	2.56	0.49	12.14
11	9.09	2.79	0.53	12.41
12	9.09	3.03	0.58	12.70
13	9.09	3.26	0.62	12.97
14	9.09	3.49	0.67	13.25
15	9.09	3.74	0.71	13.54
16	9.09	3.74	0.71	13.54
17	9.09	3.74	0.71	13.54
18	9.09	3.74	0.71	13.54
19	9.09	3.74	0.71	13.54
20	9.09	3.74	0.71	13.54

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ANNEX H TABLE 3

YEAR FROM THE START OF THE PROJECT	USAID PROJECT COSTS	TOTAL VALUE OF WATER SAVINGS	NET BENEFIT STREAM FOR WATER SAVINGS
1	2.118	0	- 2.12
2	2.970	0	- 2.97
3	3.010	1.96	- 1.05
4	2.238	3.93	- 2.33
5	1.725	5.39	3.66
6	2.082	6.85	4.77
7	1.333	8.32	6.99
8	0	11.59	11.59
9	0	11.87	11.87
10	0	12.14	12.14
11	0	12.41	12.41
12	0	12.70	12.70
13	0	12.97	12.97
14	0	13.25	13.25
15	0	13.54	13.54
16	0	13.54	13.54
17	0	13.54	13.54
18	0	13.54	13.54
19	0	13.54	13.54
20	0	13.54	13.54

Note: To derive similar tables for the other options calculated, add $ 0.440 million per year to reflect GOM project costs and $ 0.111 per year private sector project costs during Project Years 1 to 7. GOM recurrent costs of $ 0.750 million per year should be added for Project Years 8 to 20.

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In the first case of USAID grant investment alone and without consideration of GOM recurrent costs, the present values of the net benefit stream discounted at 10, 20, 30 and 40 percent are, respectively $ 58.832 million, $ 17.203 million, $ 6.148 million, and $ 1.864 million. The internal rate of return on the investment was computed at 50.1 percent.

In the second case of total project investment and without consideration of GOM recurrent costs, the present values of the net benefit stream discounted at 10, 20, 30 and 40 percent are, respectively $ 48.1 million, $ 15.2 million, $ 4.6 million, and $ 0.6 million. The internal rate of return on the investment was computed at 42.8 percent.

In the third case of total project investment and with consideration of GOM recurrent costs, the present values of the net benefit stream discounted at 10, 20, 30 and 40 percent are, respectively $ 45.4 million, $ 14.3 million, $ 4.2 million, and $ 0.4 million. The internal rate of return on the investment was computed at 42.1 percent.

It appears, therefore, that the water savings to be derived from project Elements 1 and 2 are more than sufficient in themselves to justify approval and implementation of this project on economic grounds. This would be so even if there were to be no additional benefits forthcoming from project Elements 2, 3 and 4 -- which certainly will not the case as explained below.

Moreover, the projected net benefits from water savings alone provide a very substantial cushion for adding in a higher estimate of the additional recurrent costs to the ORMVAT incurred in assuming project activities over a twenty year period and/or lowering the assumed values for irrigation water applied to existing or new fields over the same period. Since essentially all of the technical personnel required to implement the project activities are already in place at ORMVAT, however, it is not anticipated that recurrent expenditures for personnel will be a very significant cost item. Some expenditures over time will be needed to replace and/or update system-level equipment, computer hardware and software and possibly to secure the services of Moroccan consultants for short-term special assignments at ORMVAT after the life of the project.

II. Assessment of Complementary Benefit Streams from Agricultural and Agro-Industrial Enterprises

The assessment above concentrated on the net benefits to be derived solely from water savings in the Tadla perimeter. The Element 2 and 4 interventions, however, are expected to have positive effects on other aspects of the regional economy. At least five other potential benefit streams were be identified by the design team. These potential additional benefits flow from:

- Cost savings from more efficient pumping and conjunctive use of groundwater;

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- Increases in net farm incomes derived from a gradual shift away from uneconomic industrial and food crops -- i.e., sugar beets, hard and soft wheats, cotton -- to higher value crops -- i.e., forages, fruits, vegetables, specialty crops -- in the Tadla perimeter;

- Efficiency gains and cost savings to be derived from increased private sector participation in agribusiness in the regional economy and privatization of inefficient government public and parastatal businesses;

- Efficiency gains and cost savings to the government from ORMVAT's disengagement from commercial activities and better management of its residual mandate; and

- Efficiency gains in PAGI 2 infrastructural investments derived from the complementary activities undertaken in the project.

As the internal rate of return calculations above already take into account the total USAID, GOM and private sector project investment costs -- and, in the third case, an estimate of the ORMVAT recurrent costs as well -- any quantifiable benefits from these additional benefit streams would have the effect of further increasing the economic attractiveness of the project.

III. Environmental Considerations

A. Economic Costs of Pollutants

Pollutants are unwanted outputs of agricultural and agro-industrial processes, generating costs defined according to several alternative accounting frameworks. Costs accrue to individuals directly, in the form of decreased availability or impaired quality of desired goods and services, or indirectly, through decreased production efficiency on farms, in agro-industrial plants and the economy at large. Certain categories of costs are reflected in market prices, while other very important costs are external to market systems.

A comprehensive sequence of costs recognizes avoidance costs, abatement costs, damage costs, compensation costs, and transaction costs. Avoidance costs are expenditures to minimize wastes and reduce risks of injury from pollutants. Abatement costs are remedial measures for pollutant removal and disposal. Damage costs are the adverse impacts on human health and the environment from pollutants which are neither avoided nor abated. Compensation costs are financial transfers to injured individuals, communities, and other industries for losses incurred because of pollutant injury -- sometimes classified as a particular form of damage costs. Lastly, transaction costs refer to expenditures by both industries and governments to monitor, evaluate, and respond to pollution problems -- e.g., costs of data management, enforcement of regulations, legal proceedings, adjudication, etc..

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Pollution costs are interrelated, such that increased expenditures in one category often reduce expenditures in other categories. Thus, increments in avoidance costs reduce abatement, damage, compensation, and transaction costs. Similarly, increased spending for pollution abatement decreases other types of costs down the line. From the perspective of national economic welfare, the objective is to minimize the sum of these combined costs.

Yet in practice, systems of complete cost accounting outstrip analytical capacity. This is explained by gaps in knowledge regarding pollutant dose-response relationships, incidence of cost bearing, behavioral adjustments in the presence of pollutants, and other essential informational requirements. These deficiencies are particularly pronounced in Morocco, where efforts to understand and control industrial pollutants are only nascent.

1. Framework of Pollution Costs

Among alternative frameworks for classifying the economic consequences of pollutants, a classification proposed by M. Freeman (Air and Water Pollution Control, 1982) has wide acceptance. Effects on living systems are distinguished from effects on non-living systems, and market effects are distinguished from non-market effects.

a. Effects on Living Systems (Biological Mechanisms)

- Human health (non-market) -- morbidity and mortality;
- Economic productivity of ecological systems (market) -- yields in agriculture, forestry and fisheries;
- Other alterations of ecological systems impacting directly on human activities (non-market) -- fishing, wildlife viewing, outdoor recreation and aesthetics; and
- Alteration of ecological systems with unknown consequences for human welfare (non-market) -- species diversity, ecosystem stability, weather and climate.

b. Effects on Non-Living Systems

- Industrial processes (market) -- corrosion and other materials damage, cleaning costs, waste storage, waste disposal and diminished product quality; and
- Residences (market and non-market) -- materials damage, cleaning costs and property values.

The composition and magnitudes of these impacts vary by economic structure and seriousness of pollution problems. Thus, in Morocco, it is possible that agricultural and agro-industrial pollutants cause sickness and shorten human life, reduce yields of commercial crops, corrode metals and masonry, destabilize aquatic ecosystems, lessen the

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enjoyment of outdoor recreation, and add to costs of maintaining factories and residences. Additionally, complex psychic costs and inconvenience costs are incurred by residents who may fear illnesses from pollution, and who adjust living and working patterns to reduce their exposure to pollutants. While each of these impacts can be hypothesized, the truly challenging issue is determining their relative importance and consequence.

2. Judgments About Importance of Agricultural and Agro-Industrial Pollutants

Reliable studies on the impacts and costs of agricultural and agro-industrial pollution are rare in Morocco. At this moment, therefore, the importance of different impacts rests mainly on informed judgment.

a. Human Health

In countries where research on air and water quality is advanced, most studies point to illness and premature death as a very large component of the social costs of pollution. For example, one estimating framework for the United States in the late 1970s indicates that reduced morbidity and mortality account for three-fourths of the benefits from improved air quality (Freeman op. cit.).

In the ORMVA Tadla, technicians and rural residents recognize pollution problems originating from agricultural enterprises -- e.g., aerial spraying of cotton, mixing agricultural pesticides and herbicides with water at farm wells or from drainage ditches -- and from agro-industries -- e.g., sugar mills -- in relation to contaminated groundwater. Water modification can have a direct effect on the incidence of diseases and parasitic infections, including bilharzia, typhoid, hepatitis, cholera, dysentery, and diarrhea.

Toxic and hazardous substances are also a major part of the potential health risks from agricultural and agro-industrial enterprises. Risk potential increases as a direct consequence of:

- Inappropriate procedures for preparing and applying agricultural insecticides, herbicides and pesticides;
- Concentration of salts and other chemical compounds through poor management of water and soil resources;
- Overuse of chemical fertilizers which contribute to nitrate accumulation in groundwater and surface run-off flows; and
- Accumulation of toxins and hazardous substances -- heavy metals -- in agro-industrial wastes and sludges.

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The precise roles of agricultural and agro-industrial pollution in Morocco are relatively unknown at present and local epidemiological work is not often able to separate the part played by specific pollutants from other causes of illness and death. Nevertheless, it is reasonable to assume that the variety of pollutants present in the ORMVA Tadla are important contributors to local health problems.

b. Productivity of Farming, Forestry and Fisheries

This category refers to either natural or cultivated ecological systems which produce products sold in markets. Pollutants affect the biological productivity of these systems, and thus the price and supply of their products.

Sulfur dioxide and photochemical oxidants -- e.g. ozone -- are linked with various types of leaf damage and reduced photosynthesis in agriculture and forests. There may also be a long-term reduction of productivity due to increased soil acidity from "acid rain". The true nature of these relationships is highly controversial even in industrialized countries, and barely studied in most developing countries. In Morocco, the primary source of photochemical oxidants is probably motor vehicles, rather than agricultural enterprises and agro-industries.

In all likelihood, most damage costs to commercial eco-systems are through water pollution. Heavy metals, PCBs, acids, organic compounds and other toxic agricultural and agro-industrial wastes can reduce or eliminate populations of commercially valuable fish and shellfish -- e.g., oysters, shrimp and lobsters -- in estuarine areas. Other aquatic species can be rendered unfit for human consumption because of both chemical and bacterial contamination. Additionally, wastes from agro-processing industries generate high biological oxygen demand. This reduces and simplifies food chains for fisheries, further undercutting their productivity.

c. Other Effects on Ecological Systems

This refers primarily to outdoor recreation and aesthetic appreciation in relation to air and water quality. Some costs of dirty air and water are reflected in markets, including reduced revenues from tourism, and lessened property values for recreational sites. Other costs are mainly psychological in that the individual derives less satisfaction from outdoor experiences than would be possible in a cleaner environment. Other impacts relate to changes in ecological diversity and stability, including the prospect of species extinctions in polluted ecosystems. In Morocco, the magnitudes of these effects -- and the relative contributions of agricultural and agro-industrial pollution in explaining them -- are well beyond present knowledge.

d. Costs to Agricultural Enterprises and Agro-Industries

Pollutants in air and water raise the costs of production in a variety of ways. They reduce net profits or cause increases in the product prices to consumers. An example is the effect of nitrate pollution in river flows entering water treatment plants downstream from ORMVA Tadla on the costs of providing safe domestic water supplies for consumers in the Casablanca/Rabat urban area. Similarly, air pollutants may cause physical deterioration of zinc roofs, painted surfaces, rubber and elastomers, electrical switches, textiles, and other materials. Finally, suspended particulates in either air or water can increase production costs in many industries where special cleaning equipment must be used before these resources can be use in the production environment.

e. Costs to Residences

Besides their joint role in combination with other risk factors in subjecting household dwellers to greater probabilities of poor health, pollutants add to cleaning burdens and materials damage in residences, just as in industries. Moreover, homes and lots in heavily polluted areas normally have lower property values than homes and lots in lightly polluted areas, all other factors remaining the same. These effects have yet to be studied in detail in Morocco.

B. Economic Implications of Pollution Control Policies

Significant gaps were found in pollutant monitoring, regulation -- e.g., for toxic and hazardous wastes and groundwater protection -- and enforcement provisions in the ORMVA Tadla area -- and in Morocco, generally. For example, requirements for agro-industrial discharge controls are underdeveloped, penalties for pollutant generation are unenforced or non-existent, and government staff resources to oversee the legal and regulatory structure are insufficient, particularly in rural areas. To the extent that a system for pollution management exists, it relies almost entirely on legal and regulatory instruments, with very little emphasis on voluntary and market-based approaches.

