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R2015-0121/1

June 18, 2015

Closing Date: Wednesday, July 8, 2015 at 6 p.m.

FROM: The Corporate Secretary

Morocco - Large Scale Irrigation Modernization Project

Project Appraisal Document

Attached is the Project Appraisal Document regarding a proposed loan to Morocco for the Large Scale Irrigation Modernization Project (R2015-0121), which is being processed on an absence-of-objection basis.

Distribution:

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The World Bank

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Report No: PAD1208

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED LOAN

IN THE AMOUNT OF US$150 MILLION

TO THE

KINGDOM OF MOROCCO

FOR A

LARGE SCALE IRRIGATION MODERNIZATION PROJECT

JUNE 16, 2015

Water Global Practice
MIDDLE EAST AND NORTH AFRICA REGION

CURRENCY EQUIVALENTS
(Exchange Rate Effective 30 April 2015)

Currency Unit	=	Moroccan Dirham (DH)
DH9.7	=	US$1
US$0.1	=	DH1

FISCAL YEAR
January 1 – December 31

ABBREVIATIONS AND ACRONYMS

ADA	Agricultural Development Agency (*Agence pour le Développement Agricole*)
AFCC	Audit Clause and the Fraud and Corruption Clauses
CPS	Country Partnership Strategy
CRTS	Royal Centre for Remote Sensing (*Centre Royal de Teledétéction*)
DB	Directorate of Budget (*Direction du Budget*), MEF
DEPP	Directorate of Public Enterprises and Privatization *(Direction des Entreprises Publique et de la Privatisation)*, MEF
DF	Directorate of Finance (*Direction Financière*), MAPM
DH	Moroccan Dirhams *(Dirhams Marocains)*
DIAEA	Directorate of Irrigation and Rural Infrastructure *(Direction de l'Irrigation et de l'Aménagement de l'Espace Agricole)*, MAPM
DPL	Development Policy Loan
EIRR	Economic Internal Rate of Return
EMP	Environmental Management Plan
ESIA	Environmental and Social Impact Assessment
EX-ACT	Ex-Ante Carbon-balance Tool
FAO	Food and Agriculture Organization of the United Nations
FDA	Agricultural Development Fund *(Fonds de Développement Agricole)*
FLAP	Framework Land Acquisition Plan
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GIS	Geographic Information System
GoM	Government of Morocco
GRM	Grievance Redress Mechanisms
ICB	International Competitive Bidding
IGA	General Inspectorate of the Ministry of Agriculture (*Inspection Générale du Ministère de l'Agriculture*)
IGF	General Inspectorate of Finance *(Inspection Générale des Finances)*
IUFR	Interim Unaudited Financial Report
LAP	Land Acquisition Plan
LSI	Large Scale Irrigation
M&E	Monitoring and Evaluation
MAPM	Ministry of Agriculture and Marine Fisheries *(Ministère de l'Agriculture et de la Pêche Maritime)*
MEF	Ministry of Economy and Finance *(Ministère de l'Economie et des Finances)*

MENA	Middle East and North Africa
MTEF	Medium-Term Expenditure Framework
NCB	National Competitive Bidding
O&M	Operation and Maintenance
ONCA	National Agency for Agricultural Advisory Services (*Office National du Conseil Agricole*)
ORDAR	Regional Agriculture and Rural Development Office *(Office Régional de Développement Agricole et Rural)*
ORMVA	Regional Agricultural Development Office *(Office Régional de Mise en Valeur Agricole)*
ORMVAD	Regional Agricultural Development Office Doukkala
ORMVAG	Regional Agricultural Development Office Gharb
ORMVAH	Regional Agricultural Development Office Haouz
ORMVAT	Regional Agricultural Development Office Tadla
PDAIRE	Regional Masterplans for Integrated Water Resources Management *(Plans Directeurs d'Aménagement et de Gestion Intégrée des Ressources en Eau)*
PDO	Project Development Objective
PMV	Morocco Green Plan *(Plan Maroc Vert)*
PNEEI	National Irrigation Water Saving Program *(Programme National d'Économie de l'Eau d'Irrigation)*
PPP	Public-Private Partnership
PROMER	Oum er Rbia Basin Irrigated Agriculture Modernization Project *(Projet de Modernisation de l'Agriculture irriguée dans le Bassin de l'Oum er Rbia)*
QCBS	Quality and Cost Based Selection
SABA	Agricultural subsidies database *(Système des aides aux bonifications agricoles)*
SOE	Statement of Expenditures
SORT	Systematic Operations Risk-Rating Tool
STEP	Energy Transfert Pumping station *(Station de Transfer d'Énergie par Pompage)*
TA	Technical Assistance *(Assistance Technique)*
UCGP	Central Project Management Unit *(Unité Centrale de Gestion du Projet)*
URGP	Regional Project Management Unit *(Unité Régionale de Gestion du Projet)*
WUA	Water User Association *(Association des Usagers des Eaux Agricoles, AUEA)*

Regional Vice President:	Hafez Ghanem
Country Director:	Joelle Businger (Acting)
Senior Global Practice Director:	Junaid Kamal Ahmad
Practice Manager:	Steven N. Schonberger
Task Team Leader:	Gabriella Izzi

KINGDOM OF MOROCCO
Large Scale Irrigation Modernization Project

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PAD DATA SHEET

Kingdom of Morocco

Large Scale Irrigation Modernization Project (P150930)

PROJECT APPRAISAL DOCUMENT

MIDDLE EAST AND NORTH AFRICA

Report No.: PAD 1208

Basic Information			
Project ID P150930	EA Category B - Partial Assessment		Team Leader Gabriella Izzi
Lending Instrument Investment Project Financing	Fragile and/or Capacity Constraints [ ] Financial Intermediaries [ ] Series of Projects [ ]		
Project Implementation Start Date 08-July-2015	Project Implementation End Date 31-Dec-2022		
Expected Effectiveness Date 30-Sept-2015	Expected Closing Date 31-Dec-2022		
Joint IFC No			
Practice Manager/Manager Steven M. Schonberger	Senior Global Practice Director Junaid Kamal Ahmad	Country Director Joelle Businger (Acting)	Regional Vice President Hafez Ghanem

Borrower: Kingdom of Morocco			
Responsible Agency: Ministry of Agriculture and Marine Fisheries (MAPM)			
Contact:	El Bouari Ahmed	Title:	Director, Directorate of Irrigation and Rural Infrastructure (DIAEA)
Telephone No.:	00212530103178	Email:	bouariahmed@gmail.com

Project Financing Data(in US$ million)					
[X]	Loan	[ ]	IDA Grant	[ ]	Guarantee
[ ]	Credit	[ ]	Grant	[ ]	Other

Total Project Cost:	187.50	Total Bank Financing:	150.00
Financing Gap:	0.00		

Financing Source	Amount
Borrower/Recipient	37.50
International Bank for Reconstruction and Development	150.00
Total	187.50

Expected Disbursements (in US$ million)

Fiscal Year	2015	2016	2017	2018	2019	2020	2021	2022	2023
Annual	0	1	15	38	45	32	13	4	2
Cumulative	0	1	16	54	99	131	144	148	150

Institutional Data

Practice Area / Cross Cutting Solution Area

Water

Cross Cutting Areas

[ ] Climate Change
[ ] Fragile, Conflict & Violence
[ ] Gender
[ ] Jobs
[ ] Public Private Partnership

Sectors / Climate Change

Sector (Maximum 5 and total % must equal 100)

Major Sector	Sector	%	Adaptation Co-benefits %	Mitigation Co-benefits %
Agriculture, fishing, and forestry	Irrigation and drainage	80	100%	
Agriculture, fishing, and forestry	Agricultural Extension and Research	3	3%	
Public Administration, Law, and Justice	Public administration – Agriculture, fishing and forestry	17	100%	
Total		100		

Themes

Theme (Maximum 5 and total % must equal 100)

Major theme	Theme	%
Rural development	Rural services and infrastructure	67
Environment and natural resources management	Water resource management	33
Total		100

Proposed Development Objectives		
The objectives of the project are: (i) for the Doukkala ORMVA, the Gharb ORMVA, the Haouz ORMVA and the Tadla ORMVA, to provide an improved water service to farmers; and (ii) for targeted farmers in the Project Area, to have better access to improved irrigation technologies.		
Components		
Component Name	**Cost (US$ millions)**	
Component 1: Improving Irrigation Network Infrastructure	135	
Component 2: Supporting Farmers' Access to Improved Irrigation Technologies	6	
Component 3: Supporting the Project Implementing Entities to Manage the Irrigation Network and to Implement the Project	9	
Systematic Operations Risk- Rating Tool (SORT)		
Risk Category	**Rating**	
1. Political and Governance	Moderate	
2. Macroeconomic	Moderate	
3. Sector Strategies and Policies	Low	
4. Technical Design of Project or Program	Substantial	
5. Institutional Capacity for Implementation and Sustainability	Substantial	
6. Fiduciary	Moderate	
7. Environment and Social	Moderate	
8. Stakeholders	Substantial	
OVERALL	**Substantial**	
Compliance		
Policy		
Does the project depart from the CAS in content or in other significant respects?	Yes [ ]	No [X]
Does the project require any waivers of Bank policies?	Yes [ ]	No [X]
Have these been approved by Bank management?	Yes [ ]	No [ ]
Is approval for any policy waiver sought from the Board?	Yes [ ]	No [X]
Does the project meet the Regional criteria for readiness for implementation?	Yes [X]	No [ ]
Safeguard Policies Triggered by the Project	**Yes**	**No**
Environmental Assessment OP/BP 4.01	X	
Natural Habitats OP/BP 4.04		X

Forests OP/BP 4.36		X
Pest Management OP 4.09		X
Physical Cultural Resources OP/BP 4.11		X
Indigenous Peoples OP/BP 4.10		X
Involuntary Resettlement OP/BP 4.12	X	
Safety of Dams OP/BP 4.37	X	
Projects on International Waterways OP/BP 7.50		X
Projects in Disputed Areas OP/BP 7.60		X

Legal Covenants

Name	Recurrent	Due Date
Staffing of ORMVA of Haouz (Project Agreement ORMVA Haouz, Schedule, Section I.A.2)	No	No later than eighteen (18) months after the Effective Date

Description of Covenant

The ORMVA of Haouz shall recruit two engineers and two technicians.

Team Composition

Bank Staff

Name	Title	Specialization	Unit
Aissatou Diallo	Finance Analyst	Finance Analyst	CTRLA
Xavier Chauvot de Beauchene	Sr. Water & Sanitation Specialist	Team member	GWADR
Jean-Charles Marie De Daruvar	Senior Counsel	Senior Counsel	LEGAM
Christine Heumesser	Jr. Professional Officer	Team member	GFADR
Gabriella Izzi	Sr. Agricultural Specialist	Team leader	GFADR
Claudine Kader	Program Assistant	Team member	GWADR
Abdoulaye Keita	Senior procurement Specialist	Procurement team member	GGODR
Hassan Lamrani	Consultant	Irrigation engineer	MNCMA
Khadija Faridi	Senior procurement Specialist	Procurement team member	GGODR
Laila Moudden	Operations Assistant	Team member; Financial management	GGODR
Achraf Rissafi	Team Assistant	Team member	MNCMA
Khadija Sebbata	Program Assistant	Procurement Assistant	MNCMA

Ruma Tavorath	Senior Environmental Specialist	Team member; Environmental safeguard	GENDR
Nicolas Daurensan	Consultant	Irrigation engineer	GWADR
Omar Aloui	Consultant	Agricultural Economist	GWADR
Herve Plusquellec	Consultant	Irrigation engineer	GWADR
Najat Mijd	Consultant	Team member; Social specialist	GWADR
Khalid Anouar	Consultant	Team member; Environmental specialist	GWADR

Locations

Country	First Administrative Division	Location	Planned	Actual	Comments
Morocco		Fquih Ben Salah		X	ORMVAT
Morocco		Marrakech		X	ORMVAH
Morocco		El Jadida		X	ORMVAD
Morocco		Kenitra		X	ORMVAG

I. STRATEGIC CONTEXT

A. Country Context

1. **Morocco has been on a steady path of growth in the past decades, which has proved relatively resilient in the face of the recent global economic slowdown.** Growth averaged 3.6 percent over 2010-14, compared to 4.7 percent in the 2000s and 2.8 percent in the 1990s. The Gross Domestic Product (GDP) per capita more than doubled during 2001 to 2014 reaching US$3,277, unemployment declined from 13.6 percent in 2000 to 10 percent in 2014, and absolute poverty decreased from 15.3 percent in 2001 to 8.9 percent in 2007.

2. **Morocco has engaged on a wide-ranging reform program, with the adoption of a new constitution through a popular referendum on July 1, 2011.** The new constitution lays the foundation for extended regionalization as a democratic and decentralized system of governance. It also contributes to improving the status of women through the adoption of the principle of gender equality and through provisions on increasing the participation of women in decision-making bodies. In November 2011, parliamentary elections followed the promulgation of the constitution, leading to the formation of a four-party coalition government that has embraced the constitution's principles and called for more social solidarity and inclusion.

3. **Inequality, poverty, and vulnerability remain significant challenges in Morocco.** A quarter of the population is still economically vulnerable (near-poverty). There are persistent disparities as 70 percent of the poor live in rural areas, and most development indicators in rural areas lag behind urban. Ten percent of Morocco's 13.4 million rural residents lived below the poverty line in 2011. Rural poverty exacerbates gender disparity with relatively higher illiteracy and primary school dropout rates for rural women, and higher infant and maternal mortality.

4. **Morocco has engaged in a dynamic process towards strengthening economic opportunities and social inclusion.** Several high profile development programs (e.g. the second phase of the National Human Development Initiative, INDH-2) and new sectoral strategies in the areas of education, employment, and youth have been initiated. Nonetheless, additional efforts are needed to support the country-led reforms. The Moroccan State has engaged in reforms, notably in the areas of job creation and improvement of the quality of public services delivered.

B. Sectoral and Institutional Context

5. **Agriculture is central to Morocco's economy, as evidenced by the strong correlation between GDP and agriculture GDP.** During the agricultural campaign 2013-2014, as a result of favorable weather, the sector represented 15.6 percent of GDP and was the main contributor to the country's overall growth. The 20 percent increase in agricultural production allowed Morocco's GDP to jump from 2.7 percent in 2012 to 4.4 percent in 2013. The agricultural sector represents a critical element in the country's demographic and socio-economic situation, generating 40 percent of jobs nationwide, mostly in rural areas where the majority of the poor live. The sector is largely composed of small farmers mostly dedicated to subsistence agriculture, but also counts a group of dynamic and well performing large farmers, with state-of-the-art technologies and well integrated

into the national and international markets. The sector exhibits gender disparities: women's work is typically within the family farm or, when remunerated, it is seasonal and unstable.

6. **Irrigation increases both the level and stability of incomes in rural areas.** Despite representing only 16 percent of the cultivated land, irrigated agriculture contributes to about half of the agricultural GDP, 75 percent of agricultural exports, and 15 percent of overall merchandise exports. The country has 1.46 million ha of permanently irrigated land, 682,600 ha of which are part of nine Large Scale Irrigation (LSI) perimeters operated by nine public Regional Agricultural Development Offices (ORMVAs). The ORMVAs are autonomous agencies tasked with developing the potential of agricultural land through constructing new irrigation schemes, and rehabilitating and modernizing existing ones; ensuring Operation and Maintenance (O&M) of irrigation and drainage facilities; and providing irrigation advisory services to farmers. The remaining area is shared between small and medium scale irrigation schemes managed by Water Users Associations (WUA, 334,000 ha) and private irrigation (441,000 ha). Morocco is one of the first countries with experience in irrigation Public-Private Partnership (PPP). In 2004, it launched the first successful irrigation PPP in the world, in the citrus production perimeter of Guerdane. Other PPPs are at various stages of preparation (Azemmour Bir Jdid, Dar Khrofa, Chtouka).

7. **The ability of irrigated agriculture to continue to drive shared prosperity in Morocco is threatened by increasing water scarcity.** Reduced rainfall, increased rainfall variability, reduced run off, groundwater depletion, and degradation of water resources have reached alarming levels. Annual renewable water resources total 22 billion m^3, corresponding to 730 m^3/inhabitant, which is below the United Nations' threshold for indicating water stress (1,000 m^3/inhabitant). The water deficit is estimated at around 2 billion m^3. Climate change is expected to worsen this situation. Impacts of climate change are already visible in Morocco: the proportion of dry years increased by four times and surface water availability decreased by 35 percent between the period 1947-1976 and 1977-2006. Water scarcity impacts irrigated agriculture in different ways:

- **In private irrigation**, which largely relies on groundwater, reduced and more variable rainfall translates into groundwater overexploitation. The majority of the wells are neither registered nor monitored, and improvements in water pumping technologies and butane subsidy facilitate over-extraction. Decreasing groundwater levels have a specific equity dimension, impacting at first smallholders with less capacity for drilling and pumping deeper.[1]
- **In LSI perimeters**, which rely on surface water, water scarcity translates into reduced volumes allocated to farmers and limits summer crops production. While agriculture remains the primary user of surface water, accounting for about 85 percent of the withdrawals, severe restrictions in irrigation have been common in the last 15 years. The LSI perimeters in the Oum er Rbia River basin received, on average, only 60 percent of the water volumes they were designed for. These volumes were consistently lower than the water allocation stated in the Regional Masterplans for Integrated Water Resources

[1] In the LSI perimeter of Tadla, farms of less than 5 ha represent 60 percent of the total farms with groundwater access, but 82 percent of the farms in the perimeter. On the contrary, farms of more than 20 ha represent 8 percent of farms with groundwater access, but only 1 percent of farms in the perimeter (Source: A. Hammani, M. Kuper. Caractérisation des pompages des eaux souterraines dans le Tadla, Maroc. Troisième atelier régional du projet Sirma, Jun 2007, Nabeul, Tunisia. Cirad, 10 p. <cirad-00262001>).

Management (PDAIRE). Wherever possible, farmers in LSI perimeters have been making up for this shortfall by complementing water allocated by the ORMVAs with groundwater, bearing the extra pumping costs and further aggravating groundwater depletion.

8. **Farmers in LSI perimeters face constraints that limit the productive use of the water resource and that push them to make low-risk but low-return choices.** These constraints include:

- **Collective water management**: Land consolidation (so-called *Trame B*) established hydraulic units (blocks) of 24 to 40 ha, designed for collective farming and imposed a cropping pattern. Within the block, farmers are jointly responsible for the maintenance of either quaternary canals (under gravity irrigation) or mobile equipment (under sprinkler irrigation). Collective management often translates into poor on-farm performance due to lack of maintenance of the common elements. With the liberalization of irrigated agriculture, collective water management is a constraint to modernization.
- **Rigid water distribution rules**: Water is distributed on rotation. The ORMVAs define the length of the rotation based on water availability and on the needs of strategic crops (cereals, industrial crops, and tree crops).
- **Frequent shut-downs**: Prolonged interruptions of service due to insufficient Operation and Maintenance (O&M) increase farmers' uncertainty regarding water supply.
- **Unequal access to water**: Farmers located in disadvantaged locations within the network can receive poorer service.
- **Land tenure issues**: In an attempt to avoid fragmentation, since 1969, regulations preclude land transactions that would result in farms smaller than five ha in irrigated areas. This has however resulted in joint ownership of the land which has proven equally problematic.

9. **The ORMVAs cannot improve the irrigation water service due to insufficient cost recovery.** The LSI perimeters suffer from aging infrastructure and poor O&M. Notwithstanding the financial efforts at the central level over the last years, the ORMVAs have limited budget to address the needs for maintenance, rehabilitation, and modernization of the irrigation systems. Water tariffs are in some LSI perimeters insufficient to cover the O&M costs, and even more so the amortization costs, translating into the need for subsidies from the Government of Morocco (GoM). Tariffs in LSI perimeters vary between 0.27 and 0.77DH/m^3 depending on the perimeter and the associated energy bill, compared to 1.30 to 1.80DH/m^3 in perimeters managed through PPP. While there was an increase in O&M budget since 2009[2], the allocation remains insufficient to meet the needs. Cost recovery rates in Morocco are amongst the highest in the Middle East and North Africa region (MENA), averaging 76 percent (2010). While the recovery of water bills should be improved in the LSI perimeters, this improvement would not be sufficient to meet the cost of the irrigation water service. Consequently, a plan to progressively increase water tariffs in LSI perimeters was adopted in 2009, but it sparked protests by farmers, which led the GoM to postpone the measure. The GoM, with support from the World Bank and other donors, carried out a Political Economy analysis of the irrigation sector reform (June 2012), with a comprehensive consultation process within the ORMVAs of Gharb, Loukkos, and Tadla. The study revealed that

[2] Average 2001-08: Tadla DH14.6 M, Doukkala: DH18.6 M; average 2009-13: Tadla DH31.1 M, Doukkala DH36.8 M.

there is typically no problem with the capacity to pay, but that generally farmers demand an improvement of the service quality in association with the water tariff increase.

10. **The GoM is putting in place incentives, investments, and institutional reforms to ensure greater returns at the farm and overall economy level in light of increasing water scarcity**. This is done through two synergic strategies:

- **The Morocco Green Plan (PMV)** aims to double the agriculture sector's value-added and create 1.5 million jobs by 2020, thus transforming the sector into a stable source of growth, competitiveness, and broad-based economic development. In addition to its transversal institutional and policy reforms, the PMV comprises two Pillars reflecting the dualistic nature of Moroccan agriculture: Pillar I targets commercial farmers and their integration into national and international markets through high-value agriculture, while Pillar II targets small farmers mainly in marginal areas. Under both pillars, technology and organizational support is provided to implement an agri-food chain approach linking farmers to market. The Agricultural Development Fund (FDA), the GoM's principal agricultural subsidy instrument, has been reformed and its measures have been aligned with the strategic directions of the PMV. Since PMV's launch in 2008, production has increased by 45 percent, agricultural exports have risen by 18 percent, and 77,000 permanent jobs have been created.
- **The National Programme for Saving Water in Irrigation (PNEEI)** promotes more productive water use by introducing more efficient irrigation technologies (mainly drip irrigation) on 555,000 ha of the country's irrigated land by 2020, of which 335,000 ha through individual conversion in private farms, and 220,000 ha through joint conversion in LSI perimeters. This process is supported though the FDA, with up to 100 percent subsidy for the adoption of localized irrigation (drip and microsprinkler), and up to 50 percent subsidy for deficit irrigation (sprinkler). Since PNEEI's launch in 2008, the adoption of drip irrigation has been proceeding at a fast pace for individual conversion, with over 230,000 ha completed (68 percent of the 2020 target). In LSI perimeters, conversion is ongoing on 66,800 ha only, due to the need for prior investments in the irrigation networks. The figure is expected to increase steadily in the near future, as feasibility and detailed studies have been completed for 100,000 ha. While impacts remain to be observed, field experiments in Tadla demonstrated that agricultural water productivity (defined as value of produce per unit of water used) could be doubled by switching from the traditional surface irrigation to improved water management under drip irrigation.

11. **An institutional reform of the ORMVAs is in discussion, with the objective to improve performance, responsiveness, and accountability of irrigation water service to farmers.** The GoM is planning a reform which aims to regroup all deconcentrated services of the Ministry of Agriculture and Marine Fisheries (MAPM) at the regional level under umbrella institutions named Regional Agriculture and Rural Development Offices (ORDAR). As part of the World Bank support to the PMV, the draft Laws creating the ORDARs were submitted by MAPM to the Secretary General of the Government on January 15, 2013 and it is currently being reviewed within the Government.

12. **The Large Scale Irrigation Modernization project is fully aligned with the comprehensive reform process of Morocco.** The project supports the ORMVAs of Tadla, Haouz, and Doukkala in the Oum er Rbia River basin, and of Gharb in the Sebou River basin in providing farmers located in the LSI perimeters with an improved water service. This entails individual access to water (rather than collective), on-demand (rather than on rotation), reliable (with faster re-establishment of the service in case of shut-downs), and equitable (in terms of flow and pressure across the irrigation network). Targeted farmers will be relieved of some structural constraints, and will have better access to improved irrigation technologies. In the long term, farmers will have the opportunity to adopt these improved irrigation technologies (with a focus on drip irrigation) and improve their farming choices, with positive effects on their income and livelihood.

13. **The World Bank is well positioned to support this project.** This is due to: (i) its long experience in assisting large scale irrigation improvement projects in Morocco (Large Scale Irrigation Improvement Projects, LSII1 and LSII2, 1985-2000; Oum er Rbia Basin Irrigated Agriculture Modernization project, PROMER, 2010-2016); (ii) its involvement in the Water Resources Management Project (1999-2004) including a significant component regarding the Oum er Rbia basin; (iii) its involvement in supporting the water sector reform in general, and irrigation in particular (Water Sector Development Policy Loan, DPL, 2006; PMV DPL series, 2011 and 2013); and (iv) the fact that the project belongs to a package of integrated operations supported by the World Bank in the Oum er Rbia basin, including water supply and sanitation projects and grant-funded activities to build the capacity of the Oum er Rbia Basin Agency to adapt to climate change.

Box 1: Theory of change (see also Figure 6, Annex 3).

An improved water service:
A breakthrough towards environmental and financial sustainability

Farmers in LSI perimeters are often confronted with collective water management, water distribution on rotation, frequent shut-downs, and unequal access to water. The ORMVAs, responsible for the distribution of surface water, cannot lift these constraints due to the insufficient cost recovery of the water service. These constraints push farmers to make low-risk but low-return choices. Farmers who want to engage in higher value production to achieve higher returns, have to compensate the unreliable water service of the ORMVAs by using water reservoirs and/or tapping into the groundwater (if available), bearing the pumping costs and adding pressure on the already overexploited aquifers.

By providing individual, on-demand, reliable, and equitable access to water, the ORMVAs would allow farmers to invest into higher value agriculture. The more reliable access to surface water would reduce the need to tap into the groundwater. The improved water service, coupled with improved irrigation technologies that can be adopted as a consequence, would allow farmers to use water more effectively (better responding to the crop requirements in water and nutrients through a more precise irrigation scheduling) and efficiently (reducing evaporation and percolation losses), thus increasing yields, increasing cropping intensity, and/or changing cropping pattern towards higher value crops. These changes would translate into increase in agricultural water productivity, in both physical and monetary terms, whereby farmers would improve their income and livelihood. Satisfied with the service provided by the ORMVAs, farmers would be more inclined to pay the water bill. The individualization of the water service would make water metering more transparent and facilitate taking targeted actions towards farmers who do not meet their water bill. The finances of the ORMVAs would improve, allowing for adequate budgeting of the O&M of irrigation networks, thus ensuring long term sustainability. In parallel, farmers would reduce the use of groundwater in favor of cheaper and better quality surface water provided by the ORMVAs, while contributing to environmental sustainability.

The project will contribute to this long term process by supporting the ORMVAs in providing individual, on-demand, reliable, and equitable access to water to farmers, and by supporting farmers in accessing improved irrigation technologies.

C. Higher Level Objectives to which the Project Contributes

14. **The project is consistent with the Country Partnership Strategy (CPS) for Morocco (FY14-17**) (Report No. 86518-MA) which was discussed by the World Bank Group's Board of Executive Directors on April 1, 2014. It contributes to the Strategic Outcome 1.3, "Increase the productivity and value-added of the agri-food sector" under Result Area 1 "Promoting Competitive and Inclusive Growth". The project would be an integral part of a comprehensive sector dialog in the agricultural and irrigation sectors in Morocco. As stated in the CPS, this sector dialog focuses on improving the prospects of the rural poor which requires sustainable farming practices, higher incomes, and more diverse income opportunities. It also focuses on increasing the value added from irrigation water and crops produced, improved agriculture value chain management and commercialization practices, reform of extension services, and promotion of local transformation through agroindustry for a better sector performance which contributes to Morocco's overall economic performance.

15. **The project contributes to the World Bank Group's twin goals of ending extreme poverty and boosting shared prosperity in a sustainable manner.** The majority of the targeted farmers are smallholders, about half of them having less than two ha, with higher figures in Doukkala and Gharb compared to Tadla and Haouz (Table 1). Feasibility studies of the targeted irrigation sectors demonstrate that small farmers usually engage in low-value agriculture: polyculture farming helps managing risks but undermines competitiveness on the market. As small farmers have access to improved water service, and as improved irrigation technologies are made available, they are expected to reduce production of low value crops (typically cereals) in favor of higher value crops (industrial crops, vegetables, and/or tree crops depending on the area). Crop switching and increased cropping intensity are estimated to increase small farmers' revenues between two to three times across all perimeters targeted by the project, supporting the World Bank Group's twin goals of ending extreme poverty and boosting shared prosperity in a sustainable manner.

16. **The project creates the enabling conditions for farmers to increase agricultural water productivity in the long run.** Agricultural water productivity is defined as production (in physical or economic terms) per unit of water, and can increase as a consequence of increase in yield, increase in cropping intensity, change in cropping pattern (crop switch towards higher value crops), and/or decrease in water used. By ensuring an improved water service, and by promoting the adoption of improved irrigation technologies, the project would create the enabling conditions for farmers to intensify production of high value crops. This would result in increased agricultural water productivity, and ultimately improve income and farmers' livelihood. Feasibility studies suggest an increase in value per cubic volume of surface water applied from 3 to 5.8 DH/m^3 in Tadla, and from 3 up to 8.8 DH/m^3 in Doukkala.

17. **The project contributes to the long-term joint effort of the GoM and the World Bank of a more sustainable use of groundwater resources.** Some farmers located in the LSI perimeters have private wells, and groundwater is used to complement surface water distributed by the ORMVAs in between turns of the rotation. Despite the provisions of the water law No. 10-95, which imposes that all water users must register their wells, apply for an abstraction authorization, and pay the fee for groundwater abstraction, enforcement of the law has proven challenging. Global experience teaches that attempts to control groundwater abstraction through coercive actions have often failed. As the project will make surface water available to farmers on-demand (instead of rotation), it is expected to reduce the need to complement surface water with groundwater. In focus discussions during project preparation, farmers reported the following three reasons when justifying their preference for surface water over groundwater: (i) lower cost, up to half of the cost of groundwater; (ii) better quality, with lower nitrates and salinity content, thus expanding the range of crops that can be irrigated and maintaining better soil characteristics over time; and (iii) ability to pay the water bill to the ORMVA at the end of each six-month period, versus the continuous energy expense for the pump.

18. At the same time, the project promotes more efficient irrigation technologies (mainly drip irrigation), which reduce percolation.[3] In Gharb, percolation represents a minor contribution to groundwater recharge, which occurs mainly from natural resources (high rainfall); thus, a change

[3] Roughly, surface irrigation results in 40-45 percent losses in deep percolation, sprinkler in 10-15 percent, and drip in 5 percent.

in irrigation practice is not expected to have an impact on the groundwater level. Conversely, in Tadla, percolation represents an important contribution to the recharge of the shallow aquifer, thus the introduction of drip irrigation can potentially reduce the groundwater level. Projections for the Beni-Moussa scheme, Tadla estimate that, if the volume pumped remains unchanged, groundwater level would decline by 5 to 10 m by 2030, and by an additional 20 to 25 m if the irrigation system is converted to more efficient irrigation technologies. In this case, the project's assumption is that the reduction in percolation into the shallow groundwater aquifer (as a result of more efficient irrigation technology) will be broadly evened out by the reduction in pumping (due to the improved water service), such that overall the project will not have an added negative impact on the groundwater level than currently observed. To prove this assumption, the project will carry out groundwater monitoring using two approaches: (i) direct measures, by installing meters on a sample of wells prior voluntary agreement with farmers; and (ii) estimation of a water balance before / after project, through the use of remote sensing. By reducing groundwater withdrawals, the project is in line with the goals of the ongoing World Bank Green Growth DPL series, which promotes piloting the preparation of a new generation of groundwater management contracts in Tadla.

19. **The project is committed to monitor progress towards the higher level objectives.** Box 1 concisely outlines how the project activities relate to sectoral goals of increasing farmer's income, ensuring the financial sustainability of the ORMVAs, and promoting a sustainable use of water resources. To monitor progress towards achievement of these higher-level objectives, a specific set of indicators is proposed (Table 13, Annex 3).

II. PROJECT DEVELOPMENT OBJECTIVES

A. PDO

20. The project development objectives (PDO) are: (i) for the Doukkala ORMVA, the Gharb ORMVA, the Haouz ORMVA and the Tadla ORMVA, to provide an improved water service to farmers; and (ii) for targeted farmers in the Project Area, to have better access to improved irrigation technologies.

21. The Project Area refers to the irrigated areas under the management of the four ORMVAs targeted by the project.

22. To achieve the first part of the PDO related to the water service, the project supports: (i) the conversion of gravity networks and the modernization of pressurized networks (Component 1); and (ii) the institutional strengthening of the service providers (ORMVAs) to improve their institutional capacity in the O&M of the irrigation network (Component 3). The improved water service is defined as individual access to water (rather than collective), on-demand (rather than on rotation), reliable (in case of shut-downs, service re-established within 1-2 days, rather than 7-10 days), and equitable (optimal flow and pressure throughout the irrigation network, rather than having flow and pressure drops in specific areas / time). To achieve the second part of the PDO related to farmers' access to improved irrigation technologies, the project includes a technical assistance to develop farmers' access to, knowledge of, and management of improved irrigation technologies, mainly drip irrigation (Component 2).

B. Project Beneficiaries

23. The primary project beneficiaries are farmers of targeted irrigation sectors in four LSI perimeters: Tadla, Haouz, and Doukkala in the Oum er Rbia basin; and Gharb in the Sebou basin.

24. The project targets about 9,300 beneficiaries (Table 1) in an area of about 30,000 ha. Quantification of the primary project beneficiaries requires clear definitions. In 1969 the Code for Agricultural Investment was passed to avoid land fragmentation, precluding land transactions resulting in farms smaller than 5 ha in irrigated areas. This resulted in a discrepancy between the cadastral information and the situation on the ground, where widespread joint ownership among co-heirs is proving equally problematic. Each ORMVA has been dealing with this situation differently. Where conflicts among co-owners for water use are limited, the ORMVA has built its list of clients based on the cadastral information. On the ground, the client plays the role of delegate of the co-owners, ensuring that water is shared and fees are collected. In case the co-owners do not manage to organize themselves in the management of water, the ORMVA has chosen to recognize some co-owners as clients, to facilitate collection of the water fee. As no official information is available on the number of farmers, the primary project beneficiaries are defined as the ORMVAs' clients, recognizing that this number is lower than the number of farmers cropping the land.

Table 1: Number of clients by sector and share of farm size.

	Tadla		Haouz	Doukkala		Gharb	
Size (ha)	**M10-M18**	**G13-G18**	**Bouida**	**Z0**	**Extension Faregh**	**N3**	**N4**
0-2	32%	32%	24%	78%	72%	63%	85%
2-5	38%	38%	32%	16%	21%	21%	11%
5-10	20%	20%	41%	5%	7%	9%	3%
> 10	10%	10%	4%	1%	-	7%	1%
Number of clients	**1,078**	**1,848**	**1,002**	**2,054**	**761**	**1,261**	**1,270**

25. The secondary project beneficiaries are the staff of the ORMVAs and of the MAPM, whose capacity in providing an improved water service will be strengthened.

26. About 12 percent of the project beneficiaries are women. The project ensures that services are provided in a fair manner. As part of the monitoring system, gender-disaggregated data will be collected. With the exception of the irrigation sectors in Gharb, where 30 percent of the clients are women, only a limited number of women can be counted among the ORMVAs clients. Nevertheless, the project is expected to positively impact the whole household. Indeed, while women do contribute to agricultural activity in the project area, this usually takes the form of support to the male head of the household during specific phases of the agriculture season (for example, harvesting), or complementary activities (for example, livestock) to enhance household income. Women in Morocco are increasingly playing a decision making role in areas where male rural-to-urban migration is occurring. In irrigated agriculture men remain the main actors. As part of the technical assistance under Component 2, the project will make a dedicated effort to provide a conducive environment for women to benefit from the proposed project activities.

C. PDO Level Results Indicators

27. The project results framework is presented in Annex 1, alongside a proposed list of indicators. The PDO level indicators are the following:

- Direct project beneficiaries (number), of which female (percentage) (core sector indicator)
- Area with access to water on-demand in peak period (percentage)
- Area with a request for improved irrigation technologies approved (hectare)

III. PROJECT DESCRIPTION

A. Project Components

Component 1: Improving Irrigation Network Infrastructure (cost excluding taxes: US$135 million)

28. Component 1 will construct pressurized irrigation networks to replace existing gravity networks (Tadla, Haouz), and renovate existing pressurized irrigation networks (Doukkala, Gharb). Under adequate management, the networks' design will provide farmers with an improved water service, in line with the technical requirements of improved irrigation technologies.

29. Component 1 activities will include: (i) carrying out detailed studies, including topographic works and laboratory tests; (ii) provision of technical assistance for monitoring and control of works; (iii) upgrading main irrigation canals and constructing reservoirs to install flow-regulation systems necessary for on-demand irrigation; (iv) constructing feeder pipes for areas that benefit from gravity pressurization, and modernizing pumping stations for areas that need artificial pressurization; (v) constructing filtration stations; (vi) constructing distribution piped networks to replace existing canals, or modernizing and extending existing distribution piped networks; and (vii) installing outlets and associated devices, including meters, at the block and farm levels, to regulate, measure, and control water delivered to farmers.

30. This component will be executed by the ORMVAs.

Component 2: Supporting Farmers' Access to Improved Irrigation Technologies (cost excluding taxes: US$6 million)

31. Component 2 will strengthen farmers' knowledge and awareness in accessing improved irrigation technologies (mainly drip irrigation), which could be adopted as a result of the improved water service provided by the ORMVAs. It will facilitate access to financing opportunities by supporting Water User Associations (WUAs) in jointly applying to FDA subsidy on behalf of farmers. Once the improved irrigation technologies are in place, farmers will develop their capacity to manage and maintain the irrigation systems. Farmers will also develop better knowledge of their groundwater, where appropriate.

32. Component 2 activities will include: (i) provision of technical assistance to the Project Implementing Entities to support farmers to access and manage improved irrigation technologies; (ii) acquisition of equipment for the Project Implementing Entities to monitor performance of

irrigation systems; and (iii) provision of technical assistance to, and acquisition of equipment for the Project Implementing Entities to create an irrigation information system, and/or to strengthen an existing irrigation information system.

33. This component will be executed by the ORMVAs.

Component 3: Supporting the Project Implementing Entities to Manage the Irrigation Network and to Implement the Project (cost excluding taxes: US$9 million)

34. Component 3 will strengthen the institutional capacity of the ORMVAs in operating and maintaining the irrigation networks, to ensure that new and renovated networks are managed so as to provide farmers with an improved water service, in line with the requirements of improved irrigation technologies, and that performance remains satisfactory over time. Component 3 will also support the MAPM's Directorate of Irrigation and Rural Infrastructure (DIAEA) and the ORMVAs in implementing the project.

35. Component 3 activities will include: (i) provision of training and technical assistance to selected staff of MAPM, and acquisition of computer equipment, software and associated tools for Project coordination and for supporting the Project Implementing Entities as needed; (ii) provision of technical assistance to the Project Implementing Entities for improving the O&M of the irrigation network; (iii) provision of training and technical assistance to the Project Implementing Entities, and acquisition of goods for Project implementation; and (iv) rehabilitation of selected buildings and acquisition of office equipment for the Project Implementing Entities.

36. This component will be executed by the MAPM (DIAEA) (subcomponent i) and the ORMVAs (subcomponents ii, iii, and iv). The MAPM (DIAEA) will be responsible for those activities requiring coordination across ORMVAs.

B. Project Financing

37. The project is an Investment Project Financing (IPF). World Bank financing is US$150 million, corresponding to total project costs excluding taxes. Borrower financing is US$37.5 million, corresponding to funds needed to cover taxes. Table 2 provides an overview of the costs by component.

Table 2: Project costs by project component (excluding taxes).

Project Components	Project Cost (US$ million)	IBRD Financing (US$ million)	% Financing
1. Improving irrigation network infrastructure	134.625	134.625	100
2. Supporting farmers' access to improved irrigation technologies	6.000	6.000	100
3. Supporting the project implementing entities to manage the irrigation network and to implement the project	9.000	9.000	100
Total Costs			
Total Project Costs	149.625		
Front-End Fee	0.375		
Total Financing Required	150.000		

C. Lessons Learned and Reflected in the Project Design

38. Several lessons were derived from the ongoing PROMER and the continuous World Bank engagement through the sector dialog. The PROMER, for which a mid-term review was carried out in parallel to the proposed project preparation, represents the first project in support to the PNEEI. In the perimeters of Tadla, Haouz, and Doukkala, the PROMER targets areas which are mostly contiguous to the project, and finances similar activities.