The present project will support a range of monitoring studies and policy analyses to identify how policies on agricultural and agro-industrial pollution can be improved. To complement legal and regulatory approaches, the project will also give attention to voluntary and market-based efforts. Among the policy and abatement reforms most urgent in the short term are:

1. Gaps in Regulations Pertaining to Toxic and Hazardous Wastes and Groundwater Protection

There are few market approaches to control disposal of toxic and hazardous substances or to protect groundwater. For toxic and hazardous wastes, instruments developed will include regulatory improvements, examination of the financial feasibility of private/public cost-

sharing in treatment and disposal facilities, and meeting the operational costs of pollution abatement measures through a system of user charges.

- Voluntary Pollution Reductions

One of the least-cost strategies to reduce agricultural and agro-industrial pollutants is voluntary action motivated by economic incentives, good will, or both. Economic incentives for the installation of pollution control equipment might be advanced by tax credits or exemptions from tariff duties. This could be combined with a graduated system of effluent charges to make it costly not to install such equipment.

- Distribution of Authority and Budgets Among National, Regional and Local Governments

While the national government is charged with pollution control and abatement policies and regulations, local government units are often charged with implementation and enforcement. Provision of trained staff and other resources at the local level is necessary if the objectives of any national strategy is to be enforced. Another problem is that programs that exist are scattered among several agencies. This further complicates data compilation on key variables which adversely affect the environment.

- Policies on Fees and Penalties for Non-compliance with Pollution Regulations

An important policy issue to be evaluated is whether or not the fee and penalty structure in place needs revision in light of its deterrent effects, administrative efficiency in fee collection and penalty enforcement and end use of revenues, and several other criteria. Such evaluation may lead to revised fee structures or policy alternatives to fees and penalties.

- Market-based Instruments for Management of Agricultural and Agro-industrial Pollution

In market-based approaches, the emphasis is not so much on legal restrictions as on economic incentives. Alternative market-based incentives include effluent charges, taxes on agro-industrial products, marketable discharge permits, and deposit-refund programs. These and other economic instruments should be compared to determine the choices of market-based incentives for pollution reduction in Morocco.

The economic benefits of the project's environmental component cannot be estimated ex ante in quantitative terms. It should be possible, however, to define categories of benefits and costs as the Element 3 interventions are initiated and refined. Although, the economic benefits of the environmental component are not incorporated in the present discussion of project benefits, it is certain these interventions have the potential for substantial contributions to allocative efficiency and distributional equity.

ANNEX I

ANNEX I

Social Soundness Analysis

The social soundness analysis is organized around three distinct but related aspects. The first is the compatibility of the project with the socio-cultural environment in which it is to be introduced -- i.e., its socio-cultural feasibility. The second is the likelihood that the new practices or institutions introduced among the initial project target population(s) will be diffused among other groups -- i.e., the potential spread effects. And, third, the social impacts or distributions of benefits and burdens among different groups, both within the initial project population(s) and beyond.

1. Socio-Cultural Feasibility

a. Who Lives Where?

The ORMVAT currently has irrigation water delivery and/or agricultural extension responsibilities for farm families on 325,067 hectares of agricultural and grazing land in the Tadla plain. According to the most recent information (ORMVAT, 1991), there are 27,916 farm families in the Beni-Amir and Beni-Moussa irrigation sub-perimeters. During the 1989/1990 summer and winter seasons, they planted crops on 114,334 hectares. In addition to farming community in the irrigation perimeter, there are 26,646 farm families in the area outside the two irrigation sub-perimeters, but within the total ORMVAT area. They have rainfed crop and livestock enterprises on the remaining 210,773 hectares.

The ORMVAT area comprises portions of the Provinces of Beni Mellal and Azilal, with 13 rural communes and the 5 major towns of Fkih Ben Salah, Souk Sebt, Beni Mellal, Ouaouizerth, and Bzou. The total population of the ORMVAT area is estimated to be 424,000, of which 318,000 are classified as rural inhabitants and 106,000 are urban dwellers. If all rural inhabitants were also enumerated as members of farm families within the ORMVAT, then the average size of a rural family would be approximately 6 persons. The overall population density was 118 persons per square kilometer in the Tadla at the last population census.

According to statistics from the Ministry of Health office in Beni Mellal, the population in the ORMVAT is quite young, with 42.8 percent being less than 14 years of age, 20.5 percent being between 15 and 24, 17.1 percent between 25 and 39, 13 percent between 40 and 59, and 6.6 percent being over 60 years of age.

For reasons of forced displacement during the colonial period and in and out-migrations since then, the farming population of the ORMVAT perimeter is quite heterogeneous. Prior to initiation of irrigated agricultural activities in the early 1930s, the dominant tribal confederations on the Tadla plain were the Banu Amir and the Banu Moussa. These peoples, due to their soldier -- Guich -- status vis-a-vis the Moroccan ruler, had collective

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access and usufruct rights to the land on both sides of the Oum Er Rbia river.

With irrigation in the Beni-Amir sub-perimeter, the tribal confederations lost many of their land use rights and were effectively excluded from much of the irrigated area through colonial decree and private "land sales" to outsiders -- colonialist and Moroccan. In the 1990s, however, the tribal confederations still have influence in the ORMVAT, with the eastern and western fractions of the Banu Amir tribal confederation having their headquarters in Fkih Ben Salah on the right bank of the Oum Er Rbia river and the several major groups of the Banu Moussa having their center in Souk Sebt on the left bank. Only in parts of CMVs 507 and 509 do members of the Banu Moussa inhabit the right bank of the river. Both confederations descend from the Hilali Arab invasion of Morocco in the 12th century and both were given collective lands in the Tadla by the Almohade Dynasty.

Most of the population of the perimeter is said to be of Arab origin but, in the eastern part of the perimeter against the foothills of the Middle Atlas mountains in Azilal Province, three CMVs -- i.e., 525, 529 and 532 -- have largely Berber populations. Most of the inhabitants are from the Ait Atta tribal fraction; but, close to Beni Mellal, there is a significant population of Berbers of the Ait Rbaa fraction.

Ethnicity is a mediating factor which has determined administrative jurisdictions within the Tadla -- i.e., there are rough correlations between tribal/fractional distributions and the delineation of Cercle/Commune boundaries -- and affected patterns of association and cooperation.

b. How Are They Organized?

The core operational objectives of the project are to, first, evaluate and then affect changes by participants in the management of resources -- primarily water and land -- in Tadla in the context of a more open Moroccan economy. In this regard, it is essential to have or to develop an understanding of who the landowners and agricultural operators are within the Tadla irrigated perimeter and how they organize their activities. This is so because owners and operators of land in the perimeter are -- in matters concerning them -- simultaneously interlocutors with the State and direct actors in resource management.

Any meaningful discussion of resource allocations within the Tadla must start from a very detailed base of current information about property ownership and actual management of agricultural enterprises and household activities. Unfortunately, at present, this is the area of greatest weakness in the existing literature. Detailed farm-level information of the kind needed to assess and recommend changes in resource allocations is simply lacking for the Tadla perimeter and, while the reasons for this lack can be explained, the deficiency could not be remedied in the course of the project design exercise. The only alternative was to design a series of diagnostic studies into project implementation and this has been done for all 4 Elements of the project.

The information problem at present stems essentially from the approach adopted by the GOM over the past three decades toward agricultural enterprises in all of the nine large-scale Moroccan irrigation perimeters. During that period, the practical reality was that the Moroccan government was not overly concerned about how farm families actually organized themselves because the central thrust of irrigation policy was to narrow -- and, to the extent possible, eliminate entirely -- the range of possible management options open for farmer decision-making. In a very real sense, the Moroccan government sought to intervene so massively in the technical, economic and social operations of the large-scale irrigation perimeters that critical resource allocation decisions were essentially taken by the State on behalf of the farming community, not in collaboration with it or by the farmers themselves.

The Moroccan model for large-scale perimeter development entailed a very high level of internal technical rationality and coherence which made it intellectually very appealing to the government engineers who designed the physical infrastructure and largely ran the agricultural operations. The "solutions" it proposed for agricultural production problems were elegant in concept and obeyed a compelling internal technical logic. Unfortunately, those same solutions essentially ignored the farmer as a legitimate participant in decision-making processes and the complexities of his situation. The working out of the model also led to persistent attempts to make local market operations and the general economic environment conform to an idealized technical solution for large-scale irrigation perimeters, instead of adapting the model(s) employed to the economic realities faced by farmers and/or Morocco in general.

The large-scale perimeter model sought to coherently link the size of irrigation systems, the precise layouts of fields within irrigation blocks, the selection of specific crops and crop rotations, and the location of agro-industrial enterprises servicing the agricultural producers. As a result, the model generated a strong internal propulsion toward highly centralized management which was seen as the only way to ensure systems worked efficiently.

The magnitude of the public investments expended in creating and running the irrigation systems reinforced the government's perceived need for centralized authority. And, as a consequence, many obligations were imposed on farmers in the guise of a "moral contract" between them and the government to produce for the good of the Moroccan "public". The responsibilities of the parties to the "contract" were spelled out precisely in the Agricultural Investment Code of 25 July 1969. The crop rotations, production norms, and cultivation techniques were established by annual decrees published in the GOM's Official Bulletin. They were mandatory for all farmers and carried graduated sanctions -- including expulsion from their land -- in the event they were violated.

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The operative irrigation model assumed an ideal type of operation in which:

- A farm unit of, at least, five hectares was to be maintained as the minimum economic unit for a Moroccan farm family and sub-division below this size by either sale or successional division was prohibited by the law;

- A unified farm plot was to be operated as a single enterprise, and mandatory land consolidation of parcels was implemented to reassemble properties in a geometric layout;

- A balanced mixed farming operation was to be maintained, where crop and livestock enterprises were closely integrated; and

- A stable farming operation was to be managed by the owner or under a regulated term lease.

Under the operative model, the government did almost everything in the large-scale perimeters. It conceived, constructed, operated and maintained the on-site and off-site infrastructure used in irrigated production. It chose the crop rotations for the farmers and imposed crop and irrigation techniques on them. It distributed irrigation water on a regulated seasonal schedule and established the unit price for this water. It granted agricultural credit through public financial institutions and bought, transported and processed the crops for fixed prices. And, finally, through agents at the processing plants, it deducted farmers' credit reimbursements from the crop payments due to them before they received net payments.

Implementation of such a techno-economic irrigation model obviously provided neither encouragements nor incentives for government officials to view farmers as legitimate participants in the process of discussion and formulation of perimeter activities or to investigate how farm enterprises actually functioned in the perimeter. To the contrary, as the model proved itself increasingly fragile in implementation because there were simply too many factors for any centralized management to control, many officials perceived their institutional roles as defenders of the system. They spent little or no time investigating actual farm conditions – or why the model was not yielding the results anticipated.

The "model" experiment of the last three decades explains in large measure why there is currently such a paucity of detailed farm-level information. Most "farm-level" information recorded at the ORMVAT through the 1980s reports on "actual" agricultural production for the "major" crops vis-a-vis the plan targets for the 26 CMVs in the perimeter, accompanied by explanations as to why targets were or, more often, were not attained.

The same type of informational deficiencies apply to questions of land ownership and tenure in the perimeter. It is evident in discussions with ORMVAT staff that government land titling agencies do not always know precisely how many rightful owners there actually are

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for any given farm parcel, although nominal ownership is usually ascribed to one owner. On the 94 percent of the land which is privately owned -- nearly always in joint ownership -- government officials are often unaware of how each property is actually sub-divided among co-inheritors and who among these individuals and other non-owners actually works the land.

In the case of irrigated land, this lack of precise information is detrimental for a number of reasons. First, after consolidation, the overall layout of plots within an irrigation block -- with its geometric precision and alignment -- gives a false impression of orderliness when in reality agricultural production enterprises may be scattered among several parcels. Second, the ownership and management functions with respect to any particular field or crop enterprise actually be divided among several different persons making agricultural innovation difficult. And, third, technical operations within the perimeter are still based in large measure on the facile assumptions of complete respect for the system's original development model -- i.e., minimum size of properties, plot operations which respect certain cropping patterns and rotations, etc. -- even though everyone acknowledges informally that the underlying organization of plots and farm resource allocation patterns are not and effectively cannot be respected.