39. **Long duration of works for the irrigation network calls for long implementation period.** In the PROMER, networks' infrastructure development required three to five years, about two years longer than initially estimated. This was due – among other reasons - to the non-optimal sequencing of the works, inadequate consideration of the slowdown of works due to bad weather or other constraints related to technical and social aspects (expropriation), and limitations due to application of national procurement procedures over World Bank procurement procedure. During preparation, particular focus was devoted to investment and procurement planning to ensure the timely implementation of works. In addition, project duration was set at seven years compared to the six years of the PROMER, to ensure adequate support to the ORMVAs and the farmers once the new system is in place.

40. **Early start of technical assistance to farmers is essential for efficient implementation.** The PROMER showed that the signed engagement provided by farmers at the moment of the feasibility study does not guarantee the actual buy-in during project implementation. Farmers are not required to financially contribute to the modernization, which facilitates obtaining the commitment at the concept stage, but opposition can arise during implementation. The launching of the technical assistance in support to farmers (Component 2) at an early stage is thus essential to engage with farmers early on and maintain a continuous dialogue, in particular on timing of the interventions, grievances related to irrigation networks' works, need for land acquisitions, and support for timely preparation of the documents to receive on-farm equipment.

41. **Clear administrative procedures for accessing subsidies are critical to accelerate the adoption of improved irrigation technologies.** Through the PROMER, a number of hurdles linked to the access to FDA subsidies for the financing of the on-farm equipment were identified,

most of them linked to the small sizes of farms and low financial capacity of farmers. The DIAEA, with support from the ORMVAs, developed solutions to simplify and accelerate the procedure. For instance, farmers are no longer required to pay an advance on the cost of the on-farm equipment to the equipment company. Instead, the company is directly reimbursed by the FDA once the system is in place. Also, farmers that jointly submit a request for on-farm equipment benefit from simplified procedures (simplified administrative procedures, support for the selection of the equipment company, support in the preparation of the technical and administrative documents, etc.).

42. **The transition from the gravity to pressurized networks, and the management of pressurized networks require a new skill set within the ORMVAs in order to provide an improved and accountable water service to farmers.** The sustainability of the investment requires a change in the way the ORMVAs ensure the O&M of the network, with consequent adjustments in staffing and skills to manage the new system. Under Component 3 the project includes the development of adapted strategies to ensure that the means of the ORMVAs are consistent with the objective and challenges of an improved water service.

IV. IMPLEMENTATION

A. Institutional and Implementation Arrangements

43. The project will have four implementing entities: the ORMVAs of Tadla (ORMVAT), Haouz (ORMVAH), Doukkala (ORMVAD), and Gharb (ORMVAG) will implement most of the activities in coordination with the DIAEA of the MAPM. Some training and technical assistance, and acquisition of computer equipment, software and associated tools for project coordination and for supporting the ORMVAs as needed under Component 3 will be implemented by the MAPM (DIAEA).

44. The project will have a Central Project Management Unit (UCGP) at the MAPM, and a Regional Project Management Unit (URGP) within each ORMVA.

45. The MAPM (DIAEA) and the ORMVAs of Tadla, Haouz, and Doukkala are experienced in managing World Bank-funded projects, the Oum er Rbia basin irrigated agriculture modernization project (PROMER, 2010-2016) being the most recent. Although the ORMVA of Gharb does not have previous experience in implementing World Bank financed projects, it does have experience implementing several other donor funded projects such as African Development Bank (AfDB), European Investment Bank (EIB), Arab Fund for Economic and Social Development (AFESD), and the Agence Française de Développement (AFD). Each ORMVA targeted by the project manages a LSI perimeter covering about 100,000 ha. They have good technical and managerial capacity to implement big irrigation development and modernization projects, but they increasingly suffer from lack of manpower and logistical means. Training and technical assistance will be provided as needed.

B. Results Monitoring and Evaluation

46. The ORMVAs will be responsible for monitoring the implementation of the project in their areas. The MAPM (DIAEA) will consolidate the information into one progress report at the end of each semester of the calendar year. The ORMVAs will receive the same simple computerized application to enter and process data from relevant departments in charge of implementation of different components, and calculate output and intermediate results indicators set in the monitoring and evaluation plan.

C. Sustainability

47. The sustainability of the project is ensured by the commitment of the Government, the implementing entities, and the beneficiaries, through the maintenance of the irrigation network infrastructure and the irrigation equipment, as well as the preservation of the environment.

48. Government commitment to the project is reflected in the close fit of the project with broader sectorial strategic goals of the PNEEI and the PMV. The Government has consistently provided the MAPM with sufficient budget to implement the strategies since their launch.

49. The ORMVAs commitment is reflected in their engagement in ensuring the Operation and Maintenance (O&M) of irrigation networks financed under the project. The targeted ORMVAs have proven capacity to maintain both gravity and pressurized networks. However, a comprehensive assessment of staffing and skills requirements, combined with a new O&M strategy, are required to ensure an improved service over time: the acceptable duration of interruption of service is drastically reduced when farmers switch from surface and sprinkler to drip irrigation, and being reduced to 48 hours maximum. Sustainability of the investment depends on the capacity of the ORMVAs to put in place the appropriate means to respond to the new challenges. Moreover, sustainability passes through the identification of a long-term staffing and skills plan of the ORMVAs, which have in recent years seen a reduction in technical staff that risks affecting the capacity of the institution to respond to the new challenges. Activities under Component 3 are designed to strengthen project sustainability by providing training and equipment to the ORMVAs.

50. By improving the performance of the ORMVAs in providing the irrigation water service, the project is expected to contribute to their financial sustainability in the long-term. Following the farmers' protests to the increase in tariffs in LSI perimeters in 2010, the GoM, with support from the World Bank and other donors, carried out a Political Economy analysis of the irrigation sector reform (June 2012), with a comprehensive consultation process within the ORMVAs of Gharb, Loukkos, and Tadla. The study revealed that there is typically no problem with the capacity to pay, but that generally farmers demand an improvement of the service quality in association with the water tariff increase. The study recommended refocusing the reform process to first improve the water service delivery, efficiency, and accountability of the ORMVAs. These conclusions were fundamental for the project design.

51. Farmers' commitment is visible at two stages: (i) providing a signed commitment at the stage of the feasibility study for the joint modernization; and (ii) confirming this commitment with

the request for subsidy for the installation of the on-farm drip irrigation equipment. Farmers commit to maintain the on-farm equipment for at least five years. Activities under Component 2 are designed to strengthen project sustainability, by supporting farmers to access, use, and maintain improved irrigation technologies.

52. Environmental sustainability relates to the long-term management of aquifers through reduction of groundwater abstraction over time. By making surface water available to farmers on-demand, and considering that surface water is usually cheaper and of better quality than groundwater, the project is expected to reduce farmers' use of groundwater. In situations in which percolation of irrigation water contributes substantially to groundwater recharge, the project assumes that this reduction in contribution will be evened out by the reduction in groundwater abstraction. To promote environmental sustainability, the project will finance: (i) under Component 2, awareness activities on aquifer management among farmers, and monitoring of groundwater abstraction by installing meters on a sample of wells prior voluntary agreement with farmers; and (ii) under Component 3, groundwater monitoring and estimation of a water balance before / after the project through the use of remote sensing.

V. KEY RISKS AND MITIGATION MEASURES

A. Risk Ratings Summary Table

Table 3: Risk rating according to the Systematic Operations Risk-Rating Tool (SORT).

Risk Category	Rating
1. Political and Governance	Moderate
2. Macroeconomic	Moderate
3. Sector Strategies and Policies	Low
4. Technical Design of Project or Program	Substantial
5. Institutional Capacity for Implementation and Sustainability	Substantial
6. Fiduciary	Moderate
7. Environment and Social	Moderate
8. Stakeholders	Substantial
OVERALL	**Substantial**

B. Overall Risk Rating Explanation

53. The overall substantial risk rating reflects the innovative approach of the project, with its focus on the quality of the water service provided by the ORMVAs, which is not common in the irrigation sector projects. Out of eight risk categories, three (Technical Project Design; Institutional Capacity for Implementation and Sustainability; and Stakeholders) are rated substantial. The project builds on strong capacities and experience of the PROMER, which allows a well-informed design and implementation of risk mitigation measures.

54. *Technical Project Design* - There is the risk related to the focus on a single core irrigation technique. Morocco's conversion to drip irrigation in LSI perimeters is unique, as no other country

has attempted a conversion at this scale in publicly managed perimeters. The level of the FDA subsidies for the introduction of drip irrigation pushes farmers to choose this irrigation technique over others. While drip irrigation is extensively adopted in privately developed irrigated areas in Morocco, it represents a new technology for targeted farmers, requiring substantial behavioral change regarding farming practices in order to provide the expected benefits in the long term. Farmers' participation should not be taken for granted as no financial contribution is required and due to the subsidy incentives, oppositions can emerge during implementation. Benefits in terms of individual access to irrigation water can be limited by the joint ownership of the land. Among the mitigation measures, activities under Component 2 will present pros and cons of drip irrigation compared to other techniques. They will promote switching to high value crops that are better suited for drip irrigation and which would allow higher returns to farmers. Flexibility will be embedded in networks design and management to allow for the use of other irrigation techniques. The ORMVAs are identifying targeted solutions. There are sectors (Tadla), where the identification of a representative of the coheirs, responsible for the water bill, has been traditionally successful. In cases where social tensions are widespread (Gharb), the ORMVA will evaluate the possibility of having more than one meter per farm, to account for the actual situation of sharecropping even if not legally recognized.

55. *Institutional Capacity for Implementation and Sustainability* - In the ORMVAs, lack of human capacity and adequate skillset for the new challenges can prevent the efficient implementation of the project. The success of the project crucially depends on putting in place the adequate means to ensure that the ORMVAs can provide over time a high quality water service in line with the requirements of drip irrigation, for which – among others elements – the acceptable duration of interruption of service is drastically reduced. Among the mitigation measures put in place, the MEF has opened the budget line for the hiring of six staff (three engineers and three technicians) in each of the four ORMVAs targeted by the project. In parallel, staff of the ORMVAs will be supported by technical assistance under Components 1, 2, and 3. The combination of additional staff and technical assistance will ensure adequate support to farmers.

56. *Stakeholders* - In order to launch works in a given irrigation sector, the project requires that farmers over at least 70 percent of the area express their interest in participating in the project. However, this expression of interest does not necessary reflect their buy-in, as no financial contribution is demanded, and there is a risk that farmers raise concerns as off-farm works start. Achievement of high level objective depends on the behavioral change of the farmers. To derive the utmost benefit of the adoption of the improved technology and to be able to support the maintenance cost over the next years, farmers have to change their behavior, e.g. regarding their agricultural practices and irrigation management choices. This will be based on a diverse range of incentives, and demands investment and risk-taking from their side. During preparation of the project, the Borrower has carried out participatory studies to identify sufficiently-concentrated groups of farmers and figure out and address reasons why farmers may not want to participate. Prompt launching of the technical assistance under Component 2 will be essential to ensure farmers' buy-in.

VI. APPRAISAL SUMMARY

A. Economic and Financial Analysis

57. The project's principal economic and financial benefit will be an increase in the value-added of production in the project area. The improved water service, coupled with improved irrigation technologies that can be adopted as a consequence, would allow farmers to use water more effectively and efficiently. The increase in agricultural water productivity will be realized as a consequence of increase in yield, increase in cropping intensity, and / or switching to high value crops.

58. Based on the economic analysis, the EIRR results as follows:

- Tadla: 18.8 percent;
- Haouz: 11.6 percent;
- Doukkala: 17.1 percent in Z0 and 17.5 percent in Extension Faregh; and
- Gharb: 32.2 percent in N3 and 23.7 percent in N4.

59. Overall, the economic analysis reveals that the economic justification is the most robust in Gharb and Tadla, thanks to the projected increase in cropping intensity combined with the introduction and/or expansion of high value crops. The economic internal rate of return (EIRR) is higher in Gharb, due to the lower conversion costs of the network which is already pressurized compared to the gravity network of Tadla; and the higher water availability than in Tadla which allows for the introduction of high value crops like melon, artichoke, and tomato. The current low water demand in Gharb is the result of poor water service quality, which can only be positively impacted by the project. In Doukkala, the conversion costs are low (similar to Gharb), but returns are expected to be lower than in other areas targeted by the project as only limited change in the cropping pattern is expected. The economic justification in Haouz is the weakest, which was to be expected due to the low water availability along with high conversion costs of the gravity system. However, the EIRR is based on average values, and does not incorporate the benefits in terms of increased resilience of farmers to inter-annual variability.

60. The financial analysis confirms that the project will be financially attractive to all categories of farmers. The distribution of financial benefits will however be skewed, partly because land distribution is highly uneven and partly because different farming systems will benefit differently. The skewed incidence of project benefits does not undermine the viability of the project, but it underlines the importance of paying attention to the specific needs of smallholders in implementation and impact monitoring. In terms of distribution of the benefit, it should also be noted that the large-scale farmers in Gharb and Tadla, who have access to groundwater, largely started converting to drip irrigation equipment already, even without the collective projects. Therefore, the majority of project beneficiaries are *de facto* farmers who, for technical and financial reasons, could not individually access the drip irrigation technology. Thus, the project would have a positive impact on equity.

B. Technical

61. **Individualization is a key element to improve irrigation performance and ORMVA's cost recovery.** Traditionally, water has been managed collectively at the level of block, both under gravity (Tadla, Haouz) and sprinkler (Gharb, Doukkala) irrigation, with groups of farmers jointly responsible for the maintenance of either quaternary canals or mobile sprinkler equipment. Collective management has resulted in poor maintenance of the common elements and a decline in on-farm irrigation performance. In sectors using sprinkler irrigation, whenever some farmers fail to pay the water bill, the ORMVA has little possibility of taking targeted actions, which results in social tensions. The project promotes the introduction of individual outlets equipped with meters at the farm gate, with clear accountability for each farmer for the water consumed.

62. **Access to water on-demand coupled with the introduction of annual quota is expected to promote a change in cropping patterns towards high value crops.** Traditionally, water in LSI perimeters has been distributed on rotation, with turns organized by the ORMVAs ranging from one week to up to a month. This rigid access to water prevents farmers from scheduling irrigation according to crop water requirements, resulting in over-irrigation when water is available, and crop stress in between turns. In addition, the ORMVA decides water allocation in function of the cropping pattern, prioritizing the needs of strategic crops (cereals, industrial crops, and tree crops). Crop diversification is constrained as a consequence. The project promotes access to water on-demand, which offers flexibility to farmers in terms of what, when, and how much to irrigate. Farmers would thus be able to respond to the market signals, changing cropping pattern in favor of high value crops. This will be even more the case if farmers have clear information at the beginning of the season on the amount of water available, to decide how to allocate it over the season and across crops, as to maximize revenues. The switch to annual quota per hectare represents a profound change in the approach of the ORMVAs to water allocation. This change requires – among others - an improved communication strategy with farmers to alert them about the revision of the quota throughout the season; reductions of the quota in drought years, and reliable alerts in case the farmers are close to reaching their quota.

63. **Drip irrigation has widely recognized benefits compared to other irrigation techniques that justify making it the core technique in the PNEEI and, accordingly, in the project.** If correctly managed, drip irrigation:

- allows for better targeted applications of water and fertilizers to precisely meet crops' needs, thus boosting production;
- reduces evaporation losses by wetting only the soil surface closer to the plant. This benefit is particularly evident for crops planted in rows, typically high value crops;
- reduces percolation losses by providing smaller doses per irrigation application; and
- allows for frequent irrigation applications, thus facilitating crop switching in favor of high value crops (typically water sensitive).

64. Overall, drip irrigation can contribute to increasing agricultural water productivity, income, and farmers' livelihood. Results are available in Morocco,[4] where drip irrigation is widely adopted in privately developed irrigated areas. Also, by allowing an efficient use of water and reducing evaporation losses, drip irrigation can help farmers' adapt to climate change.

65. **While supporting drip irrigation as the core irrigation technique, the project accounts for the fact that not the whole surface is expected to be converted to drip irrigation.** Farmers might wish to convert to drip irrigation, but may lack the necessary documentation to access subsidy and means to finance the conversion themselves. Sometimes, they might produce crops for which satisfactory performances can be achieved also with other irrigation techniques. This is the case for cereals or fodder production under sprinkler irrigation, when irrigation is limited to two or three emergency applications during the season, so to allocate more water to high value crops on the rest of the farm. The project accounts for the coexistence of different irrigation techniques at three levels:

- Under Component 1, adequate design will respond to requirements of irrigation techniques other than drip. For example, the outlets will have a minimum flow of 10 l/s to meet surface irrigation requirements; the pumping stations and the filtering systems will be renovated in such a way to keep providing adequate pressure to meet the requirements of sprinkler irrigation.
- Under Component 2, demonstration plots will compare not only drip irrigation and traditional irrigation techniques, but also focus on options to improve performance of other pressurized irrigation techniques.
- Under Component 3, the management strategy will also focus on ensuring that the different irrigation techniques coexist without decreasing the network's overall performance. For example, by concentrating surface and sprinkler irrigation in a specific time / day to avoid pressure drop in the network.

C. Financial Management

66. The MAPM and ORMVAs staff have significant experience in the accounting and financial monitoring requirements of World Bank-funded projects, and past experience indicates that their capacity meets the World Bank financial management requirements. The fiduciary risk for this project is therefore assessed as moderate. The World Bank carried out an assessment of the financial management capacity of the ORMVAs as part of preparation of the project, which concluded that the accounting and internal control system is adequate and that annual external financial audit arrangements are satisfactory.

67. Each ORMVA shall prepare and furnish to MAPM not later than thirty (30) days after the end of each semester of the calendar year, interim unaudited financial reports (IUFR) for its respective part of the project covering the semester, for incorporation and forwarding by MAPM to the World Bank not later than forty five (45) days after the end of each semester of the calendar

[4] The World Bank-financed Water Resources Management Project (1999-2004) financed pilot installations of drip irrigation on ten small farms in the Tadla, Doukkala, and Souss areas. These pilots achieved outstanding results and support the theory of change of the project. Farmers changed cropping pattern, improved agricultural water productivity, and reported increased incomes.

year. The MAPM (DIAEA) will supervise project implementation and will coordinate its planning, including preparation and transmission to the World Bank of project progress reports. The Financial Directorate (DF) of MAPM will be responsible of project budgeting, review of statements of expenses, and their transmission to the Ministry of Economy and Finance (MEF).

Disbursement

68. Given that project expenses will be pre-financed through the general budget, and taxes will be financed through the GoM contribution to the project, disbursements will be made based on presentation of statements of expenditure (SOEs) for the expenditure amount exclusive of taxes to be financed by the Loan, in compliance with World Bank disbursement procedures. Each ORMVA will use a standard statement of expenditures form. All documents will be addressed to the DIAEA for eligibility control. The DIAEA will send all documents to the Financial Directorate (DF) of MAPM for review and transmission to the Directorate of Budget (DB) of the MEF for transmission to the World Bank.

D. Procurement

69. Procurement for the proposed project would be carried out in accordance with: (i) the World Bank's Guidelines On Preventing and Combating Fraud and Corruption in Projects Financed by IBRD Loans and IDA Credits and Grants, known as the 'Anti-Corruption Guidelines' dated October 15, 2006 and revised in January, 2011; (ii) the 'Guidelines: Procurement of Goods, Works, and non-consulting services under IBRD Loans and IDA Credits and Grants by World Bank Borrowers' (known as Procurement Guidelines) published by the World Bank in January 2011 and revised in July 2014; (iii) the 'Guidelines: Selection and Employment of Consultants under IBRD Loans and IDA Credits and Grants by World Bank Borrowers,' (known as Consultant Guidelines) dated January 2011 and revised in July 2014; and (iv) all the accompanying standard bidding documents for any new procurement and the provisions stipulated in the Loan Agreement.

70. The MAPM (DIAEA) and the ORMVAs of Tadla, Haouz, and Doukkala, are experienced in implementing World Bank-financed projects including the ongoing PROMER. During implementation of PROMER, staff involved in procurement participated in several training events organized by the World Bank, and have improved their skills and understanding of World Bank procedures. However, instances of non-compliance and delays were observed, partly due to a misinterpretation of applicable procedures, particularly for the first few contracts. This will therefore require some capacity building and closer guidance by the World Bank.

71. The capacity assessment of the ORMVA of Gharb was carried out during project preparation. It showed that this agency has a good organization in place, which includes: a manual of procedures with specific module on procurement that comprises detailed procurement procedures and standard documents to be used, an internal audit unit, services and departments with dedicated staff that is generally experienced in procurement. The evaluation noted also that the ORMVA of Gharb has no experience in World Bank financed projects, although it has experience with several other donors (AfDB, EIB, AFESD, AFD ...). The ORMVA Gharb, like all other ORMVAs, is subject to the control of the Directorate of Public Enterprises and Privatization

(DEPP) of the MEF for commitments and payments, and to the audits by the General Inspectorate of Finance (IGF) and by the Court of Auditors.

72. The overall risk for procurement is assessed as moderate, and a set of actions to mitigate the risk were identified during project preparation (Annex 3).

E. Social (including Safeguards)

73. OP 4.12 on Involuntary Resettlement is triggered due to potential land acquisition. No physical displacement and no resettlement of persons will occur under the project. The specific sites of infrastructures that might require land acquisition are not yet defined. The Borrower has prepared a Framework Land Acquisition Plan (FLAP), which benefited from thorough consultations with stakeholders, and was disclosed in-country on March 6, 2015 and at the World Bank InfoShop on March 12, 2015. The FLAP specifies the process for preparing, reviewing, approving, and implementing subsequent site specific Land Acquisition Plans (LAPs) prior to relevant civil works being launched.

74. The strengthening of the Grievance Redress Mechanism (GRM) is a prerequisite for the ORMVAs to manage the irrigation network in a way which is more responsive to clients. Currently, farmers can express their complaints to the ORMVAs using different channels, but most complaints are made verbally, and not systematically recorded in logbooks. The DIAEA and the ORMVAs are working with the World Bank's support, on strengthening these existing mechanisms.

F. Environment (including Safeguards)

75. The Borrower has prepared an Environmental and Social Impact Assessment (ESIA), including an Environmental Management Plan (EMP), which benefited from thorough consultations with stakeholders, and was disclosed in-country on March 6, 2015 and at the World Bank InfoShop on March 12, 2015. No major negative irreversible environmental impact is foreseen and the project is confirmed as category B (Partial assessment).

76. OP 4.37 on Safety of Dams is triggered because the irrigation sectors targeted by the project are dependent on existing dams. National legislation for monitoring and management of dams has been reviewed by the World Bank and found fully in line with the requirements of the policy.

G. Other Safeguards Policies Triggered

77. No other safeguards are triggered.

H. World Bank Grievance Redress Mechanism

78. Communities and individuals who believe that they are adversely affected by a World Bank supported project may submit complaints to existing project-level grievance redress mechanisms or the World Bank's Grievance Redress Service (GRS). The GRS ensures that complaints received

are promptly reviewed in order to address project-related concerns. Project affected communities and individuals may submit their complaint to the World Bank's independent Inspection Panel which determines whether harm occurred, or could occur, as a result of World Bank non-compliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the World Bank's attention, and Bank Management has been given an opportunity to respond. For information on how to submit complaints to the World Bank's GRS, please visit http://www.worldbank.org/GRS. For information on how to submit complaints to the World Bank's Inspection Panel, please visit www.inspectionpanel.org.

Annex 1: Results Framework and Monitoring
MOROCCO: Large Scale Irrigation Modernization Project

Project Development Objectives

The project development objectives (PDO) are: (i) for the Doukkala ORMVA, the Gharb ORMVA, the Haouz ORMVA and the Tadla ORMVA, to provide an improved water service to farmers, and (ii) for targeted farmers in the Project Area, to have better access to improved irrigation technologies.

ORMVA Tadla: Sectors G13-G18 (G) and M10-M18 (M)

Project Development Objective Indicators

Indicator	Unit	Base-line 2015	Cumulative Target Values							Data Collection and Reporting		
			YR1 2016	YR2 2017	YR3 2018	YR4 2019	YR5 2020	YR6 2021	End target 2022	Frequency	Data Source	Responsibility for data collection
Direct project beneficiaries, of which female	# %	0 -			M:1,078 G: - M:5 G: -	M:1,078 G:1,848 M:5 G:5	M:1,078 G:1,848 M:5 G:5	M:1,078 G:1,848 M:5 G:5	M:1,078 G:1,848 M:5 G:5	Semester Starting at completion of works on network	Progress reports of TA Comp. 1	ORMVA
Area with access to water on-demand in peak period	%	0				M:100 G: -	M:100 G:100	M:100 G:100	M:100 G:100	Semester After completion of works on network	Survey	TA Comp. 2 for the ORMVA
Area with a request for improved irrigation technologies approved	ha	0			M:800 G: -	M:1,200 G:1,300	M:3,200 G:3,300	M:3,400 G:5,300	M:3,600 G:5,600	Semester Starting at completion of works on network	Database SABA (FDA subsidy)	ORMVA

Intermediate Result Indicators

Component 1 - Improving irrigation network infrastructure												
Progress of works on irrigation network	%	0	M:20 G: -	M:50 G:20	M:100 G:50	M: - G:100				Monthly During work on network	Progress reports	ORMVA
Clients per metering system	#	12			M:0.95 G:-	M: - G:1.12				At completion of works on network	Contract specifications	ORMVA

Outlets with flow in line with technical specifications in peak period	%	-				90	90	90	90	Annual Following completion of works on network	Survey	TA Comp. 2 for the ORMVA
Component 2 - Supporting farmers' access to improved irrigation technologies												
Client days of training provided, gender-disaggregated	# # 	0 0	M:500 G:800 M:25 G:40	M1,000 G:1,600 M:50 G:80	M:1,500 G:2,400 M:75 G:120	M:2,000 G:3,650 M:100 G:180	M:2,800 G:4,900 M:140 G:245	M:3,600 G:6,150 M:180 G:300	M:4,400 G:7,400 M:220 G:370	Semester Throughout implemen--tation	Progress reports	TA Comp. 2 for the ORMVA
Clients that have formalized their request for improved irrigation technologies	%	0			M:10 G: -	M:30 G:10	M:60 G:30	M:70 G:60	M:70 G:70	Semester Starting at completion of works on network	Progress reports	TA Comp. 2 for the ORMVA
Clients using the irrigation information system	%	-				M:10 G: -	M:20 G:10	M:30 G:20	M:40 G:30	Annual Following completion of works on network	Survey	TA Comp. 2 for the ORMVA
Component 3 - Supporting the project implementing entities to manage the irrigation network and to implement the project												
Client days of training provided, gender-disaggregated	# #	0 0		100 10	200 20	300 30	400 40	500 50	600 60	Semester Throughout project implement.		DIAEA and ORMVAs
Clients that have signed a delivery agreement with the ORMVA	%	0				M:10 G: -	M:30 G:10	M:50 G:30	M:70 G:50	Semester Following completion of works on network	Agreements signed	TA Comp. 2 for the ORMVA
Interruptions in water service in peak period exceeding 48 hours	#	-				M:1 G: -	M:1 G:1	M:1 G:1	M:1 G:1	Semester Following completion of works on network	ORMVA's O&M Reports	ORMVA
Average time required for treating grievances related to water service	day	10	10	10	20	20	17	13	10	Semester Throughout project implement.	Grievance registries	TA Comp. 2 for the ORMVA

ORMVA Haouz: Sector Bouida

Project Development Objective Indicators

Indicator	Unit	Base-line 2015	Cumulative Target Values							Data Collection and Reporting		
			YR1 2016	YR2 2017	YR3 2018	YR4 2019	YR5 2020	YR6 2021	End target 2022	Frequency	Data Source	Responsibility for data collection
Direct project beneficiaries, of which female	# %	0 -					1,002 1	1,002 1	1,002 1	Semester Starting at completion of works on network	Progress reports of TA Comp. 1	ORMVA
Area with access to water on-demand in peak period	%	0					100	100	100	Semester After completion of works on network	Survey	TA Comp. 2 for the ORMVA
Area with a request for improved irrigation technologies approved	ha	0					1,000	1,800	2,500	Semester Starting at completion of works on network	Database SABA (FDA subsidy)	ORMVA

Intermediate Result Indicators

Component 1 - Improving irrigation network infrastructure												
Progress of works on irrigation network	%	0		20	50	100				Monthly During work on network	Progress reports	ORMVA
Clients per metering system	#	15				1.00				At completion of works on network	Contract specifications	ORMVA
Outlets with flow in line with technical specifications in peak period	%	-					90	90	90	Annual Following completion of works on network	Survey	TA Comp. 2 for the ORMVA
Component 2 - Supporting farmers' access to improved irrigation technologies												
Client days of training provided, gender-disaggregated	# #	0 0	0 0	500 5	1,000 10	1,500 15	2,000 20	3,000 30	4,000 40	Semester Throughout implemen-tation	Progress reports	TA Comp. 2 for the ORMVA

Clients that have formalized their request for improved irrigation technologies	%	0				10	30	60	70	Semester Starting at completion of works on network	Progress reports	TA Comp. 2 for the ORMVA
Clients using the irrigation information system	#	-					10	25	40	Annual Following completion of works on network	Survey	TA Comp. 2 for the ORMVA
Component 3 - Supporting the project implementing entities to manage the irrigation network and to implement the project												
Client days of training provided, gender-disaggregated	# #	0 0		100 14	200 28	300 42	400 56	500 70	600 84	Semester Throughout project implemen-tation		DIAEA and ORMVAs
Clients that have signed a delivery agreement with the ORMVA	%	0					10	30	50	Semester Following completion of works on network	Agreements signed	TA Comp. 2 for the ORMVA
Interruptions in water service in peak period exceeding 48 hours	#	-					1	1	1	Semester Following completion of works on network	ORMVA's O&M Reports	ORMVA
Average time required for treating grievances related to water service	day	20	20	20	20	20	17	13	10	Semester Throughout project implemen-tation	Grievance registries	TA Comp. 2 for the ORMVA

ORMVA Doukkala: Sectors Z0 and Extension Faregh (EF)

Project Development Objective Indicators

Indicator	Unit	Base-line 2015	Cumulative Target Values							Data Collection and Reporting		
			YR1 2016	YR2 2017	YR3 2018	YR4 2019	YR5 2020	YR6 2021	End target 2022	Frequency	Data Source/ Methodology	Responsibility for data collection
Direct project beneficiaries, of which female	# %	0 -			Z0: - EF:761 Z0: - EF:6	Z0:2,054 EF:761 Z0:11 EF:6	Z0:2,054 EF:761 Z0:11 EF:6	Z0:2,054 EF:761 Z0:11 EF:6	Z0:2,054 EF:761 Z0:11 EF:6	Semester Starting at completion of works on network	Progress reports of TA Comp. 1	ORMVA
Area with access to water on-demand in peak period	%	0			Z0: - EF:100	Z0:100 EF:100	Z0:100 EF:100	Z0:100 EF:100	Z0:100 EF:100	Semester After completion of works on network	Survey	TA Comp. 2 for the ORMVA
Area with a request for improved irrigation technologies approved	ha	0			Z0: - EF:200	Z0:1,100 EF:500	Z0:3,300 EF:800	Z0:4,400 EF:1,100	Z0:4,400 EF:1,400	Semester Starting at completion of works on network	Database SABA (FDA subsidy)	ORMVA

Intermediate Result Indicators

Component 1 - Improving irrigation network infrastructure												
Progress of works on irrigation network	%	0	Z0: - EF:10	Z0:10 EF:50	Z0:50 EF:100	Z0:100 EF: -				Monthly During work on network	Progress reports	ORMVA
Clients per metering system	#	Z0: 7.00 EF: 7.00			Z0: - EF:0.69	Z0:0.49 EF: -				At completion of works on network	Contract specifications	ORMVA
Outlets with flow in line with technical specifications in peak period	%	-				Z0: - EF:90	Z0:90 EF:90	Z0:90 EF:90	Z0:90 EF:90	Annual Following completion of works on network	Survey	TA Comp. 2 for the ORMVA
Component 2 - Supporting farmers' access to improved irrigation technologies												
Client days of training provided, gender-disaggregated	# #	0 0	Z0:680 EF:300 Z0:75 EF:20	Z0:1,350 EF:600 Z0:150 EF:35	Z0:2,050 EF:1,000 Z0:225 EF:60	Z0:3,400 EF:1,500 Z0:375 EF:90	Z0:4,800 EF:2,000 Z0:530 EF:120	Z0:6,500 EF:2,500 Z0:715 EF:150	Z0:8,200 EF:3,000 Z0:900 EF:180	Semester Throughout implemen-tation	Progress reports	TA Comp. 2 for the ORMVA

Clients that have formalized their request for improved irrigation technologies	%	0			Z0: - EF:10	Z0:10 EF:30	Z0:30 EF:60	Z0:60 EF:70	Z0:70 EF:70	Semester Starting at completion of works on network	Progress reports	TA Comp. 2 for the ORMVA
Clients using the irrigation information system	%	-				Z0: - EF: 10	Z0: 10 EF: 20	Z0: 20 EF: 30	Z0: 30 EF: 40	Annual Following completion of works on network	Survey	TA Comp. 2 for the ORMVA
Component 3 - Supporting the project implementing entities to manage the irrigation network and to implement the project												
Client days of training provided, gender-disaggregated	# #	0 0		100 10	200 20	300 30	400 40	500 50	600 60	Semester Throughout project implemen-tation		DIAEA and ORMVAs
Clients that have signed a delivery agreement with the ORMVA	%	0			Z0: - EF:10	Z0:10 EF:30	Z0:30 EF:50	Z0:50 EF:70	Z0:70 EF:80	Semester Following completion of works on network	Agreements signed	TA Comp. 2 for the ORMVA
Interruptions in water service in peak period exceeding 48 hours	#	Z0:3 EF:3	Z0:3 EF:3	Z0:3 EF:3	Z0:3 EF:1	Z0:1 EF:1	Z0:1 EF:1	Z0:1 EF:1	Z0:1 EF:1	Semester Following completion of works on network	ORMVA's O&M Reports	ORMVA
Average time required for treating grievances related to water service	day	20	20	20	20	20	17	13	10	Semester Throughout project implemen-tation	Grievance registries	TA Comp. 2 for the ORMVA

ORMVA Gharb: Sectors North 3 (N3) and North 4 (N4)

Project Development Objective Indicators

Indicator	Unit	Base-line	Cumulative Target Values							Data Collection and Reporting		
			YR1 2016	YR2 2017	YR3 2018	YR4 2019	YR5 2020	YR6 2021	End target 2022	Frequency	Data Source/ Methodology	Responsibility for data collection
Direct project beneficiaries, of which female	# %	0 -				N3:1,261 N4:1,270 N3:32 N4:23	N3:1,261 N4:1,270 N3:32 N4:23	N3:1,261 N4:1,270 N3:32 N4:23	N3:1,261 N4:1,270 N3:32 N4:23	Semester Starting at completion of works on network	Progress reports of TA Comp. 1	ORMVA
Area with access to water on-demand in peak period	%	0				N3:100 N4:100	N3:100 N4:100	N3:100 N4:100	N3:100 N4:100	Semester After completion of works on network	Survey	TA Comp. 2 for the ORMVA
Area with a request for improved irrigation technologies approved	ha	0				N3:700 N4:200	N3:1,200 N4:500	N3:1,700 N4:800	N3:2,200 N4:1,000	Semester Starting at completion of works on network	Database SABA (FDA subsidy)	ORMVA

Intermediate Result Indicators

Component 1 - Improving irrigation network infrastructure												
Progress of works on irrigation network	%	0	N3:25 N4:10	N3:70 N4:65	N3:100 N4:100					Monthly During work on network	Progress reports	ORMVA
Clients per metering system	#	N3: 1,261 N4: 1,270				N3:0.69 N4:1.36				At completion of works on network	Contract specifications	ORMVA
Outlets with flow in line with technical specifications in peak period	%	-				90	90	90	90	Annual Following completion of works on network	Survey	TA Comp. 2 for the ORMVA
Component 2 - Supporting farmers' access to improved irrigation technologies												
Client days of training provided, gender-disaggregated	# # 0	0 0	N3:420 N4:420 N3:135 N4:100	N3:840 N4:840 N3:270 N4:190	N3:1,260 N4:1,260 N3:400 N4:290	N3:2,500 N4:2,500 N3:800 N4:575	N3:3,400 N4:3,400 N3:1,100 N4:780	N3:4,200 N4:4,200 N3:1,350 N4:960	N3:5,000 N4:5,000 N3:1,600 N4:1,150	Semester Throughout implemen--tation	Progress reports	TA Comp. 2 for the ORMVA

Clients that have formalized their request for improved irrigation technologies	%	0			N3:10 N4: -	N3:30 N4:10	N3:60 N4:30	N3:70 N4:60	N3:70 N4:70	Semester Starting at completion of works on network	Progress reports	TA Comp. 2 for the ORMVA
Clients using the irrigation information system	%	-				N3: 5 N4: 5	N3: 10 N4: 10	N3: 15 N4: 15	N3: 20 N4: 20	Annual Following completion of works on network	Survey	TA Comp. 2 for the ORMVA
Component 3 - Supporting the project implementing entities to manage the irrigation network and to implement the project												
Client days of training provided, gender-disaggregated	# #	0 0		100 8	200 16	300 24	400 32	500 40	600 48	Semester Throughout project implemen-tation		DIAEA and ORMVAs
Clients that have signed a delivery agreement with the ORMVA	%	0				N3:15 N4:8	N3:36 N4:24	N3:52 N4:32	N3:60 N4:60	Semester Following completion of works on network	Agreements signed	TA Comp. 2 for the ORMVA
Interruptions in water service in peak period exceeding 48 hours	#	N3:4 N4:1	N3:4 N4:1	N3:4 N4:1	N3:1 N4:1	N3:1 N4:1	N3:1 N4:1	N3:1 N4:1	N3:1 N4:1	Semester Following completion of works on network	ORMVA's O&M Reports	ORMVA
Average time required for treating grievances related to water service	day	15	15	15	20	20	20	15	10	Semester Throughout project implemen-tation	Grievance registries	TA Comp. 2 for the ORMVA

Annex 2: Detailed Project Description
MOROCCO: Large Scale Irrigation Modernization Project

Project area

79. The project targets irrigation sectors in four LSI perimeters: Tadla, Haouz, and Doukkala in the Oum er Rbia River basin; and Gharb in the Sebou River basin (Table 4). The list of sectors was defined on the basis of feasibility studies carried out by the ORMVAs, which included a preliminary design of equipment, consultations with farmers, and financial and economic analyses. Criteria for the selection include:

- economic and financial viability of the investments: the EIRR should be around 12 percent or higher;
- farmers' participation: the areas for which farmers have committed to the project in writing should be higher than 70 percent;
- network in need of rehabilitation: the irrigation sectors recently equipped are excluded; and
- no requirement for additional pumping: the project targets pressurized irrigation sectors or irrigation sectors where topography is favorable to gravity pressure without pumping.

Table 4: Irrigation sectors.