Despite the undeniable technical successes Moroccan engineers have attained in capturing and controlling water deliveries in the ORMVAT perimeter, the overall large-scale perimeter model bears little resemblance to what is actually happening in the perimeter and therefore rarely attain its stated objectives. This is so in many instances because the theoretical layout and operations of plots within a block does not correspond at all with the realities of farm-level operations. Farm operations are very often smaller than anticipated by the model -- i.e., surveys show that the average farm holding has only 4.26 hectares and 47.5 percent of all farms have less than the minimum 5 hectares. The sub-division and amalgamation of plots, by covert private sale and because of inheritance laws, continues apace. Moreover, actual field operations are not always perpendicular within a block as anticipated by the model and many fields are planted to more than one crop in violation of the anticipated rotation. For all these reasons, the anticipated scheduling of water deliveries to farms based on fixed crop rotations and the water requirements of specific crops under specific cultivation techniques cannot be respected in reality. And, to their credit, ORMVAT system managers have finally recognized this fact and started to modify the water delivery system to accommodate the needs of the farmers but many more modifications are needed -- as detailed in the description of Element 1 activities -- before the system can be fully responsive.

The system described above pertains most directly to the 71 percent of the perimeter land -- i.e., the 68,787 physical hectares -- in 21,396 parcels controlled under private ownership. The variances from the irrigation model are even difficult complicated on the 14,818 hectares and 963 parcels -- 15 percent of the total -- of state land operated by parastatal enterprises, experiment stations and agrarian reform cooperatives and the 13,704 hectares of land in 486 parcels operated as collective or habous lands. In the former case, the

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majority of the land is operated in large blocks under a unified management and in the latter the land is often leased out to large investment companies for pivot irrigation using water from boreholes. In neither case does actual land management and resource allocations correspond with the theoretical irrigation model.

All of the above, explains, in some measure, why there is not a great deal of useful information available on farm-level organization and why the generation of such information early in the project is of critical importance to the success of project activities. Equally important, the discussion shows why working in Tadla will be such an interesting and stimulating undertaking in the 1990s. GOM decisions taken at the end of the 1980s to revamp the most fundamental elements of its policy toward the large-scale irrigation perimeters will inevitably lead to truly massive reorientations in ORMVAT and GOM thinking and to much improved prospects for meaningful interactions with farmers and other representatives of the private sector. The project Elements have been designed specifically to assist with this reorientation process and to make the policy changes concrete realities in Tadla.

Now that the GOM has adopted a disengagement policy and the ORMVAT is pulling out of commercial agricultural activities in the perimeter, it is important that this disengagement be accompanied by the development of new institutional working relationships which finally understand and address farmers' constraints and needs.

c. Allocation of Time

So little is known about how farm families in Tadla presently make their resource allocation decisions that speculation on how they might respond to project activities over the next seven years might appear somewhat specious. However, judging by the changing patterns in crop production and agricultural practices recorded in the 1980s, one can already conclude that Tadla farmers are highly knowledgeable about and responsive to economic opportunities and technological innovations -- i.e., paprika peppers as a new crop or use of well water in conjunctive use with water from the gravity system -- they perceive to be in their own interest. Conversely, experiences in the perimeter have shown that farmers will actively resist external attempts to impose changes -- i.e., replacement of the traditional robta irrigation system with furrow and siphon systems, increasing cotton cultivation during the summer season, imposition of fixed crop rotations -- where they believe technical and/or economic conditions do not justify such changes.

Beyond adoption choices based strictly on the objective characteristics of the process or technology in question, there are certain factors which may affect the responsiveness of certain farm groups within the perimeter to innovation. Farm size and the relative degree of dependence on farm production for family subsistence clearly varies widely within the perimeter. Almost one-half of all farms in the perimeter control less than five hectares of irrigable land and many people have expressed the belief that, as farm size in hectares declines below this size, the farm family's dependence on farm production for subsistence

needs increases to the point where such families have an inherently lower capacity to respond to economic changes or to adopt new technologies.

This type of statement can certainly be formulated as a valid hypothesis for testing under the project's Element 2 intensive farm management study but it is far from a proven fact. The conventional wisdom on this issue could easily be proven wrong if, for example, intensive diagnostic efforts documented that families on very small farms receive large inflows of funds from family members working in off-farm employment and were willing and able to use some of these funds for modernizing farm enterprises and/or relieve pressures to grow subsistence crops. In these situations, families on small farms might actually prove to be less risk averse than those on larger holdings.

Moreover, in irrigated areas with a large range of possible crop and livestock enterprises operating under open market conditions, there is often no reliable correlation between size of land holdings per se and the size and/or profitability of the farm business. Not only is it not true that larger farms necessarily have higher net farm revenues and, hence, profitability than smaller farms, it has often been found that the opposite case is true -- i.e., because of the constraints they face, families on smaller farms operate their enterprises more intensively, allocate their resources more efficiently, and grow higher percentages of high value crops in rotation than on larger ones. Suspicions of this sort are certainly relevant in Tadla, where virtually every technician and extension agent interviewed was of the opinion that the largest farms, run by public and parastatal agencies and/or under collective arrangements, were the least efficient allocators of resources in the perimeter and the most unprofitable in terms of enterprises undertaken.

Further to this point, interviews, particularly with government officials, often uncover very specific views on gender roles in agricultural enterprises and participants often proceed from these statements to assumptions about how males and females benefit differentially from on-farm enterprises. Women are often said to benefit most from livestock enterprises -- particularly dairy enterprises -- and less from crop enterprises. Further, because most ORMVAT extension agents are male and tend to directly relate more to male farmers as the ascribed "heads of household", it is usually assumed that women necessarily have diminished -- or even no -- roles in farm family decisions on resource allocations.

These stereotypes are reinforced in many discussions with expatriates by facile assumptions about how Islamic societies function in comparison to "western" societies. Often with the added assumption that Islamic inheritance laws necessarily lead to directly to the fractionalization of land holdings to the point where farms become too small to be viable economic units. Such comments of course carry with them the implicit assumption that Islamic societies are, by their nature, so rigid that they have not developed any alternative mechanisms for dealing with these fundamental problems.

All this is by way of reiterating the fundamental need for intensive work at the farm-level

to understand the roles of all family members in decision-making and for flexibility in determining what specific interventions will be designed, tested and disseminated at this level. It also reinforces the project design decision to mainline all project activities in the initial stages of project implementation. At present, project activities are seen by the team to be sufficiently gender-neutral and broad in scope to offer equal opportunities to all potential participants. However, if and when gender discrimination is documented as a specific factor in denying group access to project activities and/or specific activities are shown to favor certain participants unfairly over others, enough flexibility has been built into the processes for designing and implementing project activities to allow substantial reorientations in approaches and resource allocations.

d. Motivation

Farmers and other groups in Tadla will respond to the incentives provided by GOM policy changes and project activities to the extent they perceive benefits for themselves from the changes and activities. Conversely, they will respond to the extent that they see negative consequences to inaction on their parts. This is important in the current situation because various actors are responding to positive and negative stimuli in differing degrees.

For example, farmers in Tadla are already changing their specific crop enterprises and rotations and on-farm practices in response to both positive incentives -- e.g., the emergence of the paprika pepper opportunity -- and goads to greater efficiency -- i.e., elimination of government subsidies on inputs and fixed prices on certain outputs, ORMVAT/parastatal withdrawals from commercial activities. There is no reason to believe that the same mix of positive and negative incentives will not affect farmer responses to the technological and institutional innovations proposed under the project.

At the ORMVAT-level, staff are -- and will increasing be -- reacting to both positive and negative incentives. It is clear, for example, that pressures from the national level are increasing for the ORMVAs to accelerate their disengagement from commercial activities and to develop innovative methods for involving farmers and other economic actors in decision-making about water deliveries and agricultural extension needs. At the same time all ORMVA staff are feeling the spur toward improved performance, in the Tadla case, they are also looking forward to the technical assistance, training, new equipment and methods, etc. to be provided under the project as positive incentives for upgrading their individual and collective capacities, changing outdated work habits, and revamping unsuitable ORMVAT/client relationships.

Private commercial entrepreneurs and firms will participate in the Tadla economic transition to the extent they can identify and profit from new business opportunities. The project will seek to work with these economic actors to jointly test and disseminate new agricultural technologies for farmers, evaluate new market opportunities, and train staff in improved business management.

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e. Minimum Participator Profiles

Activities in this project cover such a broad range that it is extremely difficult to define a minimum participator profile that would apply in all cases. With respect to on-farm activities, the initial assumption used was that full-time farm families having between 3 to 10 hectares of irrigable land would be the primary beneficiary group. This appears to be the group most likely to have already been affected by the policy changes the GOM has made -- i.e., subsidy reductions, market liberalization, withdrawal of ORMVAT commercial services -- and most likely to benefit from improved water deliveries and other innovations under the project.

The major unknown with respect to farms having less than 3 hectares is the origin and status of financial and other resource flows to and within the households. If it can be verified that these families receive significant amounts of money from off-farm sources and can secure farm labor on demand, it is possible that they may be highly responsive to new opportunities -- particularly with respect to more economic use of agricultural inputs and initiation of new crop enterprises. They would also appear to be the operations most in need for private custom services for mechanical operations like plowing, secondary tillage, and harvesting. Conversely, they are probably not good candidates for adoption of custom micro-irrigation systems and/or installation of more efficient pumping equipment to facilitate the conjunctive use of ground and gravity water.

At the upper end of the farm size classifications, most of the land in question is held and/or operated by public and parastatal agencies or in collective arrangements. In the former case, more reliable access to irrigation water will probably be the most effective way of influencing a supply response. Beyond that step, these farms have sufficient access to credit, input supplies, and technical consultants to plan and implement changes in farming operations without extensive support from the project. Whether or not they will make such changes -- after water deliveries improve -- has more to do with what they perceive to be their "moral" responsibilities vis-a-vis the government than it does to lack of resources. Because this "moral contract" philosophy plays such a large role in the decision-making of these agencies, they may end up as the main Tadla producers of sugar beets and cotton long after the smaller, private farms have shifted their enterprises toward more profitable crops.

With respect to the lands under collective arrangements, there appear to be two different approaches. One is to continue the current process of establishing long-term leases with private companies to develop and manage the collective land using water from boreholes and capital-intensive pivot irrigation technology in return for some benefit sharing arrangement with collective members. The other is to find ways of effectively privatizing the land holdings and giving titles to individual farm families.

In the first instance, the large private pivot operations are effectively beyond the influence of most of the interventions planned for the project. In the second, the process is already converting institutions like the agrarian reform cooperatives into less restricted associations

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of farm families, each with title to their land. In this status, the households in the cooperatives may not be very different from other private land owners in their responsiveness to the project.

Finally, with respect to the environmental activities under Element 3, there appear to be no minimum requirements for participant participation. Since all parties in the perimeter appear to contribute to the existing pollution and resource misuse problems observed, all should have, at least, the potential to contribute to the process of mitigating – and, in some case, eliminating – the problems. And, project activities are designed to generate recommendations for improved environmental management at all levels in the perimeter.

f. Matching Participators and the Project

While the vast majority of Moroccans in Tadla will benefit in some measure from project activities, some groups have the potential to benefit more than others. The major beneficiaries have been identified above and in Section 3 of this Annex and in the Economic Analysis (Annex H).

Two groups which stand to benefit indirectly from project activities are seasonal migrants who come into the area to participate in agricultural activities and the populations living downstream from the Tadla. The first group may derive significant employment benefits over a larger portion of each agricultural year as cropping patterns shift toward more labor-intensive crop enterprises. The second group will benefit primarily from project activities which affect the quantities and quality of water available for use downstream.

A certain number of individuals within the perimeter will definitely not benefit from the project and may be adversely affected by the broad policy changes initiated by the GOM and supported by the project. These include employees of public and parastatal agencies within the perimeter – i.e., sugar mills, cotton ginneries, input suppliers operating under government contracts, certain ORMVAT staff – whose essential functions will be reduced and/or eliminated in the disengagement process. Many of these people, because they possess valuable skills and experience, may in fact find employment in the private sector or in other government positions but all will experience job dislocations and possibly loss of status in the transition period.

g. Obstacles to Progress

There do not appear to be any insurmountable obstacles to progress for the project as designed. But, there definitely are sensitive issues to be monitored and resolved during project implementation. These revolve around the interrelated problems of a legacy of paternalism, problems with the "industrial" crops, and problems in assessing the benefits and costs involved in the GOM's disengagement/decentralization process.

Since 1986, the GOM has embarked on a process of economic policy change, it has already

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significantly affected power relationships in the Tadla. It must be recognized that this process has been -- and will continue to be -- politically and economically painful for many stakeholders in the previous system. Moreover, the psychological transition from old to new working relationships between ORMVAT staff, farmers and representatives of the private sector is far from over and has been disturbing for many participants.

In a very real sense, both groups find themselves caught between a comfortable and established system of privileges and responsibilities that is disappearing and a new economic system in which their roles, if any, are uncertain or ill-defined. One measure of the effectiveness of the government's economic reorientation efforts to date is that so many groups in Tadla feel uncomfortable in the face of the changes, but this is cold comfort for those who stand to lose real power -- mainly government officials, managers and staff of public and parastatal agencies -- or for those who must manage the transition process so as to avoid serious dislocations in the rapidly changing environment.