ORMVA	Scheme	Sector	Area	No. farmers	Current equipment and irrigation type
Tadla	Beni-Moussa	G13-G18	7,536 ha	1,848	Surface
	Beni-Moussa	M10-M18	4,563 ha	1,078	Surface
Haouz	Tessout Amont	Bouida	3,440 ha	1,002	Surface
Doukkala	Low Service	Z0	6,332 ha	2,054	Sprinkler
	Low Service	Extension Faregh	1,989 ha	761	Sprinkler
Gharb	Second Tranche	N3	3,617 ha	1,261	Sprinkler
	Second Tranche	N4	1,769 ha	1,270	Sprinkler
TOTAL			**29,246 ha**	**9,274**	

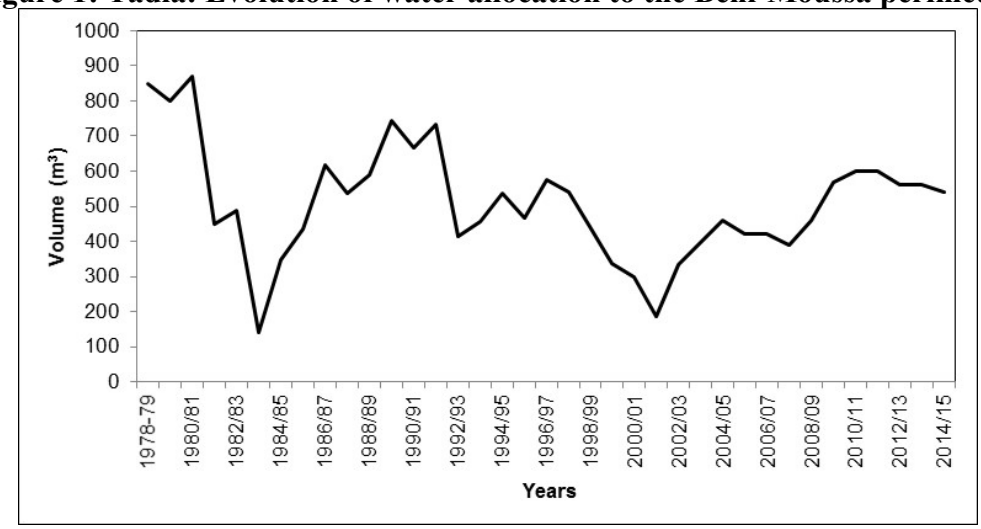
Tadla

80. The area of the ORMVA of Tadla (ORMVAT) overlaps the provinces of Fquih Ben Salah and Azilal. It includes 21 rural communes, with 571,000 inhabitants. The agricultural area is 259,600 ha, including 98,300 ha of LSI, 27,700 ha of small and medium scale irrigation, and 133,600 ha of rainfed farming. Average rainfall ranges between 250 and 350 mm/year.

81. The Tadla LSI perimeter includes two schemes. The Beni-Amir scheme covers 28,700 ha, it is fed by the Oum er Rbia River, and regulated by El Hansali dam (740 Mm^3 capacity). The Beni-Moussa scheme covers 69,600 ha, it is fed by the Oued El Abid (Oum er Rbia affluent), regulated by Bin El Ouidane dam (1,384 Mm^3 capacity) and its associated Ait Ouarda diversion dam through the Afourer hydro-electric complex of power-plants and pumped storage facilities. The schemes are equipped with gravity irrigation systems consisting of semi-circular elevated canals. An area of 9,500 ha was converted by individual farmers to drip irrigation, mainly outside of the LSI perimeter and in a scattered fashion.

82. Surface water resources have been significantly decreasing since the 1970s, which resulted in an average 30 percent deficit compared to the allocation in the PDAIRE (710 Mm^3) for the Beni-Moussa perimeter. The deficit reached its maximum during the agricultural campaign in 1983-84 (184 Mm^3) (Figure 1).

Figure 1: Tadla: Evolution of water allocation to the Beni-Moussa perimeter.



Source: ORMVAT

83. The Tadla area is well endowed in groundwater, with a multilayer system including three deep aquifers (Turonian, Senonian, and Eocene; total abstraction of 241 Mm^3/year), and one shallow aquifer (abstraction of 447 Mm^3/year). Outside the LSI perimeter, deep aquifers are over-exploited because of the declining trend in rainfall and the intensification of private irrigation through pumping. Inside the LSI perimeter, the shallow aquifer is mainly fed by percolation of irrigation water (402 Mm^3/year), and the volume of recharge is strongly related to the volume of surface water delivered to the area. Indeed, shallow groundwater level increased by about 25 m soon after the start of surface irrigation in the 1960s, to then decline to the original level. Shallow groundwater is of mediocre to poor quality, with high levels of nitrates reaching 50mg/l, and salinity in some areas (Beni-Moussa West).

84. The G13-G18 and M10-M18 irrigation sectors are located in the Beni-Moussa West scheme, on the left bank of the Oum er Rbia River. They are supplied through a main canal (GM) receiving water from the Afourer hydro-electric power plant and its recently built associated pumping storage plant. Studies of operation of the scheme have indicated that a volume of about 200,000 m^3 is needed to compensate for the differences in flow in operation of the power plants, demand for irrigation water, and errors in water measurements as well. The G and M sectors are currently fed from several outlets on both the G and the middle-western canals, respectively, which supply precast semi-circular concrete elevated canal networks constructed in 1970 and which show signs of deterioration. Currently, farmers use flood irrigation from small earth canals, with collective management of quaternary canals. The water tariff is DH0.28/m^3.

85. Land is largely privately owned (93 percent for G and 88 percent for M). Seventy percent of farms with less than 5 ha account for 40 percent of the area. Farms of more than 10 ha represent 10 percent of the total number of farms and cover 30 percent of the area. There are six WUAs

(three for G and three for M). Current cropping pattern in the G and M sectors includes: cereals (37 and 36 percent of the surface, respectively); alfalfa (25 and 28 percent); olive trees (17 and 14 percent); sugar beet (8 and 11 percent); vegetables (12 and 5 percent); and citrus (4 and 6 percent).

Haouz

86. The area of the ORMVA of Haouz (ORMVAH) overlaps the provinces of Marrakech, Al Haouz, El Kelaa des Sraghna, and Rhamna. It includes 61 rural communes, with 1,735,000 habitants (including Marrakech city) of which 745,500 people live in rural areas. The agricultural area is 473,000 ha, including 144,600 ha of LSI, 128,400 ha of small and medium scale irrigation, and 200,000 ha of rainfed agriculture. Average rainfall is 270 mm/year.

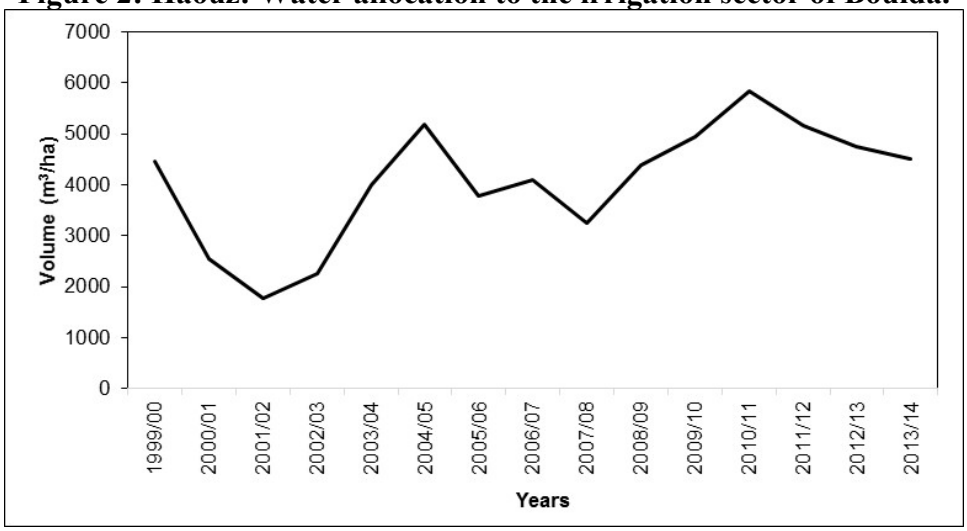
87. The Haouz LSI perimeter includes four schemes. The Tessaout Amont covers 52,000 ha which were equipped in the 1970s. It is fed by a tributary to the Oum er Rbia River (Oued Tessaout) and is regulated by Moulay Youssef dam and the compensation dam Timinoutine. The Tessaout Aval covers 44,000 ha equipped in the 1990s. It is mainly fed through intra-basin transfers from Bin el Ouidane dam (T2 channel). The N'fis and Central Haouz cover 48,600 ha. They are located in the Tensift basin, irrigated by inter-basin transfers (through the Rocade channel) from the Hassan 1st dam on the oued Lakhdar (Oum er Rbia affluent). The schemes are equipped with gravity irrigation systems, either by elevated canals, or by pressurized pipes (N'fis).

88. The Haouz area includes three main aquifers: Haouz, Bahira, and Tessaout Aval. The Haouz aquifer is the most important and is common to Central Haouz, N'fis, and Tessaout Amont schemes, covering an area of 6,000km^2. Its renewable volume is estimated at 351 Mm^3/year, including 250 Mm3/year from deep percolation of irrigation water, while abstraction is estimated at 535 Mm^3/year, resulting in an annual average deficit of 184 Mm^3. The abstraction rate is lower in the Tessaout Amont scheme, located in the Northeast of the aquifer, compared to the central area of the aquifer, where it is overexploited. The Bahira aquifer has a 45 Mm^3/year renewable volume and is slightly overexploited. The Tessaout Aval aquifer water balance is not accurately known; inflow is estimated at between 41-75 Mm^3/year and abstraction is estimated at between 55-80 Mm^3/year.

89. The Bouida irrigation sector is located in the Tessaout Amont scheme. From the Moulay Youssef dam and the compensation dam Timinoutine, water flows in a tunnel (4.25 km long, 17 m3/s flow) into a distribution reservoir (point K), from where the West and the East canals depart. The sector is located on the left bank of the West branch. It is divided in three distinct units: (i) an area of 985 ha, supplied by the secondary canals G1 and G2, where modernization is not possible without pumping and thus not included in the project; (ii) an area of 2,020 ha, supplied by the secondary canals G3 and G4; and (iii) an area of 1,532 ha, supplied by the secondary canals M1 and M2. The water tariff is DH0.35/m^3. The sector is located at the North-East of the Haouz aquifer, where overexploitation is less of a problem compared to the central part of the aquifer. Within the sector, there are about 40 wells with an estimated depth of 70-120m, which irrigate an area of less than 200 ha.

90. Figure 2 presents the annual water allocations to the sector Bouida.

Figure 2: Haouz: Water allocation to the irrigation sector of Bouida.



Source: ORMVAH

91. Land is largely privately owned (65 percent). Twenty-four percent of the land is composed by cooperatives of the agrarian reform, and 10 percent is collective land. Twenty-four percent of farms have less than 2 ha, 32 percent between 2 and 5 ha, and 41 percent between 5 and 10 ha. Current cropping pattern include: cereals (51 percent of the surface); olive trees (30 percent); forage crops (7 percent); and vegetables (6 percent).

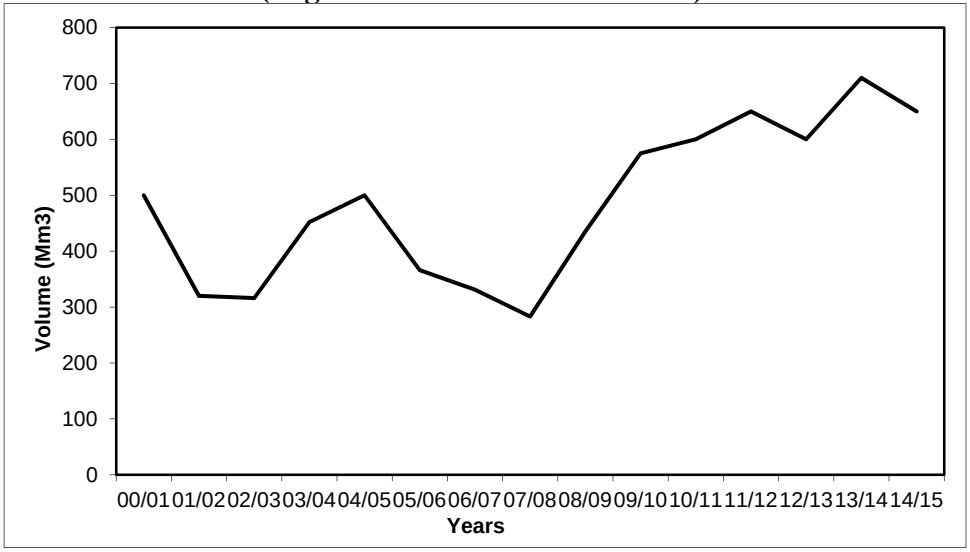
Doukkala

92. The area of the ORMVA of Doukkala (ORMVAD) overlaps the provinces of El Jadida, Safi, and Sidi Bennour. It includes 40 rural communes, with 635,500 inhabitants. The agricultural area is 428,000 ha, including 96,000 ha of LSI, 8,250 ha of private irrigation, and 327,800 ha of rainfed agriculture. Average rainfall is around 325 mm/year.

93. The Doukkala LSI perimeter includes two schemes. The Low Service scheme covers 61,000 ha, and was equipped between the 1930s and 1980s. The High Service scheme covers 35,000 ha, and was equipped in the 1990s. Both schemes are fed from the Oum er Rbia River, which is regulated by the El Hansali dam in the upper basin and El Massira dam in the middle course, and diverted at the Imfout dam. These schemes contain three irrigation types: gravity through canals on 48,500 ha; gravity through low pressure pipes on 14,000 ha; and sprinkler irrigation on 33,500 ha.

94. Surface water supplies for Doukkala strongly decreased during the last ten years, as shown in Figure 3, following a decrease in reservoirs inflows and an extension of the high service scheme.

Figure 3: Doukkala: Evolution of water allocation to the perimeter (High and Low Service schemes).



Source: ORMVAD

95. Groundwater is scarce. There are two aquifers: the aquifer of Doukkala and the aquifer of the Sahel. The aquifer of Doukkala, located under the LSI perimeter, is a low-yield deep aquifer with poor quality water. It is generally not exploited for irrigation. Recharge from percolation is limited by the stratigraphy of the Doukkala plain mostly underlain with heavy clay. The aquifer of the Sahel, located under a narrow strip of land along the coast line and outside the LSI perimeter, is overexploited by private farmers for vegetable production in greenhouses.

96. The Z0 (in the casier Zemamra) and the Extension Faregh irrigation sectors are located in the Low Service scheme. They are supplied through the Imfout dam on the Lower Oum er Rbia, the Imfout gallery (17 km), and the Canal Principal Bas Service (111 km). This canal is lined only on 10 percent of its total length in the sections crossing permeable superficial sandy sections. The actual transit capacity (29 m^3/s) is far below the design capacity (42 m^3/s) with the result that the canal cannot meet the peak demand of all the pumping stations serving the 32,000 ha under sprinkler irrigation, which are thus operated on rotation. The Z0 (composed of two sub-sectors: 322 and 324), put into operation in 1980, includes a concrete lined canal (6.5 km), a pumping station (six groups of 600 KW) regulated by a water tower (62 m high), and a pipe network feeding outlets, each supplying a group of plots in blocks (on average 16 ha). The Extension Faregh, put in operation in 1986, is fed directly from the Canal Principal Bas Service through a pumping station (five groups of 265 KW) regulated by a water tower (63 m high). The distribution network and the irrigation type are similar to those of the Z0. Currently, farmers collectively use mobile sprinkler equipment. The original project was designed for on-demand irrigation, however the deterioration of flow valves and meters resulted in imposing water delivery on rotation between sub-sectors. The water tariff is DH0.52/m^3 for Z0 and DH0.51/m^3 for the Extension Faregh. The ORMVAD has interrupted water delivery to the Extension Faregh sector since 2006 due to the high number of farmers not paying their water bills.

97. Land is largely privately owned (97 percent). The remaining share represents lands that have been distributed to farmers in the course of the agricultural reform. The land tenure structure

of both sectors is characterized by small-scale farming: 78 percent of farmers own less than 2 ha and only 6 percent own more than 5 ha. In both irrigation sectors, current cropping pattern include: cereals (51 percent of the surface), sugar beet (24 percent), fodder (14 percent), and vegetables (10 percent).

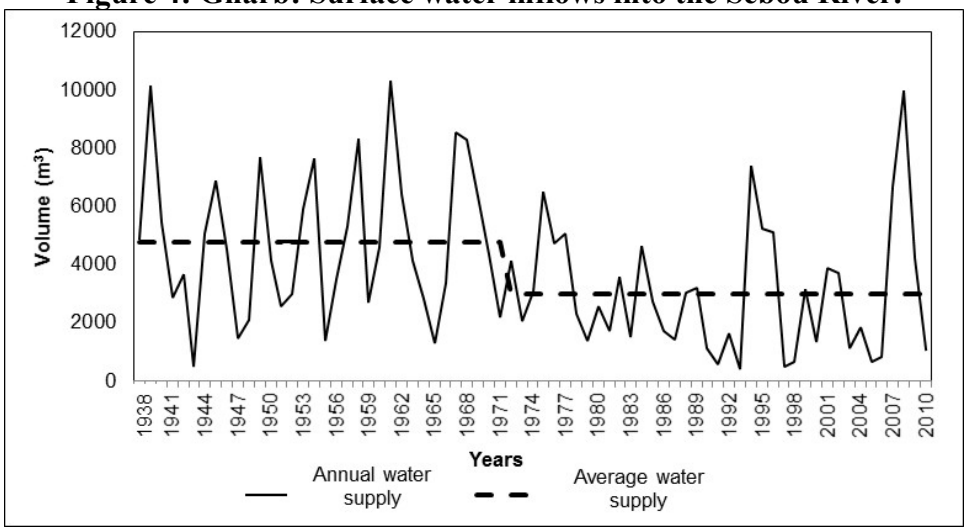
Gharb

98. The area of the ORMVA of Gharb (ORMVAG) overlaps the provinces of Kenitra, Sidi Slimane, and Sidi Kacem. It includes 41 rural communes, with 1,400,000 inhabitants. The agricultural area is 388,000 ha, including 114,000 ha of LSI, 54,000 ha of private irrigation from pumping, and 220,000 ha of rainfed farming. Average rainfall is around 500 mm/year.

99. The Gharb LSI perimeters include: (i) the Beht perimeter of an area of 29,000 ha, equipped in 1934 and of which 14,084 ha were renovated during the period 1978-1994, fed from the River Beht regulated by the dam El Kansera; (ii) the First Tranche perimeter of an area of 36,852 ha, equipped in 1974-1977; (iii) the Second Tranche perimeter of area of 34,607 ha, equipped in 1980-1998; (iv) the Third Tranche perimeter of an area of 9,338 ha, equipped in 1998-2004; and (v) the Mograne perimeter of an area of 2,200 ha, equipped in 1971. These last four perimeters are fed by the Sebou River which is regulated by the Al Wahad dam on the oued Ouergha and by the Idriss 1 on the Inaouene River. A level-control dam downstream of the irrigated perimeters was built to ensure the lift of water to the irrigated sectors and to avoid sea water intrusion. These perimeters are equipped with surface irrigation (79,000 ha), sprinkler irrigation (20,000 ha), flood irrigation (12,000 ha), and low pressure irrigation (3,000 ha).

100. The Gharb area is endowed with abundant surface water resources estimated at 4.8 billion m^3. The main rivers of the region are: the Sebou, the Beht, and the R'dom. The Sebou River is the main source of surface water in the region with an average annual flow of 137 m^3/s. The month of February reflects the highest average (350 m^3/s). The area is characterised by a long rainy season, heavy clay soils, high risk of flooding from the Sebou River, and deep drainage. Surface water resources have significantly decreased since 1973, as demonstrated by the reduction of water inflows into the Sebou River (Figure 4).

Figure 4: Gharb: Surface water inflows into the Sebou River.



Source: ORMVAG

101. There are two aquifers in the Gharb area: the Maamora and the Gharb aquifers. The Maamora aquifer (390 km^2) is located in the southern part of the Kenitra province, and it is the primary source of drinking water in the region. Water of excellent quality can be found within a depth that varies between 5 and 30 m. The Gharb aquifer (4,000 km^2), located under the LSI perimeters, includes two overlapping aquifers: the deep aquifer that flows through sandy-clay sediments and the superficial aquifer. The surface aquifer is used for irrigation within the LSI perimeter. Groundwater level has been relatively stable between 1980 and 2002, with recharge occurring mainly from natural sources.

102. The N3 and N4 irrigation sectors are located in the Second Tranche perimeter. They are fed from the Sebou River via a lift station (eight groups of 3.8 m^3/s each, for a total flow of 30.48 m^3/s) forced back in the main concrete-lined canal and two pumping stations (six groups of 420 l/s and three groups of 505 l/s, for the N3 and N4 respectively) regulated by water towers (77.30 m and 74.30 m high tank), and forced back in a branched pipe network (61 km and 31 km) supplying blocks of approximately 40 ha. Currently, farmers use collective mobile sprinkler equipment. There is significant deterioration of both the distribution network and the irrigation mobile equipment, resulting in poor performances. The water tariff is DH0.60/m^3.