In Tadla, there is a constellation of stakeholders whose positions and power are intimately tied to continuance of the local sugar beet and cotton industries. In the past, government attempts to promote production of these two crops have led to development of significant infrastructure and employment and, as important, have altered economic relationships between farmers and the government officials managing these industries. Economic liberalization and the disengagement process have struck at the heart of these relationships. They have broken the essential linkages that shaped the control relationships and, simultaneously, saddled the government with the costs of infrastructure and institutions whose value is declining with each passing year.

As a consequence, it is not surprising at this stage that many of the stakeholders in the old system are the first to raise arguments against the changes underway and make paternalistic statements about the alleged benefits of a declining system for farmers and other groups in Tadla. Many of these comments, although perhaps voiced for the wrong reasons, address real problems that remain unresolved. For example, how can the government handle the transition if it has to effectively write off investments over several decades in the sugar beet and cotton industries? Or, what will be the real balance of political and employment gains from new agricultural enterprises in Tadla versus losses from old industries? And, finally, how will the transition to a new set of political and economic relationships be handled so as to avoid adverse consequences for major constituent groups?

The underlying struggle to resolve these issues affects fundamental political and economic relationships at all levels in Tadla -- as elsewhere in the country. And, because the project seeks to assist in the process, it will inevitably be affected by it. The prospect of delays in realizing significant progress -- particularly with respect to Elements 2 and 4 -- cannot be discounted. And, only time will tell how strong is the resolve of the government in actually implementing the policy changes it has already announced.

h. Communications Strategies

The rationale for the GOM's irrigation model in the past was to impose a comprehensive technical package of irrigation management and agronomic practices on farmers. Most of the difficulties encountered in this approach can be attributed to three basic flaws in the system. First, communication patterns with farmers either individually through the extension mechanisms or in groups through the organizations the GOM created – i.e., cooperatives, professional associations, etc. – were one-way. They served only to communicate government decisions and demands to the farmers without recognizing farmers as legitimate participants in a decision-making process and failed completely to take into account the constraints under which farmers had to operate in the perimeter. Second, the model precluded any effective role for other private sector actors, except as contractors in state-run operations. And, finally, the whole system ran on a set of false economic signals devised by the government and communicated to farmers through a closed market system.

Disengagement will permit farmers and technicians far greater latitude and provide real incentives for both groups to actively foster new economic opportunities within the perimeter and adoption of improved irrigation/cropping practices. The activities designed under project Element 2 will identify critical constraints in farm-level resource allocation and specify pilot interventions which will be tested on-farm to alleviate these constraints. An examination of existing dissemination mechanisms, both formal and informal, suggests they are appropriate vehicles for disseminating results of project efforts. Their effectiveness has been compromised largely by previous restrictive policies. Mechanisms for disseminating project results have been described in the Implementation Plan and this analysis sees no real constraints to their success, if they are carried out in the new spirit of partnership and liberalization.

2. Spread Effects: The Diffusion of Innovations

a. Leadership/Authority

In a formal structural sense, the primary responsibilities for evaluating the results of project activities and disseminating them within the irrigation sub-sector will lie with government officials in the ORMVAT and the MARA. In the present network of nine ORMVAs, each is geographically-defined and faces a different constellation of problems. Each has different methods of addressing its problems, employs different types of irrigation and agricultural technology, and interacts with different client groups.

Since the team necessarily confined its design activities to the ORMVAT, it is difficult to assess the potential relevance of any single project intervention to the other ORMVAs at this time. Presently, it would appear that technical system and farm-level activities in Tadla will have their greatest relevance to those parts of the other ORMVAs where gravity irrigation is practiced. If effective methods are developed in Tadla to manage the conjunctive use of ground and gravity system water, this would be another area of potential

relevance. And, of course, work with more effective use of agricultural inputs for specific crops may have important carryover effects in other ORMVAs.

But, beyond the technical aspects of the project, it would appear that project efforts to develop and implement new working relationships between ORMVAT staff, farmers, and other representatives of the private sector would hold out the greatest possibilities for diffusion and adoption in the other ORMVAs. Prospects in this regard will be strengthened by the working relationships which have been established with the MARA/World Bank projects. These projects, after 1993, will be working with all of the nine ORMVAs on redefining operational roles and improving ORMVA management practices. To the extent that project activities in Tadla generate findings, recommendations and innovations applicable to the problems in the other ORMVAs, it has already been agreed that the projects will work together in disseminating results within the network.

In addition to the ORMVA network, results from the environmental activities under Element 3 will be disseminated through the network of agencies established during project implementation. In addition to MARA, the network will have participation from agency staffs from the Ministries of Public Works and Health.

Within the project itself, a number mechanisms are envisaged at the regional and national levels to disseminate project results and to discuss common problems. First, the project, in collaboration with the SVOP of the ORMVAT will produce and distribute technical papers in French and Arabic to all interested parties. Second, if a regional radio network for agricultural news and commentary is established, the project will supply materials for broadcast. Third, a number of regional and national workshops and seminars will be supported by the project as a forum for discussions and dissemination of project results. And, finally, standard agricultural extension techniques -- farmer field days, observational tours, audio-visual presentations, etc. -- will be used in Tadla.

b. Patterns of Mobility

The Tadla area is served by an excellent network of paved roads. These roads link the area to all the major cities in the central plain -- i.e., Fes and Meknes in the north, Marrakech in the south, and Casablanca and Rabat to the west. The area also has excellent information system links with the rest of Morocco and other countries via telephone and telex, and postal facilities. There are no major impediments to the circulation of people and information within the area or with other areas.

c. Effects of Previous Projects

USAID, to the design team's knowledge, has never had an agricultural or natural resources project in the Tadla area. The only major donor assistance to the ORMVAT in the recent past has come through the MARA/World Bank PAGI 1. Activities under this project were directed at improving the management of the ORMVA network throughout Morocco in

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support of the objectives of the GOM's Structural Adjustment processes at the macroeconomic and sectoral levels. GOM/World Bank experiences under this project were sufficiently encouraging to lead to the development of the two new irrigation sub-sector projects described elsewhere in this paper.

3. Social Consequences and Benefit Incidence

Farm families in the Tadla perimeter will be the principal project beneficiaries. Improved water management will result in better allocation and timing of water deliveries in response to farmer-generated demands. Farmers will benefit from agronomic packages to be introduced by the project. Abrupt disengagement of the ORMVAT from its previous functions, without the innovations planned under the project, would probably threaten farmers' well-being more than it would enhance their economic prospects.

The GOM has set a priority on the creation of job opportunities in the private sector. The confluence of the project and disengagement activities offers new opportunities to young entrepreneurs who deal in custom services to farmers. Few of these business operations presently exist in the perimeter, but project activities under all Elements will assist in identifying and promoting such opportunities.

Families in both urban or rural areas within the perimeter and downstream of it should benefit from Element 3 environmental monitoring and other activities which will protect their water supplies from pollutants and toxic agro-chemical residues. Information and education on management and storage of toxic products provided through the new regional environmental network will reduce the risks of health hazards for all users.

ORMVAT personnel -- particularly in the SGRID, SPA, SPP and SVOP -- will benefit from training and improved work systems. Given the difficult tasks and reorientations in working procedures they face, these staff members should benefit enormously and collectively create a completely new working environment in Tadla.

Urban populations in Casablanca, El Jedida and Safi will benefit from higher water quality and greater protection from toxic chemicals in their water, as the water treatment plant serving these cities is immediately downstream from the ORMVAT. Farmers in ORMVAD and ORMVAH will also benefit from greater qualities and/or higher quality of water entering their perimeters.

a. Access to Resources and Opportunities

The entire purpose of the project is to broaden access to and participation in decision-making about resources and opportunities in the Tadla for farmers and other private sector participants. The activities of the project seek to actively support that GOM's twin policies of public agency disengagement from commercial enterprises and reorientation of the ORMVAT toward wholly service activities in water delivery and agricultural extension. It

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will also work with local institutions -- cooperatives, professional associations, irrigation associations, etc. -- to strengthen their capacities to participate to greater degrees in the economic and political life of the community.

As the GOM's policy changes are implemented in Tadla, farmers will be given much greater responsibility and capacity to run their own farm enterprises in response to the constraints and open market economic signals they are facing. A much greater percentage of agricultural and commercial activity will be in the hands of private sector entrepreneurs and firms. Markets will be operating free of the government-imposed price and quantity distortions of the past -- i.e., taxes, subsidies, credit rationing, water allocations.

All these changes should result in significantly greater net incomes for farm families and increased market shares for private businesses in input supply, provision of agricultural services, commodity processing, and product marketing.

b. Employment Effects

Project activities per se in the Tadla will probably have only minor impacts on regional employment because the activities have been deliberately designed to work with existing institutions and retrain their personnel to assume new responsibilities. However, the project is intended to assist the GOM in turning national policy decisions into concrete realities at the regional level. If this process proceeds as planned, there will inevitably be very major changes in both employment patterns and the productivity of labor in irrigated agriculture in Tadla.

Employment patterns will change as a result of the GOM's decision to foster participation from farmers and other private sector actors in the regional development process. As the result of the ORMVAT disengagement and the liberalization of markets and perimeter operating procedures, farmers have begun to reallocate the resources under their control to new crop enterprises -- i.e., paprika peppers, other vegetables and fruit -- and away from lower value crops -- i.e., sugar beets and cotton. These crops are both more labor-intensive to produce and process and more profitable per unit of labor invested.

The project is aimed at assisting farmers in furthering this process in the 1990s by increasing access to and the reliability of critical agricultural resource delivery systems. It will also develop, test and disseminate farm-level innovations which will further increase the productivity of existing labor and create new opportunities for on-farm employment of both skilled and unskilled labor. In addition, the new on-farm innovations will create market demands for new goods and services from the private sector -- i.e., needs for new enterprise inputs, consulting services, equipment maintenance, commodity processing, and marketing.

Finally, because of the presence of many small farm units in Tadla with limited capital resources and the more general need to create employment opportunities in the Moroccan

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economy, the project activities have been deliberately oriented toward introducing agricultural innovations which will increase both labor and land intensities. Work on water delivery systems will allow farmers to work their land more intensively. Introduction of innovations in crop tillage and use of inputs -- i.e., seed, fertilizers, and other agro-chemicals -- will increase both land and labor productivities while actually lowering capital costs per unit of output. And, deemphasis of activities with agricultural machinery will avoid problems of labor displacement in agricultural enterprises.

c. Rural Displacement, Migration and Urbanization

The Tadla plain before the construction of infrastructure to manage the water resources from the Oum Er Rbia river in 1928 and initiation of irrigated agriculture in the early 1930 was an area devoted primarily to transhumant livestock grazing and with some rainfed production of cereals -- i.e., wheat and barley. The plain was seen by the French colonial government as "asleep on its riches" and it was said that "the day when French plows trace their furrows in the plain and French farmhouses enliven the landscape .... the region will become one of the most prosperous and fertile in Morocco".

The Beni-Amir project from the start had to contend with the "strength and bellicosity" of the tribes in the area and "sensitive political manipulations ... were needed to lay the foundations for this new development". These manipulations led to the creation of three "perimeters" of official colonization on the plain covering some 45,000 hectares downstream from the new diversion dam at Kasbah Tadla. The "perimeters" were "deducted from the native lands".

The official colonization program in Beni-Amir, however, soon ran into difficulties over problems which were to persist. The first was the slow procedure for expropriating "native lands". Before land could be delivered to colonization, it needed to be surveyed and registered, its boundaries delimited and established by decree, and "native" residents settled elsewhere. As these steps were taking place, however, "clever adventurers" swept in the area, attracted by the promise of government-supplied irrigation water and anxious to acquire large holdings before the government could conduct land registration.

Lively land speculation occurred throughout the irrigable portion of the Beni-Amir plain. The collective, unsurveyed status of the land made it easy for abuses to take place. Speculators were able to obtain titles, for small sums, from Moroccans willing to sell land out from underneath their fellow tribal members or land of which they did not even share possession. This process was described by one French administrator as:

> "A veritable field day of land-grabbing, which the public powers could only oppose with feeble means due to the confused legal status of the land, soon ended with a few individuals -- most agents of powerful land investment companies -- amassing an important part of Beni-Amir's patrimony." (Swearingen, 1987, p. 87)

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This situation led to a number of reformulations of the Beni-Amir colonization scheme over the next fifteen years, with certain groups advocating complete privatization and French occupation of the perimeters and other arguing for "native" settlements as an answer to the problem of drought vulnerability and to have the labor resources to cultivate "strategic, labor-intensive crops".

Ironically, the second problem encountered was one of the inherent salinity in the middle course of the Oum Er Rbia river, which initially placed the whole project in doubt. By 1936, however, test results from the experiment station at Dar Ould Zidouh led to conclusion that the Oum Er Rbia's salinity would present no obstacle whatsoever to agriculture. The tests also had "discovered" that the permeable soils in the Beni-Amir plain would permit removal of accumulated salts by off-season flushing. These findings rekindled flagging colonial interests in the area and land speculation again broke out in the plain.

The objective of this section of course is not to recount the history of the Tadla irrigation systems from the 1930s to the present but it seems useful to remind the reader that the plain has been the site of rural population displacements, labor in-migrations and out-migrations for a long time. These occurrences have been triggered by many factors over time -- government policies, conditions elsewhere in Morocco and outside it, and the development of very valuable irrigated land in the midst of an area subject to periodic and severe droughts.

There are consequences of these factors in Tadla in the 1990s. The first is, as discussed above, that the farming community in the Tadla perimeter displays a high degree of heterogeneity. It is a complex mosaic of peoples from the tribes -- i.e., the Beni-Amir and Beni-Moussa -- and specific clans -- i.e., the Chorfa and Oulad Abdalla -- occupying the land before the 1930s and "outsiders" who have acquired access to the land since that time.

The second is that, because irrigated land is by its nature limited and alternative economic opportunities are available elsewhere, there is a continuing pattern of out-migration, primarily by young people, in search of temporary or permanent employment in other parts of Morocco and in Europe. Some of the participants in this out-migration are said to regularly send portions of their earnings back to family members in Tadla and these in-flows may in part explain the apparent paradox of relatively large Moroccan families "surviving" on very small parcels of irrigated land within the perimeter. In this regard, it is reported that transfer of money into the Tadla region from migrant workers in 1989 amounted to approximately 50 percent of farm families' off-farm revenues, but 80.4 percent of these revenues for farms of less than 2 hectares, and 91.4 percent for farm families having access to 2 to 5 hectares (A. Ftouhi. 1989. "Les Revenus des Agriculteurs dans le Perimetre Irrigue du Tadla.". IAV, Rabat, Maroc. pp. 30 and 89).

The third is that irrigated crop enterprises have generated a continuing demand for seasonal farm labor in-migrations. Although present information on these in-migrations is limited, it appears that much of the seasonal movement involves unskilled female laborers

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from areas immediately adjacent to the perimeter -- i.e., from highland areas of Azilal province -- and from other areas of the country.

In this complex picture and long history of in and out-migrations, it is very difficult to predict a priori how project activities might ultimately affect net flows. It is evident that improved reliability in irrigation water deliveries, relaxation of prior restrictions on fixed crop rotations, and the anticipated shifts to higher value agricultural enterprises in Tadla will make access to irrigated land a much more valuable asset. Adoption of certain types of agricultural machinery and irrigation techniques will also place premiums on accumulation of blocks of land that are sufficiently large to support the costs of capital investments and modernization. But no clear picture emerges as to whether these changes will result in actual displacements of farm families largely through changes in ownership of private land within the perimeter or whether these families will retain ownership of the land but allow it to be managed in larger blocks under cost/revenue sharing arrangements.

The major factors which determine these migration patterns in the future are largely beyond the purview of the project. However, in designing project activities great care was taken to, first, install internal mechanisms -- i.e., the various diagnostic studies, the effort to develop an accurate typology of farm units, and the permanent monitoring and evaluation unit -- to develop a much better understanding as to what is actually happening to specific groups within the perimeter. And, second, to deliberately introduce agricultural and institutional innovations which, at least in part, will be neutral with respect to scale of individual farm operations -- i.e., more reliable water deliveries to all farms; concentration on better use of seeds, fertilizers and agro-chemicals, which inputs are low cost per unit of coverage and investment; and assistance to the private sector to lower unit transaction costs to the purchaser through more competitive market conditions.

With respect to in-migration of farm labor, it again appears evident that conditions which engender farm-level shifts to higher value crop and livestock enterprises will also increase local demands for seasonal -- and, probably, permanent -- farm labor. Increased net farm revenues from these enterprises will also provide the resources and powerful incentives to retain skilled farm labor at higher levels of daily wages and other benefits.

Finally, regarding urbanization effects, the project activities in themselves are anticipated to have no significant effects on the rate of urbanization within the perimeter. Improved business prospects for a variety of private sector input supply, service, processing and marketing enterprises may result in their growth in the small towns in and around the perimeter but most of this growth is expected to come from expansion of existing commercial enterprises. The major impacts on the urban populations in Tadla are expected to come from project activities in the environmental field. If successful, the activities will inevitably lead to significant improvements in the quality of life of these populations through pollution abatement and a lowering of environmental risks. These benefits also have potential for extension to other urban populations in Morocco -- particularly the

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Casablanca metropolis -- to the extent that pollution abatement activities in Tadla affect changes in the quality of water flowing back into the Oum Er Rbia river and to downstream water filtration plants.

d. Changes in Power and Participation

The project will help empower farmers in the perimeter to participate in decision-making by strengthening the capacity of the groups in which they participate -- i.e., private sector firms, farmer groups, professional associations, cooperatives and Irrigation Associations. Project activities will support private sector actors at all levels to progressively fill the vacuum left by ORMVAT disengagement from commercial enterprises and provide mechanisms for farmers, technicians and others to discuss water management problems in the perimeter and to transfer greater responsibilities for water and soil management to farmers.

This water management effort will start both at the primary/secondary system level through Element 1 activities and at the tertiary and quaternary levels and with respect to conjunctive use of surface and groundwater in Elements 2 and 3.

Prior to 1986, the ORMVAT, working from directives sent from MARA, set hectarage and production levels for certain "industrial" crops, which were chiefly cotton in summer and sugar beets in winter. Multi-year crop rotations were then "fixed" around these crops. Field cultivation and irrigation techniques were essentially dictated by the technical constraints of the physical irrigation system and the water distribution amounts and schedules. Finally, the farmers operated in a government system of fixed output price schedules, inputs and agricultural credit tied to certain crops, and closed processing and marketing channels for their agricultural commodities.

In practice, farmers did not always respect the ORMVAT irrigation/crop rotation systems as designed by technicians and engineers. They grew crops out of the prescribed rotation. They installed traditional robta irrigation techniques on land supposedly dedicated to the more "modern" border and furrow systems supplied by siphons. Recently, they have adopted new crops like paprika peppers, in conflict with cotton as a summer crop.

This highly constraining system is now being relaxed as a result of GOM agricultural policy changes starting in 1986. The government has adopted a policy of disengagement and, as a result, ORMVAT, among many other agencies, has been instructed to comply. It is now progressively pulling out of all commercial agricultural activities in the perimeters. The ORMVAT plans to turn operations and maintenance management of the tertiary and quaternary canals over to the Irrigation Associations, which have yet to become viable and sustainable entities. The Associations will play a number of key roles: they are expected to control allocations in the tertiary system; work with ORMVAT hydraulic system managers to determine seasonal water allocation plans; develop weekly delivery schedules; and handle the maintenance of lower level canals and drainage ditches.

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Achieving reliable water supply through Element 1 is critical to the success of the sustainability of irrigation user groups. At the same time, Irrigation Associations are potentially important factor to Element 1 because success of the technical improvements to the water management system depends on how flexible it is in the future with respect to the quantities and timing of water deliveries and how it is managed at the farm-level.

Recent GOM policy changes have put severe pressures on both the ORMVAT and the private sector. ORMVAT staff will need to become client-responsive, while the professional associations, cooperatives, Irrigation Associations and private firms will need to be developed into entities which can represent the interests of their members. A new balance in decision-making between the public and private sectors will have to emerge, and the project should not underestimate the difficulties involved in this process.

Through the diagnostic study and the monitoring and evaluation efforts, the project will collect information on the development of the Irrigation Associations. This information will be used to review and revise project efforts to support this brokering of power between the ORMVAT and the private sector entities.

The project seeks also to strengthen a variety of other private sector organizations, including multi-service cooperatives, professional associations, and others because their organization is consistent with local social groupings and because people receive immediate financial benefits from their activities. Members of these cooperatives have demonstrated their control over resources and ability to devise strategies to overcome inadequacies of market goods and services. Planned project inputs should further develop their decision-making efforts.

ANNEX J

ANNEX J

Administrative Analysis

The key GOM counterpart agency for this project will be the ORMVAT, which is one of the oldest and best established regional irrigation authorities in Morocco. It has a solid reputation for sound perimeter management and a positive orientation toward implementation of the country's new irrigation policies. In addition to the ORMVAT, a number of other GOM agencies will collaborate in specific project activities, particularly with respect to implementation of Elements 1 and 3. Third, the project will encourage participation from private entrepreneurs and agribusiness firms, Professional Associations, the Chambers of Commerce and Agriculture, and non-governmental organizations, particularly in activities under Elements 2 and 4. And, finally, selected cooperatives and irrigation associations will participate in project activities.

A variety of mechanisms for involving all of these agencies in project activities are described in the Project Implementation Plan -- see Section III. These mechanisms are designed to ensure that project participants are fully prepared to assume their roles in the pursuit of the project's objectives.

A. The ORMVAT

Development of large-scale irrigation (LSI) projects constitutes the central thrust of Moroccan efforts in irrigated agriculture. There are nine LSI projects in Morocco with a potential irrigated area of 780,000 hectares. Approximately 500,000 of these hectares have been completely equipped to date. The LSIs range in area from 20,000 hectares to 250,000 hectares and represent major investments in infrastructure for water regulation and distribution.

In the development of the LSIs, Morocco adopted an interventionist type of irrigation policy. The policy was supported by a comprehensive set of measures, included in the 1969 Code of Agricultural Investment, which constituted a framework for promoting the rational use of resources within the LSIs. The government regarded the Code as a contract between the State and the farmers to build the national economy through irrigation development. It paid for the dams, the irrigation networks and necessary on-farm development. It provided credit, selected seeds, farm equipment and certain mechanized operations at subsidized prices. Finally, it guaranteed the prices of crops -- i.e., sugar beets, sugar cane, rice, hard and soft wheat, and cotton -- through contracts between farmers and parastatal agribusinesses. In turn, the farmer was obligated to farm his irrigated land in the "national interest", to follow the norms dictated by the hydraulic system within his perimeter block, and to repay the State through a land improvement tax and water charges.

From the beginning, Morocco strove to develop administrative structures to implement its program in an integrated manner. In 1961, an independent Office National des Irrigations

(ONI) was created. It had full responsibility for irrigated agricultural development throughout Morocco. The ONI brought under the same roof all the various GOM agencies involved with irrigation development. It introduced specialized crops -- principally sugar beets, sugar cane and cotton -- and, in 1962, developed the land consolidation model known as Trame B. This model was used as the basic design in all subsequent LSI projects. In 1965 and 1966, ONI was dissolved in favor of a more decentralized approach to irrigation management and autonomous regional offices (ORMVAs) were created and attached to the MARA. ORMVAT is one of these regional offices.

The ORMVAs were constituted as civil agencies, with legal autonomy to manage their own personnel, property, legal and financial affairs. They were -- and still are -- administratively responsible to the MARA. In addition to the tutorial role played by MARA, the Ministry of Finance also plays a tutorial role in ORMVA budgeting and in ensuring financial audits on a regular basis.

As originally conceived, the mandate of each ORMVA was to develop and manage the irrigated perimeter under its control and to improve agricultural production within it. In this role, the ORMVAs developed a double character as public utility and parastatal commercial enterprise. The ORMVAs were -- and still are -- responsible for the design, construction, operation and maintenance of the irrigation networks within their perimeters. In addition, ORMVA technicians directly supervised farming operations for the "industrial" crops and assisted in the establishment and monitoring of agricultural cooperatives. All productive services required by farmers were integrated under one management structure. ORMVAs were responsible for distributing inputs, providing extension and agricultural equipment services to farmers, supervising seasonal crop credit, and running genetic improvement and health control services for livestock within the perimeter. The ORMVAs had powers of land expropriation as public utilities and/or powers of temporary occupation. They also had powers of eminent domain, with respect to water resources to be developed for agricultural use, as delegated to them by the Ministry of Public Works (Decret Royal No. 810-67 of 29 December 1967).

This original mandate has changed recently with modifications in GOM economic policies. In the future, the role of the ORMVAs is to be substantially reduce in scope to center on water management and on agricultural extension. All ORMVAs have been ordered to progressively withdraw from direct involvement in commercial activities. These activities are to be taken over by the private sector. The World Bank projects discussed in the report -- i.e., PAGI I and II -- were designed to reinforce these new policies by strengthening the ORMVAs as autonomous, client-oriented service agencies, with decentralized decision-making authority and a "pay-as-you-go" status in financial management. Interventions in this project are designed to make these new policy orientations concrete realities in the Tadla perimeter.

Within each ORMVA, the ORMVA Director is responsible to a Board of Directors -- i.e., Conseil d'Administration, which is comprised of the Minister of the MARA (or his

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designee), the Provincial Governor(s), the President of the Provincial Assembly, and the President of the local Chamber of Agriculture. This Conseil has major responsibilities, as defined by Article 9 of the ORMVA constitution, for planning each ORMVA's program and allocating and managing its budget.