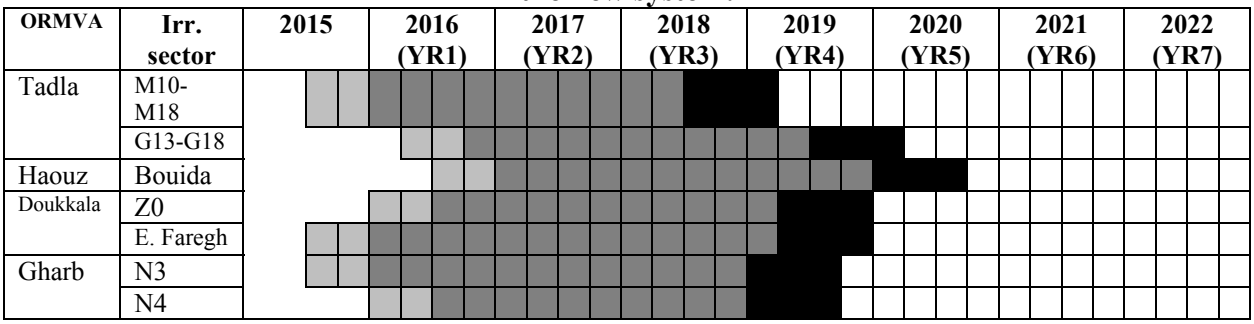
103. Land is privately owned (99 percent for N3 and 63 percent for N4); the N4 sector is characterized by 30 percent state-owned land. In the N3 sector, 63 percent of farms have less than 2 ha of land and cover 18 percent of the area, and 16 percent of farms have more than 5 ha and cover 60 percent of the area. In the N4 sector, 85 percent of farms have less than 2 ha and cover 42 percent of the area, and 4 percent of farms have more than 5 ha and cover 32 percent of the area. Current cropping pattern in the N3 and N4 sectors include: cereals (40 and 38 percent of the surface, respectively); sunflower (18 and 10 percent); sugar beet (8 and 13 percent); forage crops (14 and 12 percent); vegetables (10 and 5 percent); and citrus (0 and 5 percent).

Project Components

104. The project includes 3 components: (1) Improving irrigation network infrastructure; (2) Supporting farmers' access to improved irrigation technologies; and (3) Supporting the project implementing entities to manage the irrigation network and to implement the project.

105. Component 1 supports the conversion of gravity networks and the modernization of pressurized networks, which will take place over the first three to four years of project implementation. In parallel to the works on the networks, Component 2 will facilitate farmers' access to improved irrigation technologies, and it is expected that a large portion of farmers will adopt improved irrigation technologies within 18 months following the completion of the networks. Over the last two to three years of project implementation, Component 2 will support the farmers in the use and management of the improved irrigation technologies, and Component 3 will support the ORMVAs in defining and implementing a strategy for a sustainable O&M of the networks (Figure 5).

Figure 5: Timing and duration of main project activities. In light grey, the procurement of the irrigation network infrastructure; in dark grey, the works on the irrigation network infrastructure; in black, the on-farm equipment; and in white, the use and management of the new system.



Component 1: Improving Irrigation Network Infrastructure (cost excluding taxes: US$135 million)

106. Component 1 will construct pressurized irrigation networks to replace existing gravity networks (Tadla, Haouz), and renovate existing pressurized irrigation networks (Doukkala, Gharb). Under adequate management, the networks' design will provide farmers with an improved water service, in line with the technical requirements of improved irrigation technologies.

107. Component 1 activities will include: (i) carrying out detailed studies, including topographic works and laboratory tests; (ii) provision of technical assistance for monitoring and control of works; (iii) upgrading main irrigation canals and constructing reservoirs to install flow-regulation systems necessary for on-demand irrigation; (iv) constructing feeder pipes for areas that benefit from gravity pressurization, and modernizing pumping stations for areas that need artificial pressurization; (v) constructing filtration stations; (vi) constructing distribution piped networks to replace existing canals, or modernizing and extending existing distribution piped networks; and (vii) installing outlets and associated devices, including meters, at the block and farm levels, to regulate, measure, and control water delivered to farmers.

108. This component will be executed by the ORMVAs.

109. Tables 5 to 8 present the list of activities in Component 1 by ORMVA and by irrigation sector. Unit cost per hectare of off-farm works (including taxes and contingencies) is about DH73,400 (US$7,700) in Tadla and DH63,000 (US$6,600) in Haouz, presently served by gravity system; and about DH30,300 (US$3,200) in Doukkala and DH34,300 (US$3,600) in Gharb, already served through pressurized networks. The share of costs allocated to technical assistance over off-farm works is five percent in Tadla and three percent in Haouz, currently equipped with gravity systems; and seven percent in both Doukkala and Gharb, currently equipped with pressurized networks.

Table 5: ORMVA Tadla: costs for Component 1 activities (Loan financing: 100 percent excluding taxes).

Activity	Description	Quantities		Costs (in DH million) Including taxes	
		G13-G18	M10-M18	G13-G18	M10-M18
Technical assistance	Service provision by expert staff for the monitoring and control of works			24.0	19.2
Control laboratory	Laboratory services for occasional and unscheduled quality and compliance monitoring of equipment and works			7.0	
Construction of reservoir		200,000 m^3		97.0	
Construction of filtration station	Filters installation at the head of the distribution network to eliminate suspended solids and avoid drip lines blockage, and construction of shed	Flow: 4.5 m^3/s	Flow: 2.7 m^3/s	12.0	8.0
Construction of feeder pipes	Supply, transport, and installation of water supply pipes, including hydro-mechanical devices (irrigation valves, valves, etc. .), construction of sheds, and including a stock of replacement parts	Length: 5 km Ø: 1,600 mm		81.7	
		Length: 23.2 km	Length: 19.5 km	86.3	41.8
Construction of distribution network	Supply, transport, and installation of various diameters branched pipe network supplying irrigation blocks; including hydro-mechanical equipment (irrigation valves, suction cups, valves etc.), their sheds, and including a stock of replacement parts	Length: 137 km Ø: 400 to 800 mm Length: 154 km Ø: < 400 mm		113.0	71.5
Installation of block and property outlets equipped with meters and connecting pipes	Supply, transport, and installation of the overall hydro-mechanical equipment (valves, pressure regulators, flow control valves, relief valves, meters, etc.) for flow and pressure regulation and volume measurement at each block and farm levels, including a stock of replacement parts, and of connecting pipes allowing the connection of outlets at the head of blocks to outlets at the head of properties	# block outlet: 293 Length of connecting pipe: 308 km # property outlets: 1,645	# block outlet: 221 Length of connecting pipe: 270 km # property outlets: 1,138	149.4	90.6
Remote data collection system	For property outlets equipped with meters			2.0	2.0
Total cost **Total cost including contingencies**				**805.5** **887.9**	

Table 6: ORMVA Haouz: costs for Component 1 activities (Loan financing: 100 percent excluding taxes).

Activity	Description	Quantities	Cost (in DH million) Including taxes
		Bouida	**Bouida**
Technical Assistance	Service provision by expert staff for the monitoring and control of works		7.0
Control laboratory	Laboratory services for occasional and unscheduled quality and compliance monitoring of equipment and works		1.5
Construction of reservoir		50,000 m^3	35.0
Construction of filtration station	Filters installation at the head of the distribution network to eliminate suspended solids to avoid drip lines blockage and construct the required shed	Flow: 2.04 m^3/s	12.0
Construction of feeder pipes	Supply, transport, and installation of water supply pipes, including hydro-mechanical devices (irrigation valves, valves, etc. .), construction of sheds, and including a stock of replacement parts	Length: 6.24 km Ø: 1,600 mm	42.0
Construction of distribution network	Supply, transport, and installation of various diameters branched pipe network supplying irrigation blocks; including hydro-mechanical equipment (irrigation valves, suction cups, valves etc.), their sheds, and including a stock of replacement parts	Length: 33 km	44.0
Installation of block and property outlets equipped with meters and connecting pipes	Supply, transport, and installation of the overall hydro-mechanical equipment (irrigation valves, pressure regulators, flow control valves, relief valves, meters, etc.) for flow and pressure regulation and volume measurement at each block and farm levels, including remote data collection system and a stock of replacement parts, and of connecting pipes allowing the connection of outlets at the head of blocks to outlets at the head of properties	# block outlet: 136 # property outlets: 1,002	52.0
	Total cost		**193.5**
	Total cost including contingencies		**220.5**

Table 7: ORMVA Doukkala: costs for Component 1 activities (Loan financing: 100 percent excluding taxes).

Activity	Description	Quantities		Cost (in DH million) Including taxes	
		Z0	Ext. Faregh	Z0	Ext. Faregh
Technical Assistance	Service provision by expert staff for the monitoring and control of works, including the environmental monitoring			16.0	
Control laboratory	Laboratory services for occasional and unscheduled quality and compliance monitoring of equipment and works			2.2	
Rehabilitation of Canal Principal Bas Service				30.0	
Modernization of pumping stations				25.0	
Construction of filtration stations	Filters installation at the head of the distribution network to eliminate suspended solids to avoid drip lines blockage and construct the required shed	Flow: 4.6 m^3/s	Flow: 1.4 m^3/s	10.4	3.9
Rehabilitation of distribution network	Replacement of deteriorated hydro-mechanical devices (irrigation valves, suction cups, valves etc.), including a stock of replacement parts			107.6	33.8
Installation of block and property outlets equipped with meters and connecting pipes	Supply, transport, and installation of the overall hydro-mechanical equipment (irrigation valves, pressure regulators, flow control valves, relief valves, meters, etc.) for flow and pressure regulation and volume measurement at each block and farm levels, and including a stock of replacement parts, and of connecting pipes allowing the connection of outlets at the head of blocks to outlets at the head of properties	# block outlets: 584 Length of connecting pipe: 157 km # property outlets: 4,186	# block outlets: 233 Length of connecting pipe: 50 km # property outlets: 1,096		
Remote data collection system	For property outlets equipped with meters			4.0	
Total cost **Total cost including contingencies**				**233.0** **252.6**	

Table 8: ORMVA Gharb: costs for Component 1 activities (Loan financing: 100 percent excluding taxes).

Activity	Description	Quantities		Cost (in DH million) Including taxes	
		N3	N4	N3	N4
Technical Assistance	Service provision by expert staff for the monitoring and control of works			6.1	5.0
Modernization of pumping station	Renovation of all pumps: (i) Purchase of an electric motor which functions at variable speeds; (ii) Renovation of the command table of all groups and installation of an programmable automat to replace the existing relays with a monitoring system; and including a stock of replacement parts			33.0	21.0
Construction of filtration station	Filters installation at the head of the distribution network to eliminate suspended solids to avoid drip lines blockage, and construction of shed	Flow: 2.5 m^3/s	Flow: 1.5 m^3/s		
Rehabilitation of distribution network	Deteriorated hydro-mechanical devices replacement (valves, suction cups, valves etc.), including a stock of replacement parts			64.0	37.0
Network extension through connecting pipes	Supply, transport, and installation of small diameter pipes allowing the connection of outlets at the head of blocks to outlets at the head of properties	Length: 151 km	Length: 94 km		
Installation of block and property outlets equipped with meters and connecting pipes	Supply, transport, and installation of the overall hydro-mechanical equipment (valves, pressure regulators, flow control valves, relief valves, meters, etc.) for flow and pressure regulation and volume measurement at each block and farm levels, and including a stock of replacement parts, and of connecting pipes allowing the connection of outlets at the head of blocks to outlets at the head of properties	# bloc outlets: 178 Length of connecting pipe: 149 km # property outlets: 1,831	# bloc outlets: 93 Length of connecting pipe: 94 km # property outlets: 931		
Remote data collection system	For property outlets equipped with meters			1.0	1.0
Total cost **Total cost including contingencies**				**168.1** **184.7**	

Component 2: Supporting Farmers' Access to Improved Irrigation Technologies (cost excluding taxes: US$6 million)

110. Component 2 will strengthen farmers' knowledge and awareness in accessing improved irrigation technologies (mainly drip irrigation), which could be adopted as a result of the improved water service provided by the ORMVAs. It will facilitate access to financing opportunities by supporting Water Users Associations (WUAs) in jointly applying to FDA subsidy on behalf of the farmers. Once the improved irrigation technologies are in place, farmers will develop their capacity to manage and maintain the irrigation systems. Farmers will also develop better knowledge of their groundwater, where appropriate.

111. Component 2 activities will include: (i) provision of technical assistance to the Project Implementing Entities to support farmers to access and manage improved irrigation technologies; (ii) acquisition of equipment for the Project Implementing Entities to monitor performance of irrigation systems; and (iii) provision of technical assistance to, and acquisition of equipment for the Project Implementing Entities to create an irrigation information system, and/or to strengthen an existing irrigation information system (Table 9).

112. This component will be executed by the ORMVAs.

Table 9: Costs for Component 2 activities (Loan financing: 100 percent excluding taxes).

Activity	Cost (in DH million) including taxes			
	ORMVAT	ORMVAH	ORMVAD	ORMVAG
Provision of technical assistance to the ORMVAs to support farmers to access and manage improved irrigation technologies	25.0	6.0	12.0	14.3
Acquisition of equipment for the ORMVAs to monitor performance of irrigation systems	0.8	0.8	0.8	0.8
Provision of technical assistance to, and acquisition of equipment for the ORMVAs to create an irrigation information system, and/or to strengthen an existing irrigation information system	1.2	1.2	1.2	1.9
Total cost	**27.0**	**8.0**	**14.0**	**17.0**
Total cost including contingencies	**31.2**	**9.1**	**16.2**	**19.6**

Technical assistance to the ORMVAs to support farmers to access and manage improved irrigation technologies

113. This technical assistance will accompany farmers along the modernization process and facilitate their engagement in the project. Activities will be clustered around farmers' specific needs before / after the introduction of improved irrigation technologies (mainly drip irrigation). The two sets of activities will overlap, as not all farmers will transition at the same time. One contract with a firm will be passed by each ORMVA for the whole duration of project implementation. Throughout implementation, dissemination material will be made available in local language, and regular reports will be produced. As the ORMVAs and the National Agency for Agricultural Advisory Services (ONCA) are responsible of the irrigation and agricultural advisory services, respectively, their staff will be involved in specific activities carried out by the technical assistance to facilitate transition.

114. Before the introduction of improved irrigation technologies, and in parallel with the off-farm works, the technical assistance will focus on (but not be limited to):

- Participatory social diagnostic: Building on the results of the feasibility studies, this diagnostic will provide an understanding of participating farmers' characteristics, needs, and challenges. Farmers will be made aware of the details of project design and the timeline of works and activities for their specific sector. Further opportunities for farmers' engagement and for activities that strengthen women in the project area will be identified. A comprehensive training program in support to farmers and for the whole duration of the technical assistance will be conceived, to ensure a coherent approach. Farmers' feedback will be considered when designing the training program, including feedback on appropriate timing (regarding time of year and time of day), and location or venue as well as ways in which such trainings may attract a greater audience. Specific attention will be devoted to women.
- Land: A review of the actual situation of land use to account for the joint ownership and informal arrangement for joint farming will be carried out. This review will provide information on the actual number of farmers benefitting from the project compared to the number of clients accounted for in the M&E system. If needed, the area will be georeferenced (GIS). These activities will allow refining the design for off-farm works (in terms of location and number of outlets), and it will set the basis for the on-farm equipment.
- Awareness activities on improved irrigation technologies: Farmers will familiarize themselves with improved irrigation technologies, with a focus on drip irrigation. Demonstration plots (established among farmers within the sector that have already privately converted to improved irrigation technologies, or among farmers in nearby irrigation sectors for which the modernization has already taken place) will allow comparing traditional and improved irrigation technologies. In-door training and visits to modernized irrigation sectors will also be organized.
- Access to financing: Farmers will receive support to jointly request the subsidy of the FDA for purchase and installation of drip irrigation equipment, with assistance to master the administrative and legal requirements. Application for the subsidy can be submitted by farmers individually or jointly: the technical assistance will focus on joint requests which are eligible for a higher subsidy (virtually 100 percent for drip irrigation). In order to allow for joint requests of the subsidy, the technical assistance will strengthen Water Users Associations (WUAs) where they are already in place (Tadla, Haouz, Doukkala), or their creation for the specific purpose (Gharb). Farmers will delegate WUAs to procure irrigation equipment, and to ensure duly completion of on-farm works.
- Awareness activities on groundwater: Farmers will benefit from awareness activities on aquifer exploitation, and will be made aware of potential impacts of climate change on groundwater resources. Farmers will be encouraged to adopt meters on their wells on a voluntary basis.

115. Once the ORMVAs start providing an improved water service, and for those farmers who will convert to the improved irrigation technologies, the technical assistance will focus on (but not be limited to):

- Information on improved water service: Farmers will receive information on the characteristics of the water service and will be given an opportunity to provide their feedback. The technical assistance will facilitate the dialogue between farmers and ORMVAs as the new rules are established, and will consolidate inputs to improve the service over time.
- Information on how to use, manage, and maintain the on-farm irrigation systems: Training will be provided on how to operate and maintain the on-farm equipment, to ensure satisfactory performances in the long term. As the ORMVAs and the ONCA are responsible of the irrigation and agricultural advisory services, respectively, their staff will be involved at this stage to facilitate a smooth transition. Among others, the ORMVA staff will collaborate with the technical assistance in the periodical assessment of on-farm performance. The ONCA staff will collaborate with the technical assistance in providing advisory services to farmers on sustainable use of agricultural inputs (fertilizers, pesticides). Linkages will be made with the irrigation information system provided by the ORMVAs, to define optimal irrigation scheduling in terms of irrigation application and timing.
- Monitoring of groundwater use: The monitoring of groundwater extraction by farmers who volunteer to have meters installed on their wells will continue throughout project implementation. The collected data will allow verification of the project's assumption that the provision of an improved water service by the ORMVAs, accompanied by more efficient on-farm irrigation techniques, will reduce farmers need to tap into the groundwater.

116. Throughout the project, the technical assistance will support the ORMVA in the Monitoring and Evaluation (M&E). The technical assistance will be responsible for periodic sampling and surveys. Annex 1 specifies the indicators the technical assistance will report on.

Equipment for the ORMVAs to monitor performance of irrigation systems

117. Small equipment (manometers, water leak detectors, or data-loggers, etc.) will be purchased to allow ORMVA staff to monitor the functioning and performance of the network, the outlets, and the on-farm water distribution. In collaboration with the technical assistance described above, ORMVA staff will periodically select a sample of farmers and assess performance of the improved equipment. This periodical assessment will also inform farmers on the need to carry out proper maintenance of the on-farm equipment to ensure that performances remain satisfactory over time.

Technical assistance to, and acquisition of equipment for the ORMVAs to create an irrigation information system, and/or to strengthen an existing irrigation information system

118. Farmers will receive support in the use of the improved irrigation technologies through an irrigation information system, which - based on local climatic conditions - will calculate the water requirements by crop at each specific time in the growing cycle. Agro-meteorological stations will be purchased and installed to allow the ORMVAs to estimate the crop evapotranspiration (ETc). In collaboration with the technical assistance in support of farmers, an adequate strategy will be put in place to allow farmers to have easy access to the agro-meteorological information.

Information sharing could be done in different ways: (i) distribution bulletins in paper form; (ii) displaying data on a screen in an easily accessible and frequented place; and (iii) sending SMS to farmers who have previously registered.

Component 3: Supporting the Project Implementing Entities to Manage the Irrigation Network and to Implement the Project (cost excluding taxes: US$9 million)

119. Component 3 will strengthen the institutional capacity of the ORMVAs in operating and maintaining the irrigation networks, to ensure that new and renovated networks are managed so as to provide farmers with an improved water service, in line with the requirements of improved irrigation technologies, and that performances remain satisfactory over time. Component 3 will also support the MAPM (DIAEA) and the ORMVAs in implementing the project.

120. Component 3 activities will include: (i) provision of training and technical assistance to selected staff of MAPM, and acquisition of computer equipment, software and associated tools for project coordination and for supporting the Project Implementing Entities as needed; (ii) provision of technical assistance to the Project Implementing Entities for improving the O&M of the irrigation network; (iii) provision of training and technical assistance to the Project Implementing Entities, and acquisition of goods for project implementation; and (iv) rehabilitation of selected buildings and acquisition of office equipment for the Project Implementing Entities (Table 10).

121. This component will be executed by the MAPM (DIAEA) (subcomponent i) and the ORMVAs (subcomponents ii, iii, and iv). The MAPM (DIAEA) will be responsible for those activities requiring coordination across ORMVAs.

Table 10: Costs for Component 3 activities (Loan financing: 100 percent excluding taxes).

	Cost (in DH million) including taxes				
Activity	**DIAEA**	**ORMVAT**	**ORMVAH**	**ORMVAD**	**ORMVAG**
Provision of training and technical assistance to selected staff of MAPM, and acquisition of computer equipment, software and associated tools for project coordination and for supporting the ORMVAs as needed	8.0	-	-	-	-
Provision of technical assistance to the ORMVAs for improving O&M of the irrigation network	-	8.0	8.0	8.0	8.0
Provision of training and technical assistance to the ORMVAs, and acquisition of goods for project implementation	-	11.2	8.5	10.8	4.8
Rehabilitation of selected buildings and acquisition of office equipment for the ORMVAs	-	7.2	1.5	7.5	1.2
Total cost	**8.0**	**26.4**	**18.0**	**26.3**	**14.0**
Total cost including contingencies	**9.3**	**29.5**	**20.4**	**29.5**	**16.0**

Training and technical assistance to selected staff of MAPM, and computer equipment, software and associated tools for project coordination and for supporting the ORMVAs as needed

122. These activities will include (but not be limited to):

- Technical assistance for project implementation: As staffing is a recurrent issue for the DIAEA, technical assistances will be provided to support project monitoring and evaluation, and the production of periodical reports. The technical assistance will also aim at facilitating consistency in project implementation and coordination across ORMVAs.
- Monitoring and Evaluation (M&E): The project will finance training, technical assistance, and computer equipment, software to the DIAEA for designing and implementing technical and management tools, including design and update of the monitoring and evaluation (M&E) system, use of remote sensing to estimate a water balance before / after project implementation, and georeferencing (GIS) of the project area.
- Technical assistance in support to the implementation of the Environmental Management Plans (EMP) and Land Acquisition Plans (LAP): In order to ensure adequate implementation of the EMPs and LAPs, the project includes training for staff in MAPM.

Technical assistance to the ORMVAs for improving the O&M of the irrigation network

123. This technical assistance will accompany the ORMVAs on the challenges of operating and maintaining the irrigation networks to achieve a performing water service responsive and accountable to farmers. This will entail a series of activities directed at capacity building of ORMVA staff. Considering the practical and multi-layered nature of these challenges, an approach based on one single technical assistance contract for each ORMVA (as opposed to contracting each activity under different contracts) and relying on a peer-to-peer knowledge transfer has been identified as the most adequate. Each ORMVA will pass a contract with an irrigation utility that will provide a comprehensive package of activities matching the evolving needs of the ORMVA, focusing on the transfer of practical O&M expertise. The technical assistance will support the ORMVA through *ad-hoc* technical support, production of studies and notes, trainings, and study tours. This technical assistance will be critical to ensure the quality of the water service to farmers, and hence the long-term sustainability of the off-farm investments under Component 1. The technical assistance will be in place at least one year before the completion of the off-farm works, and continue throughout the rest of project implementation.

124. The technical assistance will focus on (but not be limited to):

- Operation strategy: Following the construction and modernization of the irrigation networks, the ORMVA will face a new set of challenges in their day-to-day operation. Water allocation between modernized / non-modernized sectors, as well as between farmers with improved / traditional irrigation technologies will have to be defined, taking into consideration the contrasting needs. In order to maximize the benefit of the investments, the ORMVA will have to switch from the traditional water allocation as function of the cropping pattern and of the production of strategic crops, to an annual quota per hectare, to allow farmers to freely respond to market signals and maximize their income. This transition is not obvious, as it requires a conceptual shift of the ORMVA staff

in addition to good communication with farmers. In addition, the ORMVA will have to operate the irrigation networks taking into account farmers who will keep irrigating using surface or traditional sprinkler irrigation, and this without disrupting the performance of the network for the farmers who have introduced the improved technique. The technical assistance will support the ORMVA in defining and formalizing its operation strategy, identifying gaps, the necessary actions to be implemented as a consequence, and the corresponding resources needed.

- Maintenance strategy: A new maintenance strategy needs to be defined and implemented to ensure a rapid response to shut-downs, with re-establishment of the service within 1-2 days (rather than 7-10 days). This fast response is needed in order to avoid or minimize negative impacts on crop production: as drip irrigation allows for frequent irrigation applications with small volumes, crops have limited water storage in the soil and rapidly suffer water stress. A comprehensive preventive and corrective maintenance strategy requires procedures for systematic inspection of the network, creation of a stock of replacement parts which would otherwise not be available on the market as need arise, identification of responsibilities to keep in-house (what can be directly done by the staff of the ORMVA) and to outsource, and quantification of adequate resources (staff and budget).
- Internal diagnostic: The technical assistance could support the ORMVA in the strategic thinking related to accountability, financial viability, and managerial autonomy. It could support the diagnostic of the current situation of irrigation water services provision (operational performance, service quality, tariff level, and cost recovery) and the identification of gaps.
- Relations with clients: As the ORMVA evolves towards a quality-based service, capacity to have smooth communication with the farmers becomes of increasing importance. The technical assistance will support the ORMVA in defining and applying the concept of "customer responsiveness". This will include – among others – support to the strengthening of the Grievance Redress Mechanism (GRM). Also, consultations with farmers might allow better assessing the current gaps in the communications between the ORMVA staff and the farmers on specific issues.

<u>Training and technical assistance to the ORMVAs, and acquisition goods for project implementation</u>

125. These activities will include (but not limited to):

- Technical assistance for project implementation: As staffing is a recurrent issue for the ORMVAs, technical assistances will be provided to support project's monitoring and evaluation, and the production of periodical reports.
- Technical assistance to the ORMVAs for the technical review of the requests for FDA subsidies: The ORMVAs are responsible for verifying the design and installation of the drip irrigation systems. The project is expected to increase uptake of drip irrigation and will add to the workload of those responsible for checking the technical validity of the systems. The project will therefore provide technical assistance to support the ORMVAs with this work.
- Monitoring and Evaluation (M&E): The project will finance training, technical assistance, computer equipment, software, and associated tools to the ORMVAs for designing and

implementing technical and management tools, including design of the monitoring and evaluation (M&E) system, use of remote sensing to estimate a water balance before / after project implementation, and georeferencing (GIS) of the project area.

- Technical assistance in support to the implementation of the Environmental Management Plans (EMP) and Land Acquisition Plans (LAP): In order to ensure adequate implementation of the EMPs and LAPs, the project includes: (i) training for staff in the ORMVAs; (ii) collection of data relating to the project's environmental indicators as defined in the EMP, including baseline data at the beginning of the project; and (iii) strengthening the ORMVA laboratories to effectively monitor the environmental indicators.

126. Goods financed will include, among others, computer equipment, software and associated tools, and vehicles.

Rehabilitation of selected buildings and acquisition of office equipment for the ORMVAs

127. This set of activities will include the rehabilitation of office buildings of the ORMVAs, in addition to the acquisition of office equipment, including office building and equipment made available for the WUAs. Also, it will include the rehabilitation of buildings for workshops for in-house maintenance.

Annex 3: Implementation Arrangements
MOROCCO: Large Scale Irrigation Modernization Project

PROJECT INSTITUTIONAL AND IMPLEMENTATION ARRANGEMENTS

ORMVAs

128. *Status* – The ORMVAs are public state owned agencies with legal status and financial autonomy. The ORMVAT, ORMVAH, ORMVAD, and ORMVAG are respectively governed by Royal Decrees nr. 828-66 and 873-66; 831-66 and 876-66; 827-66 and 872-66; and 830-66 and 875-66 of 7 Rajab 1386 (22 October 1966) related to their creation.

129. *Funds* - The ORMVAs have two major sources of funds: water revenues and transfers from the Government. Unexpected and incidental incomes, and revenues for services provided to other parties are additional minor sources of funds.

130. *Governance* - The Board of Directors composition, chaired by the Minister of Agriculture, is set by Decree. The Decree sets two annual meetings, one in June to close accounts books and one in October to adopt the budget for the upcoming year.

131. *General organization* - The organizational chart of the ORMVAs of Tadla, Doukkala, and Gharb includes departments covering the following areas:

- Service of Internal Audit and Management Control,
- Service of General Affairs,
- Human Resources Department,
- Planning and Finances Department,
- Infrastructure Development Department,
- Irrigation and Drainage Networks Management Department, and
- Agricultural Development Department.

132. The organizational chart of the ORMVA of Haouz includes services covering the following areas:

- Internal Audit and Management Control Unit,
- Means Service,
- Administrative and Financial Service,
- Planning and Programming Service,
- Infrastructure Service,
- Irrigation and Drainage Networks Management Service,
- Agricultural Production Service,
- Livestock Service, and
- Extension Service.

133. *Financial organization* - Each Planning and Finances Department of the ORMVAs of Tadla, Doukkala, and Gharb includes following services:

- Planning Service,
- Accounting and Financial Service, and
- Information Service.

134. The Planning and Programming Service of the ORMVA of Haouz includes following divisions:

- Programs and M&E Division,
- Budget Division,
- General Accounting Division,
- Financial Division, and
- Procurement Division.

135. *Information system* - The ORMVAs developed an information and management system in 1993. This information system counts several applications, including those covering integrated accounting, internal fees, human resources, and recovery procedures. On the whole, the information system is operational even if they are not standardized among the ORMVAs. They nevertheless allow developing budgetary statements (commitments and payments), activity reports, and synthesis statements. They provide a satisfactory management framework that should be upgraded through interfaces among different existing modules to get an integrated system.

136. *Staff* – The ORMVAs staff status is governed by provisional regulations similar to that of civil servants.

137. *Fiscal status* – The ORMVAs are submitted to different taxes (VAT, corporation taxes, Professional Tax, etc.) in accordance with legislation and regulation in force. They have prepared and submitted tax return to Tax authorities since fiscal year 2005.

Implementation arrangements

138. *Implementing entities and project implementation arrangements*- The project will include four implementing entities: the ORMVAs of Tadla (ORMVAT), Haouz (ORMVAH), Doukkala (ORMVAD), and Gharb (ORMVAG) will implement most of the activities in coordination with the Directorate of Irrigation and Rural Infrastructure (DIAEA) of the MAPM. Some training and technical assistance, and acquisition of computer equipment, software and associated tools for project coordination and for supporting the ORMVAs as needed under Component 3 will be implemented by the MAPM (DIAEA).

139. *Project management structure* - The project will have a national project manager (the Director of DIAEA) who will head a Central Project Management Unit (UCGP) including a national project coordinator, a M&E specialist, and a financial management specialist. Each ORMVA will establish a Regional Project Management Unit (URGP), including staff responsible for: project coordination, procurement, financial management, M&E, and environmental

monitoring. In Doukkala and Gharb, an additional staff responsible for the recovery of debts will be appointed.

140. *Project implementation arrangements* - Most project activities will be implemented by the ORMVAs in coordination with the MAPM (DIAEA), with the exception of some training and technical assistance, and acquisition of computer equipment, software, and associated tools for project management under Component 3 that will be implemented by the MAPM (DIAEA).

141. The MAPM (DIAEA) and the ORMVAs of Tadla, Haouz, and Doukkala are experienced in managing World Bank-funded projects - the Oum er Rbia Basin Irrigated Agriculture Modernization Project (PROMER, 2010-2016) being the most recent. Specific training will be provided to UCGP and URGPs staff to further strengthen their knowledge on project management and World Bank procedures. Each ORMVA targeted by the project manages large scale irrigated areas covering about 100,000 ha. There is strong technical and managerial capacity to implement large irrigation development and modernization projects. Nevertheless, technical assistance will be required to support ORMVA staff with supervision and managing the transition period to the new pressurized irrigation systems.

142. The ORMVAs will implement project activities according to the Project Implementation Manual. Coordination meetings will be organized by the MAPM (DIAEA) and the ORMVAs at least twice a year, to share information about project implementation progress and discuss relevant issues with all institutions concerned including other MAPM departments; Ministry of Economy and Finance (MEF); Ministry of Energy, Mines, Water and Environment, and the Oum er Rbia River Basin Agency and the Sebou River Basin Agency. Regular meetings will also be organized by the MAPM (DIAEA) and the ORMVAs to share information between and within the ORMVAs regarding project implementation progress and to discuss relevant issues.

Financial Management, Disbursement, and Procurement

Financial Management

143. During project preparation, the World Bank team carried out a financial management capacity assessment of MAPM (particularly DIAEA) and of the four ORMVAs. This assessment included: (i) a visit to DIAEA and ORMVAs; (ii) a series of meetings held with representatives from the implementing entities; and (iii) a self-evaluation questionnaire facilitated by the ORMVAs. The capacity assessment determined whether adequate internal control procedures were in place to enable satisfactory financial management. The assessment also determined whether adequate financial reporting and ex-post reviews were in place to ensure that project funds would be used for their intended purposes.

144. The assessment established that the project will be implemented using the country's system governed by current regulations, as it was determined to meet the World Bank's requirements.. The assessment also relied on existing staff within the ORMVAs and the DIAEA. Project-related expenses are part of the ORMVAs' and DIAEA's budgets. An independent financial monitoring system will be implemented to ensure rigorous supervision of project expenditures and payments.

145. Moreover, the capacity assessment identified the following main risks:

- Staff experienced with World Bank projects may retire or change assignments: training is planned to build capacity of the teams in charge of project financial management.
- Difficulty in obtaining consolidated project financial information: the project will apply new procedures included in the World Bank directives for simplification and not require consolidated financial data. Consequently, the MAPM (DIAEA) and each ORMVA will produce their own separate financial reports. Each year, the consolidated project financial situation will be summed up in MAPM's (DIAEA) annual report.
- Government budgetary commitment inadequate for the entire project life: the Government's strategy, the PMV, indicates increased priority to high-value irrigated agriculture and therefore reduces this risk.
- Insufficient private investment by farmers due to climate-related reasons (drought) or inappropriate incentive systems (contribution to investments cost): this risk is reduced in two ways: (i) prior to commencement of works, signed commitments from targeted farmers need to be received for at least 70 percent of the area; and (ii) the Government introduced a regulatory framework specific for the subsidies encouraging private investment in modern irrigation techniques.

146. Based on the assessment's findings and on the actions presented to mitigate the identified risks, the residual financial management risk is moderate.

Detailed Financial Management Assessment

147. *National system* - The World Bank's experience in Morocco indicates that the Moroccan public finance system is governed by an elaborate legal and regulatory framework. It also contains strong reliability and transparency safeguards. The system is based on the principle of strict separation between authorizing officers and accounting officers. Moreover, the system includes: (i) prior authorization of expenditures and supervision; and (ii) internal and external audits. Reform of the public sector financial control began under Law 69-00 of November 11, 2003, modifying Dahir of April 14, 1960, modified in 1962. The financial management risk of the Moroccan public finance system is considered low.

148. *Experience in the sector* - The PROMER is the latest of a long list of projects which provided the World Bank with experience working with ORMVAs in the sector. The MAPM benefited from several projects funded by the World Bank and other donors, gaining significant experience in donor-funded management. Lessons learned from previous projects indicate that the project should take into account the current management capacities of the ORMVAs and to adapt to potential budgetary constraints.

149. *Extent of the financial management capacity assessment* - The assessment addressed human resources, accounting systems, internal control mechanisms, audit modalities, current information systems, and financial reporting capacities related to project implementation.

150. *General framework* - The ORMVAs financial management system is based on principles and procedures defined by the legal framework applicable to the public sector, more precisely, to the principles applicable to government institutions and public agencies.

151. *Budgeting system* - Based on the projects and actions planned for the upcoming fiscal year, the ORMVAs prepare their budget. Budgets are centralized at the MAPM level and are validated by the ORMVAs' boards chaired by the Minister of Agriculture, and then, are approved by MEF. The ORMVA directors are authorizing officers for expenditures and revenues. The fiscal year expenses can be committed and paid only if they have been included in the adopted budget. Public expenses are controlled in advance by a State supply fiscal officer each time the threshold for the review is reached and afterward by the Treasury pay-master. Other controls might be the General Inspector of Finance and an independent Court of Audits. ORMVA's accounts are also subject to an annual external financial and accounting audit.

152. *Reporting* - The MAPM shall prepare project progress reports on the basis of indicators agreed with the World Bank. Each project report shall cover one semester of the calendar year and shall be provided to the World Bank not later than forty-five (45) days after the end of the period covered by the report.

153. *Interim unaudited financial reports* (IUFRs) - Each ORMVA shall prepare and furnish to MAPM not later than thirty (30) days after the end of each semester of the calendar year, interim unaudited financial reports for its respective part of the Project covering the semester, for incorporation and forwarding by MAPM to the World Bank not later than forty-five (45) days after the end of each semester of the calendar year of the overall interim unaudited financial report for the Project. The IUFRs should include data on the financial position of the project. Accordingly, they should include: (i) statement on sources and uses of funds for the reporting period and with cumulative figures, including a statement on project balances of accounts; (ii) a statement of use of funds by component and expenditure type; and (iii) a variance analysis indicating budgeted amounts versus actual and explanation of variances.

154. *Project financial statements* - The statements should include: (i) cash flow statement; (ii) closing financial position; (iii) status of ongoing commitments; and (iv) analysis of payments. There is no need to include a specific information system to consolidate financial data at the MAPM (DIAEA) level. The MAPM (DIAEA) and each ORMVA will use their own financial information system.

Flow of funds

155. The GoM has committed to provide to the ORMVAs of Tadla, Haouz, Doukkala, and Gharb the budgetary counterparty of the loan necessary for the implementation of their responsibilities with regards to the project in the form of grants. The allocation of the funds to the ORMVA will be based on budgetary procedures acceptable to the World Bank, and on the basis of an annual planning process which allows implementing the project according to the agreed planning between the GoM and the World Bank. Based on this, no subsidiary agreement will be needed. The budgetary procedures are as follows:

- The Head of Government establishes an framework letter relating to the preparation of the Budget Law;

- The MEF (Directorate of Public Enterprises and Privatization, DEPP) establishes an orientation note about the draft budgetary plans of State Owned Enterprises, which includes the ORMVAs, specifying in particular the conditions for preparation of their budget;
- The ORMVAs prepare their draft budgetary plans and submit them to the MAPM (Directorate of Finance, DF) for review and approval;
- The MAPM (DF) holds meetings on budgetary discussions in the presence of the Central Directorates of the MAPM and each ORMVA, at the end of which the draft budgetary plan of each ORMVA is consolidated;
- Each ORMVA submits its draft budgetary plan for review and approval by its Board;
- The MEF (Directorate of Budget, DB) organizes the meetings of the budgetary commissions of each ORMVA during the month of December of the year when the draft budgetary plans are examined. During this occasion, the MEF (DB) monitors the priority in budgetary allocation for projects or programs financed by external donors; The draft budgetary plans of the ORMVAs become final and effective after their approval by the MEF;
- The grants to the ORMVAs on the basis of each Budget Law will be allocated in accordance with the provisions of the Organic Budget Law;
- The budgets of the ORMVAs are approved by the MEF in the course of the first months of each year;
- The MEF (DB) requests a monthly budgets execution situation from the ORMVAs; and
- The mid-term review meetings are planned by the MEF (DB) at the end of the first semester of the current year to allow a dynamic management of the allocated budgetary funds and to conduct necessary adjustments.

Internal controls

156. The internal control system set within ORMVAs is in line with existing country internal control framework (based on an authorizing officer, controller and pay-master separate functions principle). It is considered satisfactory by the World Bank.

157. Under Law Nr. 69-00 of 2003, the ORMVAs' expenditures are controlled by a State controller (commitments) and a Treasury pay-master (payments), both appointed by the MEF. The appointed State controller is in charge of all ex-ante controls required under procurement. The Treasury pay-master jointly signs all payments that the ORMVAs make.

158. Excluding the Board of Directors, ORMVAs internal control system is strengthened by an Audit Committee, in accordance with the provisions of the Code of Practice and Governance of private firms and institutions. The audit Committee is responsible for commissioning audits and following up on audit results as well as other evaluations as necessary.

159. Each ORMVA has an internal audit unit. The ORMVAs are also subject to audits by the General Inspectorate of Finance (IGF) and the General Inspectorate of the Ministry of Agriculture (IGA). The ORMVA's internal audit unit conducts several audits under an annual internal audit program.

160. Each ORMVA has an existing procedural manual that describes all management rules applicable. This manual is independent of this project.

External Audit

161. ORMVAs' financial statements have been audited for several fiscal years by independent external auditors. As noted above, the ORMVAs are subject to controls by IGA, IGF, as well as to the external audit by the Court of Auditors.