The Conseil is assisted in these tasks by an ORMVA Technical Committee -- i.e., Comite Technique. This committee, in the case of the ORMVAT, is chaired by the Governor of Beni Mellal Province and is composed of local representatives of all of the concerned national Ministry Departments and local farmer representatives. It meets once a month -- or more often if necessary -- to examine local issues and problems affecting the ORMVAT.

The ORMVAT is divided into departments -- i.e., Services -- with several bureaus or sections -- see the ORMVAT Organizational Chart in the Preface. Agricultural extension activities, which used to be a bureau within the Service de Production Agricole (SPA), has been recently upgraded to the Service level as the SVOP, reflecting its new status and place in the ORMVAT's strategic mission.

All ORMVAs operate through the Centres de Mise en Valeur (CMVs). These CMVs are the basic units through which the ORMVAs attempt to integrate crop and livestock development activities within each perimeter. Each CMV has a manager, appropriate office staff, and several extension agents. In the Tadla perimeter, ORMVAT has established three administrative Sub-Divisions, which supervise the activities of the 26 CMVs operating within the irrigated perimeter. [Note: There are actually 31 CMVs in the total area under control of the ORMVAT but 5 of these are in rainfed agricultural areas bordering the irrigated perimeter and, therefore, are not to be involved in direct project activities]. The Sub-Divisions also coordinate the field-level activities of the various ORMVAT Services -- i.e., SGRID, SPA, SE and SVOP.

The project has been designed to institutionalize new activities and staff capacities within existing Services of the ORMVAT. All activities to be implemented by the project will address integral parts of the new mandate of the ORMVAT. The implementation of project activities, therefore, will not involve creation of any new administrative responsibilities within the ORMVAT, but simply the rearrangement of existing staff in new and more appropriate configurations. New processes and mechanisms will be installed to facilitate discussion and interaction among project participants and partners within the existing organizational structure, as described in Section III on project implementation in the main report.

The project will be concerned with engendering activity sustainability -- i.e., the continuing capacity of ORMVAT to manage effectively its enhanced responsibilities beyond USAID support -- and with ORMVAT's adaptation to changing needs in the irrigation sub-sector. Implementation of the project will be geared towards building staff capacity to ensure full involvement in project activities and fostering action-oriented mechanisms within the existing organizational structure of the ORMVAT. Since it is the ORMVAT staff who will

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make the integrated activities work, attention must be directed toward creating not only a positive organizational culture, but also toward developing positive staff attitudes in coordination of activities and dialogue with farmer-clients and other partners.

The activities proposed for each of the intervention areas under project Element 1 and 3 will be centered in the SGRID. This Service is charged with the operation and maintenance of the irrigation and drainage network, control of groundwater pumping, water pricing, and all water rights-related issues.

The SGRID is structured (Annex J Figure 1) in three major bureaus -- i.e., the Irrigation Techniques Bureau (BTI), the Operations Bureau (BE) and the Maintenance Bureau. The BTI is charged with the monitoring soil and groundwater conditions and field-testing irrigation techniques and practices. The project will establish within the BTI two operating units -- i.e., the Agro-Meteorological Unit and the Drainage Unit.

The BE is charged with general operational planning for the irrigation network, distribution of irrigation water, and identification of water rights issues. This operational mandate also includes the collection and use of accurate water distribution statistics for improving the distribution in the future. The project will consolidate within the BE two operating units -- i.e., a Water Resources Unit and a GIS Unit. The responsibilities of these two units are described in detail in the Project Implementation Plan (Section III).

Field-level implementation -- i.e., the scheduling irrigation water distribution -- is carried out by the three ORMVAT Sub-Divisions in Beni-Amir, Beni-Moussa East and Beni-Moussa West. The Sub-Divisions are areas of the perimeter defined within the same hydraulic branch or branches; as opposed to the CMVs, which are administratively defined and may cut across hydraulic system boundaries. Each Sub-Division is responsible for providing water to approximately 8,000 farms having on average 33,000 hectares. Sub-Divisions divide the canal system under the control of three head aiguadiers and a head of canal for managing flows in the main canal. Water scheduling operations for each canal secondary branch are performed by aiguadiers, under the supervision of a head aiguadier. Actual distribution operations are performed by the Gardes Vanne for principle canals under the direction of the head of canal and by the Agents de Distribution within secondaries and tertiaries under the direction of the head aiguadiers. The water distribution schedules are used by the ORMVAT billing office as the basis for water charges. Two units will be established, one in the office of the Subdivisionaire of the Beni-Amir sub-perimeter at Fkih Ben Salah, and one in the office of the Subdivisionaire of the Beni-Moussa sub-perimeter at Afourer. Each unit will be divided into a Real-Time Remote System Monitoring Team and a Mobile Monitoring Team. Units will provide a better understanding of the hydraulics of the canal system through hydraulic modeling, canal calibration and real-time system monitoring.

Element 1, in integrating the many different information-gathering and processing units into a coordinated management system, will work with the Head of the BE and the Heads

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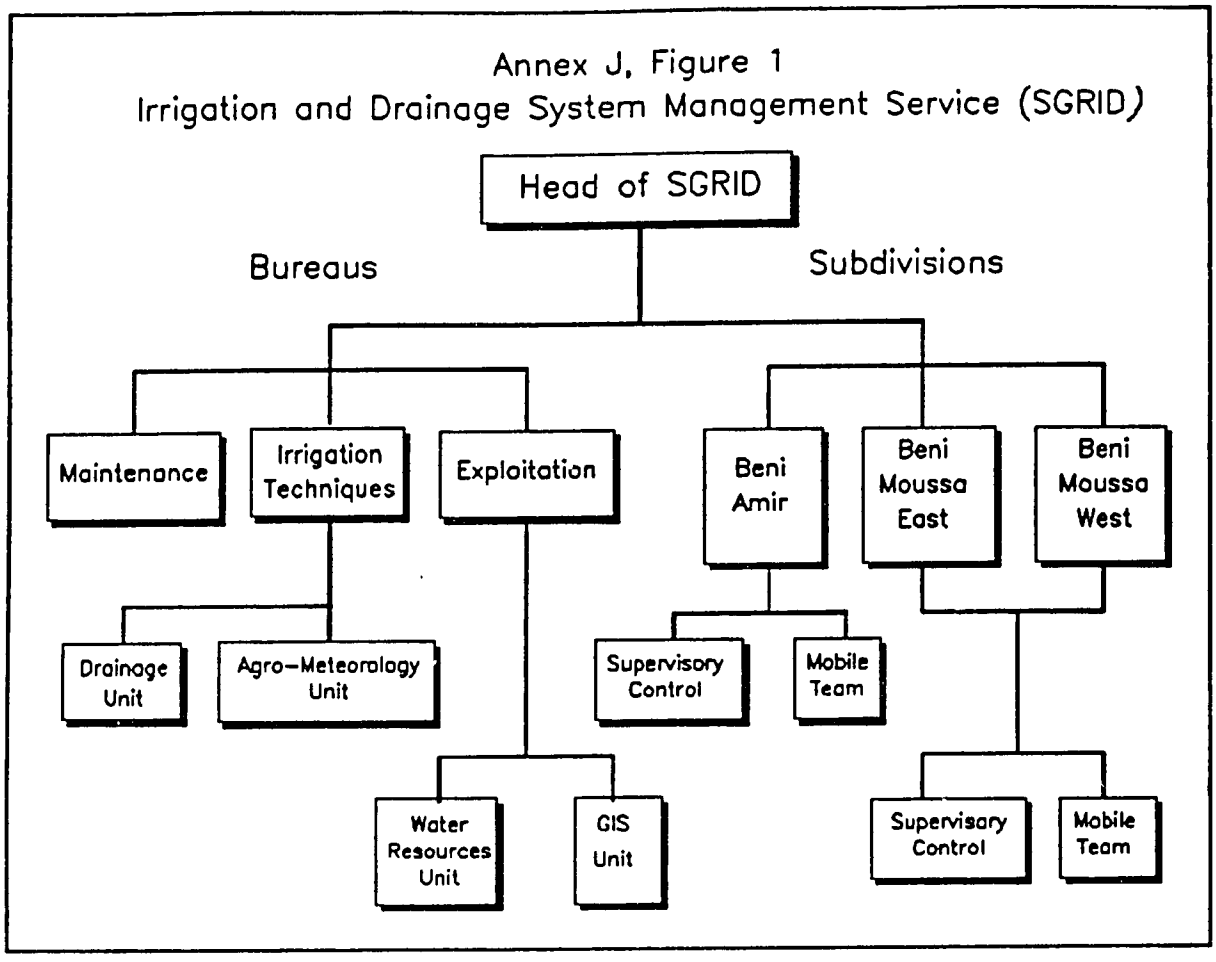

of each of the three Sub-Divisions to formulate operational policy, prepare annual and seasonal operating plans, prepare procedures for water delivery schedule preparation, and formulate an interactive process for improving system operational procedures based on real-time system measurements and field monitoring.

Project Element 2 will work within the context of a systematic program of consultation and reporting. Planning, implementation, evaluation and dissemination of results for Element 2 activities will be centered in the SPA, which under the PAGI 2/SIG restructuring plan is soon to be converted into the Service des Etudes Agro-Economiques. To facilitate work within the ORMVAT and the private sector, a small working committee will be constituted with the participation of ORMVAT staff from the SEHA, the SGRID, the SVOP and relevant private sector agents for each activity.

There is a precedent for such local technical committees in that similar committees are presently organized by the ORMVAT SPA to deal with problems related to specific high-priority crops -- i.e., cotton and sugar beets. During each agricultural season, these committees assemble all interested parties and experts on a weekly to discuss problems and

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recommend solutions. In the case of the local Sugar Beet Technical Committee, for example, participants include: the head of the Bureau des Plantes Sucrieres of SPA, an INRA representative, a representative of the MARA Direction de Protection des Vegetaux, representatives of the three sugar factories in the perimeter, and a representative of the sugar-beet Professional Association. This committee is chaired by the representative of SPA. The committee takes management decisions with respect to technical actions -- i.e., crop-dusting, planting dates, seed varieties to distribute, harvest dates, and the calendar for farming practices. Where the committee cannot achieve consensus, at the request of a member, the problem may be referred to the ORMVAT Comite Technique for resolution.

In addition, a Commission Locale de Mise en Valeur is situated at each Cercle level. It is chaired by the Super-Caid, who is the committee's reporter. It meets whenever necessary to examine the issues and problems faced locally by the ORMVAT. According to the agenda and the nature of the problem, the commission will be composed of: representatives from the Sub-Divisions and CMVs; representatives from the SGRID, the SPA, and the Service d'Elevage; local Caids; agents from agro-industrial plants; representatives of professional associations; representatives of the local Chamber of Agriculture; a representative of INRA; and elected representatives of the concerned communes.

The Super-Caid is responsible for disseminating decisions taken by the Commission with respect to agricultural campaign issues -- e.g., decisions on the mobilization of local labor resources; the type of crop rotation schedule to follow in the area; starting or stopping irrigation; or resolution of conflicts between farmers.

In the design team's opinion, all of the committees described above are potentially useful vehicles for furthering project objectives. Given the nature of their membership and mandates, they can be used to foster discussions and constructive dialogue on many of the issues raised by the GOM's new policies toward the irrigation sub-sector and the increased roles envisaged for private sector participants. They can also facilitate coordination of project activities and dissemination of results to all interested parties.

B. Other GOM Organizations

Under Element 1, the project will consolidate within the BE of SGRID a Water Resources Unit. This unit will be responsible for surface water hydrology, groundwater hydrology and water quality. Surface hydrology activities will require agreements between ORMVAT and ORMVAH, the Ministry of Public Works and the Office National d'Energy (ONE). In order to develop and maintain a database of flows in the Oum Er Rbia river at Kasba Tadla diversion dam and the inflows into Bin El Ouidane dam, an agreement will be established with Direction Regionale Hydraulique (DRH) of the Ministry of Public Works for the regular importation of such data into the ORMVAT data base. The Oum Er Rbia river flow data is available in computer format from the Administration de Hydraulique (AH), a division of the DRH in Beni Mellal. Data for the Bin El Ouidane dam flows will come from the DRH in Rabat.

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Statistical analysis of the flow data on the Oum Er Rbia river will yield the expected hydrograph of water available for diversion into the Beni-Amir main canal for use in the seasonal planning and water delivery scheduling process for this sub-perimeter. Statistical analysis of inflows into the Bin El Ouidane dam will serve as a basis for a review of the operating rules for the dam and power plant at Afourer taking into account the new constraints of supplies to canal T2 as part of the "corrected manifest of Bin El Ouidane" between ORMVAT, ORMVAH and ONE.

Activities under Element 3 will focus on the development and active use of a permanent monitoring system and database of groundwater fluctuations and water quality and the drainage system efficiency in the Tadla perimeter. In Project Years 1 and 2, the institutional contractor will work with the ORMVAT Service de Gestion de Reseau d'Irrigation et Drainage (SGRID) to establish the groundwater and drainage monitoring network. A minimum of 100 permanent sample points will be established to monitor water table fluctuations. SGRID personnel will insure that these sample points are established in a manner that will complement the 56 points currently being monitored within the sub-perimeters by the Direction Regionale Hydraulique (DRH) in Beni Mellal under the Ministry of Public Works. It is paramount that close collaboration and information sharing occur between the SGRID and the DRH.

Two activities under Element 3 will focus on monitoring soil modification and water quality in the sub-perimeters:

- Establishing a monitoring system for soil decomposition from salinity and leaching and water quality, including -- but not limited to -- nitrates and other pollutant flows in the groundwater, drainage systems and the soil profile; and

- Integrating soils and water quality data into the groundwater model to enhance real-time management of soil and water resources in the sub-perimeters.

The first activity will establish permanent sampling points for collecting soils, water quality and agro-chemical residue data during Project Years 1 and 2. It is estimated that soils data collection will consist of 3 samples per site from a minimum of 20 sites within the sub-perimeters three times per year over the life of the project. Analyses of these samples will include pH, salinity, total nitrate, mineral nitrate and cation exchange capacity. Water samples will be collected from 200 sample points once a month for Project Years 1, 2 and 3 and bimonthly -- 6 times per year -- in subsequent years. The water samples will be analyzed for pH, dry residue, nitrate, nitrite and salinity. Agro-chemical residues will be analyzed in Project Years 2 through 5 from 100 different sample points taken three times per year. It is assumed that the analyses will be done to determine the presence of a minimum of 5 toxic substances selected and prioritized in conjunction with the ORMVAT Service de Production Agricole (SPA), agro-industries operating in the area and the

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It is further assumed that the analyses of these samples will be done through a project sub-contractor. The project will investigate alternatives for sustainability of this activity. One option is to use a private sector laboratory. A second option is to supplement existing equipment and strengthen the capacity of the existing ORMVAT soils and water laboratory in Fkih Ben Salah. Costs to the project will be the primary criterion for making a final decision by present estimates indicate that the second option might be the least cost alternative, even with equipment purchases, maintenance and training included.

The second activity will integrate these data into the real-time management process of the SGRID. Results from the soil and water quality monitoring will be part of the ORMVAT GIS. These data when viewed with other overlays of real-time farming practices -- i.e., current crop areas and their agro-chemical demands -- and surface and groundwater water use will enhance the decision making capabilities of the SGRID managers.

It is extremely important that water quality and pollution information reach the local population. To help accomplish this, the project will work through the ORMVAT Service de Vulgarisation et Organisation Professionnel (SVOP) to develop an information network with the regional institutions concerned with these issues. The action-oriented groups most likely to be included are the DRH, in concert with the Office National de l'Eau Potable (ONEP) and the extension agents of the SH in Beni Mellal.

To gain a more comprehensive knowledge of on-farm and agro-industrial practices of handling, application and disposal of agro-chemicals, the contractor will provide technical assistance to survey these groups in the Tadla. The contractor's environmental specialist(s) will work with the ORMVAT/SVOP to synthesize the information from storage/disposal database and the on-farm survey to develop recommendations for improving the management of agro-chemicals in the Tadla perimeter. This will be completed by the end of Project Year 3. In order to improve awareness of the impact of these pollutants in the region, the contractor's environmental specialist will work with the SVOP to develop informational materials and a network in conjunction with other institutions in the Beni Mellal Province. This network -- most logically comprised of the SVOP and the other water quality action-oriented institutions of the DRH, the Office National de l'Eau Potable (ONEP) and the Service Hygiene (SH) -- will serve to inform the local population about improved management of agro-chemicals. This network, to be developed by the end of Year 5, will also provide a mechanism for taking joint action to mitigate the impacts of pollutants on human and animal health when and where they occur within the Tadla perimeter.

Data collected under the Element 3 environmental monitoring systems will be integrated into the GIS being developed for the ORMVAT under Element 1. The contractor and SGRID personnel will need to ensure that the information from these monitoring systems will interface with the outputs from Project Element 1.

This integration will be enhanced by the study to be conducted in Project Years 4, 5 and 6 to examine the conjunctive use of surface and groundwater and drainage system

alternatives. Using the data collected in Element 3 and complemented with outputs from Elements 1 and 2, the contractor in association with SGRID will develop different strategies of water use and determine priorities for establishing sub-surface drainage systems and vertical drainage priorities. This will be of particular importance during drought periods and will also be valuable as more efficient use of water from the Bin El Ouidane Dam becomes mandatory when the transfer canal to the upper Tessaout diversion in ORMVAH is operational.

C. Private Sector Firms, Professional Associations and Other Support Agencies

1. Private Sector Firms

Project Element 2 will work within the context of a systematic program of consultation and reporting. Planning, implementation, evaluation and dissemination of results for the activities in Element 2 will be centered in the SPA, which under the PAGI 2/SIG restructuring plan is soon to be converted into the Service des Etudes Agro-Economiques (SEAE). To facilitate work within the ORMVAT and with the private sector, a small working committee will be constituted with the participation of ORMVAT staff from the SEHA, the SGRID, the SVOP and the private sector representatives relevant to each activity undertaken.

Starting in Project Year 1, a detailed work plan will be drawn up by the working committee and presented at a workshop. Participants at the workshop will include: members of the Element 2 working committee; representatives who have been selected at the CMV level by farmers; private sector agribusiness people selected for their interests in the perimeter; professional association and cooperative representatives; and representatives of other concerned institutions within the GOM and the donor community. Starting in Project Year 2, these annual workshops will include a presentation of Element 2 accomplishments to date vis-a-vis work plan objectives. These workshops will provide the major forum for a general flow of information and feedback. In addition to its information dissemination function, it is anticipated that the dialogue generated will serve as a vehicle to catalyze cooperation between the project and the participant representatives for the following year's work. This will reduce costs and increase the interest and impact generated by the project.

As work under Element 2 proceeds, results are generated and recommendations are formulated, other fora will be used for dissemination. Working with the SVOP and private sector groups -- i.e. input suppliers, cooperatives, etc. -- these will include demonstrations of improved technical packages in farmers fields, farmer field days, and group-specific training sessions. This last activity is seen as especially important for informing the private sector of potential clients and business opportunities.

Information and recommendations with respect to discrete innovations and/or technical packages being proposed for specific farmer groups will be summarized as technical

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reference sheets – Referentiels Techniques (RT). These sheets, as well as any other occasional bulletins generated by Project Element 2, will be circulated to all concerned parties – i.e., farmers, private sector firms, professional associations, cooperatives – in French and Arabic. In addition to the means for disseminating information outlined above, Element 2 will also seek to participate in radio broadcasts of agricultural information if current plans for regional agricultural radio programming materialize.

Increasing the private sector supply of agricultural inputs and services will be realized by the combined effects of all four Elements. The Element 4 description details direct procurement of goods and services from the private sector for materials, services, and laboratory analyses. Element 2 will generate and disseminate information which will identify market opportunity in input, equipment, and service supply. Element 4 will provide short-term technical assistance to the cooperative and incorporated private sector on input and service supply in such areas as fertilizer and pesticide supply, storage, use and disposal. Both the chief of party and the agricultural economist will work with the private sector as ORMVAT disengages and major input and service suppliers – i.e., the Societe National de Commercialisation des Semences (SONACOS), the two sugar beet mills (SUBM and SUNAT) and the sugar refinery (SUTA) are privatized over the next few years. They will help identify and define options for these and other transitions ranging from service contracts with parastatals, cooperative or association take-over of supply and custom services, contracts with private service providers, expansion of companies to the Tadla, and new start-up operations. Short-term technical assistance will be used to prepare marketing and business plans, financing packages, and credit dossiers. These services will be provided on a 50/50 cost sharing basis.

Increasing private sector investment in production and value-added agro-industry will be done by provision of project short-term consulting assistance to develop feasibility studies, business plans, or provide limited start-up assistance on a 50/50 cost shared basis. Element 4 assistance will be oriented primarily toward these crops and related activities falling outside the horticultural sectors. Project staff will orient investors in horticultural crop services, production, and processing to the MAP.

2. Professional Associations

Morocco has a long history of professional associations – i.e., Associations Interprofessionelles. These organizations borrow from models created in Europe, where there are often close ties and a continuum of interest among the individual, company, regulatory agency, ministry, research and educational participants. In Morocco, professional associations have benefitted from a public interest charter. This charter identifies their public responsibilities to support programs in the national interest, while granting them a large measure of operating autonomy. While they are required to communicate and coordinate with public agencies, their directors do not have to be civil servants, nor are their day-to-day operations or financial management subject to a priori supervision by public agency staff, as is the case with most cooperatives.

There are four professional associations representing producers in the Tadla: the Association des Betteraviers du Tadla (ABT), Association des Eleveurs du Tadla (AET), Association des Maraichers du Tadla (AMT) and Association des Producteurs de Coton (ACT). There is some doubt about the representivity of these associations, despite the fact that they can mobilize significant resources, because the names of certain local personages appear frequently in the hierarchies of all four associations. With the support of local authorities, these people have accumulated both technical resources and political power. Farmers in general, however, remain passive through lack of information and lack of association efforts to mobilize them.

The associations do not provide high quality technical expertise -- e.g., ACT has only one trained technician, an adjoint technique and ABT has just two local technicians whose time is largely occupied with administrative work. Each association is burdened with unnecessarily high administrative costs. They would do well to share a secretarial pool as they share the building in Beni Mellal. Associations often incur costs for unnecessary expenses due to poor managerial decision-making -- e.g., ACT hired a permanent pilot for crop spraying operations, despite the fact that it does not own an airplane. This man spends his time supervising the operations of his previous employer, who actually does the crop spraying on a contractual basis.

The essential role envisaged for professional associations vis-a-vis project activities is to disseminate information about technical packages and crop recommendations developed, to participate and backstop project activities and research, as feasible, and to support the interests of their memberships during the period of ORMVAT disengagement. The associations can deploy real resources for these tasks if properly stimulated, but they need to become more representative to be fully credible and effective.

The project will work primarily with the professional association which appears to have the greatest potential for affecting the efficiency of soil and water resources in and around the perimeter -- i.e., the AET. This association currently plays a role in organizing the importation and distribution of purebred cattle. In the future, it may also assume a role as manager of the dairy cattle artificial insemination program when it is transferred from the ORMVAT to the private sector.

3. Other Support Agencies

The project, under the anticipated implementation schedule, will start implementation fully two years ahead of the World Bank PAGI 2 and PSDAGI. This means that the project will be generating important results and initiating pilot activities well before World Bank project activities come on line. The present planning in the MARA and at ORMVAT is to use the USAID project information and results to more precisely target the PAGI 2 and PSDAGI activities, both in Tadla and, as relevant, in the other ORMVAs. For this reason, the USAID design team has worked in close collaboration with GOM representatives at both the ORMVA and MARA levels to ensure -- to the maximum extent possible -- that all

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elements of the USAID project are not only fully compatible with PAGI 2 and PSDAGI as designed to date, but will also be contribute to the future planning and implementation of those activities after 1993.

There are two study projects operating in the ORMVA Tadla perimeter at present. One is jointly sponsored by the International Irrigation Management Institute (IIMI), the Service de l'Experimentation de l'Hydraulique Agricole (SEHA) in the Direction de l'Equipement Rural (DER) of MARA, and ORMVAT. The other is a collaborative study sponsored by Wye College and the Institut Agronomique et Veterinaire Hassan II (IAV).

USAID design team members had several discussions with the IIMI country representative about this project and means of coordinating activities in Tadla. Every effort will be made in project implementation to collaborate on field activities and to share information and field trial results.

The Morocco project director for the Wye College study was the co-team leader of this project design team and his presence on the team ensured that anticipated project activities would be compatible with -- and not duplicative of -- Wye College activities.

D. Cooperatives and Irrigation Associations

1. Cooperatives

Cooperatives are not new to the Tadla area, but the cooperative movement has become progressively more important during the past two decades. There are presently about 94 cooperative groups in the area. They are active in about one-half of the perimeter and have memberships representing about one-third of all farms. The ORMVAT currently provides management assistance for these cooperatives through an appointed Director of Cooperatives. This section describes the types of cooperatives which may be relevant to implementation of project activities.

a. Multi-Purpose Dairy Cooperatives

The existence of multi-purpose dairy cooperatives in Tadla is not new. The first cooperative was created on 5 December 1970, with 114 members. At present, 47 dairy cooperatives, with a total membership of 10,172 farm families, are active in the perimeter. Despite a rapid expansion in their early years of existence, this cooperative movement appears to have stagnated recently for two reasons:

- Within a potential clientele of 24,300 livestock producers -- including sheep-herders -- present membership of 10,172 seems to indicate a level of saturation has been reached; and

These cooperatives have appeared content to focus most of their efforts on their dairy enterprises, even in the face of declining subsidies from the GOM. Most have demonstrated little imagination or initiative in attempting to diversify their activities and/or take advantage of the new opportunities posed by ORMVAT's withdrawal from commercial activities, despite the fact that most have a reliable financial base

There are exceptional cases -- i.e., the Harchiya Cooperative -- where a cooperative has acquired its own premises, contributed to social projects, supported pilgrimages for members, constructed a school, electrified of a hamlet, created a short-term credit fund, launched a cooperative store, or installed a potable water system. However, productive investments to enlarge a cooperative's range of commercial activities and/or services for members are very rare.

This lack of initiative can be explained in part by the low quality of managerial support offered by ORMVAT personnel in the past. Cooperative directors have had only modest training in cooperative planning and management, which has not prepared them adequately to assume their managerial roles. In any cases, they have been inundated in routine paperwork and have not been encouraged to act as much more than clerical staff for their members. Finally, these managers are too few in number and too over-burdened with managing several cooperatives with different structures and objectives.

Under the previous system, cooperative members were not called upon to participate actively in the planning and management of their cooperatives. This lack of stimulation and active participation has obviously had negative consequences. Moreover, when cooperatives have exceeded certain levels in geographical and social terms, they appear to have had problems with factionalism. Within closely knit in-groups, however, where members have a clear vision of their own interests and potential, some dairy cooperatives have proven very dynamic, setting both social and economic goals and establishing very coherent internal regulation. Properly situated and supported, such cooperatives appear to present real potential.

Project Element 4, therefore, will attempt to assist selected dairy cooperatives to improving their internal management and developing a new and multi-purpose approach to servicing their memberships. This choice was made because of all the existing cooperatives in the Tadla area, these cooperatives appear to have the greatest immediate potential to change current operating practices and affect resource use productivity. They alone have major business enterprises -- i.e., dairy production and milk marketing -- which provide regular cash flows throughout the year and have enabled them to accumulate relatively large capital holdings. Some have even diversified their sources of income beyond their dairy enterprises -- i.e., into agricultural input sales, fuel sales, and custom machinery operations -- and are beginning to reduce their dependency on ORMVAT facilities and management services. Moreover, the constituting decree for these cooperatives permits to engage in a wide variety of input and service supply, production, marketing and processing activities. The coopera-

tives may also own capital and shares in agriculturally-related companies.

b. Agrarian Reform Cooperatives

There are 23 Agrarian Reform cooperatives in the Tadla area. They have 528 members on farms with a total area of 3,625 hectares. Under terms of the Law for Agricultural Investment of 1966, members obtained access to irrigated land in exchange for their participation in an agrarian reform service cooperative. Members come from different social strata. As far as can be determined, the members have no binding kinship, lineage or tribal relationships between them. Some members had never farmed before getting access to cropland within the perimeter through affiliation with a cooperative. The directors of these cooperatives are appointed by the ORMVAT.

Performance varies greatly between these cooperatives. A limited number seem to have developed a real dynamic in supporting their activities, gathering resources, and building social and education infrastructure -- e.g., Cooperative Laayoune. Others have remained moribund since their creation, unable even to undertake the efforts in group purchases of agricultural inputs, in provision of credit to members, or in common sales of produce. Moreover, the functional relationships between these cooperatives and the local Professional Associations -- i.e., the ABT, ACT and AET -- remain to be developed.

The general impression is that these cooperatives probably are not in a position to play any major role in project activities in the unforeseeable future.

c. Agricultural Equipment Cooperatives

There are 9 of these cooperatives in Tadla, with 108 member-farmers on about 703 hectares. They are plagued with a number of problems related to both the reasons for their creation and their current stage of development.

First, there is a widespread belief in the area that farmer-members created these "cooperatives" simply to take advantage of special government programs available to cooperatives -- i.e., access to preferred credit status, as well as subsidies for the purchase of agricultural equipment -- without any sense of a cooperative ethic.

Second, while the small size of many farms in the perimeter provides an incentive for farmers to cooperate in the purchase and operation of agricultural machinery, these cooperatives have had great difficulty in managing allocation of acquired machinery among member farms within the time constraints for effective plowing and other agricultural operations.

Third, the existing cooperatives suffer from the lack of a complete range of machinery and their operations are often ineffective due to a lack of spare-parts, fuel and oil, and general management expertise. They are chronically short of operational funds and often dissolve

as effective entities when a tractor breaks down or other machinery needs to be replaced.

Fourth, the attractiveness of these cooperatives to members is declining in the face of competition from aggressive private sector agents providing cheaper and more timely custom machinery services and GOM moves to reduce subsidies on agricultural inputs.

Again, these cooperatives do not appear to be good candidates for involvement in project activities.

d. Purchasing Cooperatives

There are five of these cooperatives within the perimeter, with 148 members on 5,614 hectares. Their very limited number makes it difficult to provide any analysis of their organizational constraints or a prognosis of their future potential. Nevertheless, it is evident that the ORMVAT, in its previous role of purveyor of farm inputs, did not encourage the emergence of this type of cooperative and, as a result, these cooperatives have limited themselves to group bulk purchases of diesel fuel. Their potential for the future remains to be investigated.

D. Irrigation Associations

The organization of water users into groups responsible for the maintenance of irrigation systems is not a new idea in Morocco. Traditional systems for community management of water rights in the small and medium-scale perimeters have developed under a highly complex traditional water law and delicately adjusted water management methods. The organization of the ASAP under the Law of 1924 fixed water rights and privileges in the Tadla perimeter. Other less formal and more empirical groupings of water users have also existed in Tadla from time to time.

The ASAPs in Tadla and elsewhere in Morocco were instituted by the Dahir of June 15, 1924. They were groups of agricultural landholders – often colonialists – having intent to create irrigation infrastructure, either in the public interest or for the development of their personal property. Since Independence and with the transfer of these properties to Moroccans, the ASAP idea has fallen into decline. One ASAP, however, has endured in Tadla but it has engendered considerable mistrust among its farm neighbors, due to abuses by some of its members and the undermining of its earlier objectives.

In 1971, the ORMVAT management attempted to organize farmers in blocks around the tertiary canals, with the objective of electing representatives who could serve as spokespersons in discussion water management issues with ORMVAT staff. Those elected would have been in charge of allocating the irrigation water available to each block. This effort was envisaged primarily as a means to relieve the ORMVAT of the responsibility of this task and not as a vehicle to manage the affairs and problems of the water-user blocks – i.e., vandalism and theft of water. This effort seems to have worked for about one year

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but was gradually abandoned thereafter -- except in the CMV 526, which involved a block of collective land controlled by a closely-related community of water users.

Since the law requiring Irrigation Associations in LSIs was promulgated, the process of organizing these groups has been underway. As of October 1991, three Irrigation Associations had been organized in ORMVAT perimeter -- i.e., at Al Massira, a former ASAP; at Al Ittihad in CMV 526; and at An Najah in CMV 501. Of these, only Al Massira is currently functional. The other two Associations -- i.e., Al Ittihad and An Najah -- are still in the process of electing their officers and disseminating organizational information to potential members.

Irrigation Associations have a tightly-defined charter which appears to exclude any diversification into income-generating activities. They are presently focused exclusively on water management and canal maintenance activities. The associations are seen by all parties principally as means of shifting the operational and maintenance expenses for the tertiary canals from the ORMVAT to local farmers. The technical analysis in Annex F Part 4 suggests that the ORMVAT's intent is to rehabilitate the tertiary network before it is turned over to the nascent Irrigation Associations but this plan may be stymied in the Beni-Amir sub-perimeter due to present uncertainties about amount and costs of rehabilitation required. PAGI 2 activities in Tadla as elsewhere will support the development of Irrigation Associations and the costs of rehabilitating the tertiary canals. Element 1 of this project will provide much of the information on flow measurements and water handling techniques needed to adjust system functions in accordance with farmer requirements. It is recommended, however, that ORMVAT proceed slowly with the Irrigation Association campaign to permit course corrections as needed in organizing the associations and developing management practices.

The Irrigation Associations are not intended to be state-run bureaucracies. They are expected to be farmer-run organizations. The project will help train the presidents and board members of the associations in the bookkeeping and financial management practices, plus organizational goal and program planning techniques. In addition, a small amount of short-term technical assistance will be made available to the associations, the ORMVAT and local water commissions to evaluate the financial obligations of the association, determine whether it is in the association's best interests to seek discounts available on water charges, and how best to participate in representing farmer interests in the negotiations on crops eligible for surface system water deliveries.

ANNEX K

ANNEX K

LIST OF PERSONS CONTACTED

WORLD BANK

Jean-Pierre Villaret	Senior Irrigation Engineer (Contacted in Rabat)

USAID/RABAT

Dennis Chandler	Mission Director
James Lowenthal	Deputy Mission Director
Rick Gold	Program Officer
Mark Krackiewicz	Program Economist
Rick Scott	Project Development Officer
Charles Uphaus	Agricultural Development Officer
Fenton Sands	Agricultural Economist
Eric Loken	Environmental Project Officer
Driss Meski	Project Officer
M'Hamed Hanafi	Project Officer

MINISTRY OF AGRICULTURE AND AGRARIAN REFORM

Othman Demnati	Minister
Oualid Cherif	Head of the Direction de l'Equipement Rural (DER)
Taib Benchekroun	Head of the DER Experimentation Service
Mohammed Youcubi	DER PAGI Coordinator
Abdelaoui Arifi	Head of the Direction de la Protection des Vegetaux, du Control Technique et de la Repression de Fraud (DPVCTRF)
M. Lakhdar	Engineer, DPVCTRF
Mohamed El Kanassi	Centre des Experimentation of the Direction de l'Equipement Rural (CE/DER)
Abderrahim Hamdoufe	Ingenieur Agronome, CE/DER
Chati Taoufiq	Docteur Climatologie, CE/DER

ORMVAT (Office Regional de Mise en Valeur Agricole du Tadla)

M. Boubia	Director
Azzeddine Mikou	Deputy Director and Head of Agricultural Production Service
Mohamed Chmitah	Head of Planning and Programming Service
Abderrazzak Ikama	Head of the Irrigation Equipment Service
Mohammed Harras	Head of the Livestock Production Service

Abderrahman Moungi	Head of Agricultural Extension Service
Abdellatif El Antaki	Head of System Operations and Maintenance Service
Mohamed Laaroussi	Engineer/Systems Operations and Management
Nour-eddine Arfawi	Engineer/Systems Operations and Management
Abdellah Alami	Engineer/Systems Operations and Management
Lahcen Ennahli	Engineer/Systems Operations and Management
Hassan El Iklil	Engineer/Systems Operations and Management
Ahmed El Iamani	Soil Scientist/Agricultural Production Service
Hamid Zahir	Agronomist/Agricultural Production Service
M. Mounji	Ingenieur, ORMVAT/SVOP
Olurhil Oulaid	Chef de la Station Experimental Ahl Souss
Mohamed Najih	Chef de la Station Experimental d'Hydraulique Agricole Oulad Ganou
M. Chayat	Rural Works Engineer, Equipment Division
M. Boutarmane	Head of the Hydraulics Office
M. Benhida	Head of the Soil and Water Table Monitoring Unit
M. El Boustani	Head of the Technical Irrigation Office
M. El Addai	Head of the Document and Study Unit
M. Rafik	Water Geologist
M. Zemmouni	Rural Works and Equipment Engineer
M. Qabui	Technician, Management and Application Office, Agriculture Production Division
M. Kardi	Head of the Soils and Water Laboratory
M. Montaki	Equipment Operator, Soils and Water Laboratory
M. Hassouna	Technician, Soils and Water Laboratory

SUNAT (Sucrerie National du Tadla)

M. Chihaib	Director General
M. Rachoi	Head of the Production and Maintenance Division
M. Khadiri	Head of the Beet Production Division

Hygiene Division, Ministry of Public Health

Dr. Menizi	Head of the Division, Beni Mellal Province

Regional Water Department, Ministry of Public Works

M. Benbiba	Regional Director, Beni Mellal
M. Aghazzaf	Head of the Water Geology Division
M. Akrajai	Head of the Planning Division

ISERF (Institut Sucrier d'Etudes, de Recherche et de Formation)

M. Ezekari	Head of the Agronomy Department
M. Ben Hlinini	Head of the Water Analysis Laboratory

INH (Institut National d'Hygiene)

M. El Idrissi	Head of the Toxicology Laboratory

OTHERS

Jean Verdier	Head of International Irrigation Management Institute (IIMI) Morocco Field Operations
Mohamed Essaouri	Dean of the Faculty of Letters, University of Beni Mellal

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