Audit of Project Financial Statements

162. The Borrower will have its financial statements audited in a manner acceptable to the World Bank. Each audit shall cover the period of one fiscal year. The audited financial statements for each period will be sent to the World Bank not later than six (6) months after the end of the period.

163. The annual accounts audit will cover all Project aspects, sources and uses of funds. It also will relate to financial operations and internal controls, and the financial management system.

164. The audit will be conducted by:

- An auditor acceptable to the World Bank who will cover all financial operations as well as internal and financial management controls related to all project operations implemented within the MAPM (DIAEA); and
- The external auditor of each ORMVA; audit will be conducted in compliance with professional international audit standards.

165. The auditors will develop: (i) an annual audit report including opinion on project annual financial statements, and (ii) report on internal control weaknesses. Each ORMVA's audit report along with Borrower's audit will be submitted to the World Bank within six months following the end of each fiscal year.

166. Additionally, each submission should include financial audits as well as management letters for the Borrower and the ORMVAs.

Disbursement

167. *Disbursement arrangements* - The proceeds of the loan will be disbursed in accordance with the World Bank's Disbursement Guidelines for Projects dated May 2006 and as outlined in the disbursement letter. Transaction-based disbursements will be used under this project. Withdrawal applications will be submitted for: (i) reimbursements of expenditures prefinanced by the Borrower, or (ii) direct payments to suppliers / contractors. All requests for payment from the loan account will include appropriate supporting documentation including detailed Statement of Expenditures (SOEs). The MAPM (DIAEA) and the ORMVAs will prefinance the expenditures and the project will not open a designated account to receive loan advances.

168. *Statement of Expenditures (SOE)* - During implementation, withdrawal applications will be supported with Statements of Expenditures (SOE) which indicate the expenditure amount exclusive of taxes to be financed by the Loan. The supporting documentation will be maintained at the level of the implementing entities and will be made available for World Bank supervision missions upon request. Documentation relating to SOEs would be retained for up to one year from the date the World Bank receives the audit report for the fiscal year in which the last withdrawal application from the loan was made or two years after the closing date, whichever is later.

Procurement

Guidelines and Standard Bidding Documents

169. Procurement for the proposed project would be carried out in accordance with: (i) the World Bank's Guidelines On Preventing and Combating Fraud and Corruption in Projects Financed by IBRD Loans and IDA Credits and Grants, known as the 'Anti-Corruption Guidelines' dated October 15, 2006 and revised in January, 2011; (ii) the 'Guidelines: Procurement of Goods, Works, and non-consulting services under IBRD Loans and IDA Credits and Grants by World Bank Borrowers' (known as Procurement Guidelines) published by the World Bank in January 2011 and revised in July 2014; (iii) the 'Guidelines: Selection and Employment of Consultants under IBRD Loans and IDA Credits and Grants by World Bank Borrowers,' (known as Consultant Guidelines) dated January 2011 and revised in July 2014; and (iv) all the accompanying standard bidding documents for any new procurement and the provisions stipulated in the Loan Agreement. The various items under different expenditure categories are described in general below. For each contract to be financed by the loan, the different procurement methods or consultant selection methods, the estimated costs, prior review requirements, and agreed time frame are set out in the Procurement Plan.

170. National Competitive Bidding (NCB) procedures in agreement with the standard bidding documents approved by the World Bank will be used for Goods and Non-consulting services contracts estimated to cost less than the equivalent of US$3,000,000 and for Works, Supply and installation contracts estimated to cost less than the equivalent of US$15,000,000.

171. To ensure consistency with the Procurement Guidelines, the following provisions will apply when using NCB under this project. Said procedures shall ensure that, inter alia:

- The bidding documents explicitly include the bid evaluation method, award criteria and bidder qualification criteria;
- Technical, administrative and financial envelopes are opened immediately after the bid opening session has started and prices are read aloud;
- The bids are evaluated on the basis of price and any other criteria expressed either in pass/fail terms or in monetary terms;
- Contracts are awarded to the qualified bidder who has submitted the least-cost evaluated and substantially responsive bid as stipulated in the bidding document; and
- Standard bidding documents and bid evaluation reports found acceptable by the World Bank are used.

172. Standard bidding documents for NCB for Works, Goods, and Non-consulting services agreed under the ongoing PROMER will be updated and submitted to the World Bank for approval. They will include all the adjustment clauses for NCB in Morocco as well as the Audit Clause and the Fraud and Corruption clauses (AFCC). Any future change after approval of these standard bidding documents will be submitted to the World Bank for approval, in compliance with the Loan Agreement. Moreover, it was agreed with the Borrower that each contract financed from the proceeds of this loan shall provide that suppliers, contractors, and subcontractors shall permit the World Bank, at its request, to inspect their accounts and records relating to the bid submission and performance of the contract and to have said accounts and records audited by auditors appointed by the World Bank. The deliberate and material violation by the supplier, contractor or subcontractor of such provision may amount to "obstructive practice". Prior to issuing the first call for bids, a draft standard bidding document to be used under NCB procurement must be submitted to, and found acceptable by the World Bank.

173. *Advertisement, Publication of Results and Debriefing* - In addition to advertising pertaining to each contract, a General Procurement Notice (GPN) will be published in DG-Market, in United Nations Development Business, and in at least two national newspapers. The GPN will be published after the project is approved by the World Bank and prior to effectiveness. The GPN will provide a description of the project and information on related procurement. Online (DG Market, UN Development Business, and /or Client Connection) publication of contract awards would be required for all International Competitive Bidding (ICBs), Direct Contracting, and the Selection of Consultants for contracts exceeding a value of US$300,000. In addition, where prequalification has taken place, the list of prequalified bidders will be published. With regard to ICB and large-value consulting contracts, the Borrower would be required to assure publication of contract awards as soon as the World Bank has issued its "no objection" notice to the recommended award in UN Development Business (UNDB) online and dgMarket. All consultants competing for an assignment involving the submission of separate technical and financial proposals, irrespective of its estimated contract value, should be informed of the result of the technical evaluation (number of points that each firm received) before the opening of the financial proposals. The Borrower would be required to offer debriefings to unsuccessful bidders and consultants should the individual firms request such a debriefing.

174. *Procurement of Works* - Works procured under the project would mainly include: upgrading main irrigation canals and constructing reservoirs to install flow-regulation systems necessary for on-demand irrigation; constructing feeder pipes for areas that benefit from gravity pressurization, and rehabilitating pumping stations for areas that need artificial pressurization; constructing filtration stations; constructing distribution piped networks to replace existing canals, or rehabilitating and extending existing distribution piped networks; and installing outlets and associated devices, including meters, at the block and farm levels, to regulate, measure, and control water delivered to farmers. Procurement will be carried out using the World Bank's standard bidding documents for all ICB and NCB agreed with and satisfactory to the World Bank.

- International Competitive Bidding (ICB): Contracts for civil works estimated to cost more than the equivalent of US$15,000,000 per contract shall be procured on the basis of the ICB procedures, using the applicable World Bank standard bidding documents.

- National Competitive Bidding (NCB): Each package of civil works estimated to cost the equivalent of US$15,000,000 or less may be procured on the basis of NCB procedures, using the applicable World Bank standard bidding documents.

175. *Procurement of Goods and Non-consulting services* - Goods and Non-consulting services procured under this project would include mainly: hydraulic equipment for feeder pipes and distribution piped networks; equipment to the ORMVAs to monitor performance of irrigation systems; equipment to the ORMVAs to create or strengthen the irrigation information system; computer equipment; and vehicles. Procurement will be carried out using the World Bank's standard bidding documents for ICB and NCB agreed with and satisfactory to the World Bank.

- International Competitive Bidding (ICB): Goods and Non-consulting services contracts estimated to cost more than the equivalent of US$3,000,000 per contract shall be procured on the basis of the ICB procedure, using the applicable World Bank standard bidding documents.
- National Competitive Bidding (NCB): Each package Goods or Non-consulting services estimated to cost the equivalent of US$3,000,000 or less may be procured on the basis of NCB procedures as found acceptable by the World Bank, using the applicable World Bank standard bidding documents.

176. *Shopping* - Goods and Non-consulting services estimated to cost US$200,000 or less and Works estimated to cost US$300,000 or less, may be procured using Shopping procedures.

177. *Direct Contracting* - Under circumstances which meet the requirements of paragraph 3.6 of the Procurement Guidelines, goods and works may be procured in accordance with paragraph 3.7 of the Procurement Guidelines using the Direct Contracting procurement method.

178. *Selection of Consultants* - Consultants services comprise mostly studies, training, and technical assistance. They include among others: detailed studies including topographic works and laboratory tests; monitoring and control of works; support to farmers to access and manage improved irrigation technologies; support to ORMVAs to improve O&M of the irrigation network; and training and technical assistance to MAPM (DIAEA) and ORMVAs for project management. The following World Bank methods and corresponding standard documents will be used:

- Quality and Cost Based Selection (QCBS) for technical assistance, capacity building and audits as well as contracts for consultant services above US$200,000 equivalent per contract. Standard World Bank procedures and documents will be used.
- Quality-based Selection (QBS). Services for assignments which meet the requirements set forth in section 3.2 of the Consultant Guidelines may be procured using the Quality-based Selection method in accordance with the provisions of paragraphs 3.1 through 3.4 of the Consultant Guidelines.
- Selection under a Fixed Budget (FBS) Services for assignments which meet the requirements set forth in section 3.5 of the Consultant Guidelines may be procured using the Selection under a Fixed Budget method in accordance with the provisions of paragraphs 3.1 and 3.5 of the Consultant Guidelines.

- Least-cost Selection. Services for assignments which meet the requirements of paragraph 3.6 of the Consultant Guidelines may be procured using the Least-cost Selection method in accordance with the provision of paragraphs 3.1 and 3.6 of the Consultant Guidelines.
- Selection Based on Consultant's Qualifications (CQS). Services estimated to cost less than US$100,000 equivalent per contract may be procured in accordance with the provisions of paragraphs 3.1 and 3.7 of the Consultant Guidelines.
- Single Source Selection. Under circumstances which meet the requirements of paragraph 3.8 of the Consultant Guidelines for Single Source Selection, consultant services may be procured in accordance with the provisions of paragraph 3.8 through 3.11 of the Consultant Guidelines, with the World Bank's prior agreement.
- Individual Consultants (IC). Services for assignments that meet the requirements set forth in the paragraph 5.1 of the Consultant Guidelines may be procured under contracts awarded to individual consultants in accordance with the provision of paragraph 5.2 to 5.5 of the Consultant Guidelines. Under the circumstances described in paragraph 5.4 of the Consultant Guidelines, such contracts may be awarded to individual consultants on a sole-source basis.

179. Short lists may be composed entirely of national consultants for contracts of less than US$200,000 equivalent per contract in accordance with the provisions of paragraph 2.7 of the Consultant Guidelines, complying with the remarks mentioned above,

180. *Fraud, Coercion, and Corruption* - All procuring agencies, as well as bidders, suppliers, and contractors shall observe the highest standard of ethics during the procurement and execution of contracts financed under the project in accordance with paragraphs 1.16 and 1.17 of the Procurement Guidelines and paragraphs 1.23 and 1.24 of the Consultants Guidelines.

181. *Procurement Plan* - A Procurement Plan in a format acceptable to the World Bank has been prepared for the first eighteen (18) month period and submitted to the World Bank for approval. The procurement plan indicates the contracts that are subject to World Bank's prior review. All other contracts shall be subject to Post Review. The Procurement Plan will be updated at least once a year and as required, to reflect the actual project implementation needs and improvements in institutional capacity. The procurement plan will be available in the project's database and in the World Bank's external website.

182. *Advanced procurement* – Advanced procurement can be used in line with the policy and guidelines of the World Bank to ensure swift project launch.

183. *Frequency of Procurement Supervision* - procurement supervision by the World Bank is a fundamental part of project supervision and implementation monitoring. The evaluation of existing procurement systems considers the overall risk assessment of procurement implementation for this project to be moderate. As a result, most of the procurement review will be carried out ex-post and will apply to about five (5) percent of contracts. This percentage will be adjusted during project implementation as a function of the performance of the implementing entities and the results of reviews.

184. The overall risk for procurement is assessed as moderate. To help mitigate the risk, the following set of actions is recommended:

- Standard bidding documents for National Competitive Bidding (NCB) for Works, Goods, and Non-consulting services prepared for the ongoing PROMER will be updated and submitted to the World Bank for approval. It will include all the adjustment clauses for NCB in Morocco as well as the Audit Clause and the Fraud and Corruption clauses (AFCC). Any future change after approval of these standard bidding documents will have to be submitted to the World Bank for approval, in compliance with the loan agreement;
- The Implementation manual, including a procurement section with detailed arrangements, was adopted prior to Negotiations;
- The initial Procurement Plan, indicating the thresholds for use of non International Competitive Bidding (ICB) and non Quality and Cost Based Selection (QCBS) methods as well as the prior review thresholds, was finalized at Negotiations. The Procurement Plan will be updated as often as necessary and minimum once a year and submitted to the World Bank for no objection, and used during project implementation;
- Training in World Bank procedures will be organized for all staff involved in procurement at least once a year, over the duration of the project. In particular, a well-tailored training targeting mostly staff from the ORMVA of Gharb has been conducted prior to Appraisal.
- Regular ex-post reviews will be conducted once a year. It will allow identifying the main issues and providing the necessary recommendations to help improve the quality of procurement and overall the project implementation.

185. In the use of remote sensing for project M&E, the project might take advantage from the experience gained by the Royal Centre of Remote Sensing (CRTS) since its creation in 1989. The CRTS is the national institution responsible for the promotion, use, and development of remote sensing applications in Morocco. The CRTS coordinates and carries out the national program of remote sensing in collaboration with ministerial departments, private operators, and universities, and is uniquely positioned in the use of remote sensing in the domains of agriculture and water resources.

Environmental and Social (including safeguards)

186. The Borrower has prepared an Environmental and Social Impact Assessment (ESIA), including an Environmental Management Plan (EMP). The ESIA, based on TORs acceptable to the World Bank, was disclosed in-country on March 6, 2015 and on the World Bank InfoShop on March 12, 2015 together with an Executive Summary in Arabic. As part of the ESIA, a comprehensive Environmental Management Plan (EMP) identifies mitigations measures, a monitoring and supervision plan to ensure proper implementation, and a training component. As part of the EMP, the project will carry out groundwater monitoring using two approaches: (i) under Component 2, groundwater abstraction will be monitored through direct measures, by installing meters on a sample of wells with prior voluntary agreement with farmers; and (ii) under Component 3, through the use of remote sensing. The EMP also stipulates provisions for minimizing health-related, environmental, and nuisance problems during construction. The capacity of the ORMVAs to implement and supervise the EMP is modest. A training program on ESIA and EMP targeting their technical staff, in addition to WUAs and contractors will be carried

out. Progress reports will include information on the status of EMP implementation. The EMP will be financed under the project (Component 3).

187. No major negative irreversible environmental social impact is foreseen and the project is confirmed as Category B. Potential negative impacts include:

- Reduction of aquifer recharge, due to reduction in deep percolation consequent to the introduction of drip irrigation;
- Increased salinization of soil near the root zone due to reduced leaching; and
- Potential friction between participating and non-participating farmers.

188. The ESIA concludes that agrochemicals are not a major concern for the project. The OP 4.09 on Pest Management is not triggered as the project will not finance purchase of pesticides and will not induce increased use of pesticides.

189. OP 4.37 on Safety of Dams is triggered because the irrigation sectors targeted by the project are dependent on existing dams. While the project does not finance the construction or the rehabilitation of dams, the success of the project is contingent on the storage and operation of seven existing dams for their supply of water. National legislation for monitoring and management of dams (water law No. 10-95) has been reviewed and found fully in line with the requirements of the policy. The safety inspection and assessment reports for a sample of the dams have been reviewed and compliance with World Bank requirements verified. Morocco's private sector engineering industry has high expertise in advanced dam design and construction techniques, in line with international standards. No dam failure is reported in Morocco since Independence.

190. OP 4.12 on Involuntary Resettlement is triggered because of potential land acquisition. No physical displacement and no resettlement of persons will occur under the project. The specific sites of infrastructures to be financed under Component 1 and that might require land acquisition are not yet defined. The Borrower has prepared a Framework Land Acquisition Plan (FLAP), based on TORs acceptable to the World Bank and which underwent thorough consultations with stakeholders. It was disclosed in-country on March 6, 2015 and on InfoShop on March 12, 2015 together with an Executive Summary in Arabic. The FLAP specifies the process for preparing, reviewing, approving, and implementing subsequent site specific Land Acquisition Plans (LAPs) prior to launch of relevant civil works. The FLAP deals with land acquisition for the purpose of building infrastructure to be used by farmers, and it refers to all categories of land that may be affected, such as community land (*Guich*, collective lands), privately owned land (*Melk*), state, and local authorities land. Each LAP shall define the process, content, outcomes, and monitoring of the land acquisition process including methodology for the implementation of socio-economic survey, definition of categories of affected persons, compensation to affected persons, consultation of population and stakeholders, grievance procedures, institutional and implementation arrangement, budget and follow-up modalities. The ORMVAs are responsible for implementing the FLAP and subsequent LAPs, which comply with the requirements of OP 4.12 and the Borrower's legal and regulatory framework.

191. As part of the elaboration of the ESIA and the FLAP, public consultations with farmers and WUAs were organized in each irrigation perimeter. Around a hundred people attended the

public consultations, which took place between June and September 2014, and in March 2015 for the irrigation sector of Bouida, Haouz. In addition, to assess the project's potential impact on the beneficiary population, feasibility studies included participatory components, which paid specific attention to ensure that disadvantaged groups in the target areas are not excluded from the benefits of the project. The feasibility studies produced an assessment of farmer's demand. These consultations, in addition to the meetings with farmers and WUAs held during project preparation, highlighted an interest of farmers in irrigation modernization, and specifically to the individual and on-demand access to water. Among other points, farmers indicated that the current poor quality of the service to access surface water, together with the unequal access to groundwater which is leading to economic and social hardship and increasing inequality among farmers. Without the project, the situation is likely to deteriorate. The consultations indicated that farmers generally have a good understanding of present and future problems related to water scarcity, and welcome the shift to more efficient irrigation techniques.

192. Targeted irrigation sectors in Doukkala and Gharb are characterized by accumulated arrears with the ORMVAs and as a result are prone to social tensions. Collective water management of sprinkler irrigation at the block level has prevented the ORMVAs from taking targeted actions when farmers fail to pay water bills. Over the years, low collection rates have generated significant arrears. The project promotes the introduction of individual outlets equipped with a meter at the farm gate, with clear accountability. The modernization is thus an opportunity for sectors with high debts. At the same time, the success of the project depends on farmers accepting to repay their debts. The ORMVAs of Doukkala and Gharb have assessed the capacity to pay of farmers in the targeted irrigation sectors, and an action plan aimed at increasing the recovery rate of the debts has been put in place, including targets to be achieved during project implementation (Table 11). The project report will include progress made, along with an analysis of the challenges and opportunities.

Table 11: Targets for the recovery of the debts.

	Baseline	July 2015	July 2016	July 2017	July 2018	July 2019	July 2020	July 2021
Doukkala, Z0	8%	20%	25%	30%	45%	55%	65%	**70%**
Doukkala, Ext. Faregh	36%	45%	50%	60%	**70%**			
Gharb, N3	13%	20%	25%	30%	45%	55%	65%	**70%**
Gharb, N4	12%	20%	25%	30%	45%	55%	65%	**70%**

193. The strengthening of the Grievance Redress Mechanisms (GRM) is a prerequisite for the ORMVAs to manage the irrigation network in a responsive way to clients. Currently, farmers can submit their complaints to the ORMVAs using different channels (mobile teams, ORMVAs at provincial and local levels). Farmers can also use channels that are not specific to the agriculture sector, such as local authorities and independent constitutional grievance bodies (National Human Rights Council, Mediator and Agency for Preventing and Fighting Corruption). However, most of the complaints are made verbally, and are not systematically recorded in logbooks making it difficult to ensure close monitoring of the types of incoming grievances and steps taken to address them. The DIAEA and the ORMVAs are working, with World Bank support, on strengthening existing mechanisms, by defining/developing: (i) a procedure for receiving, recording/documenting and addressing complaints that is easily accessible, culturally appropriate, and comprehensible for affected communities; (ii) the GRM process top-to-down and bottom-up

(flow charts); (iii) a procedure for informing the communities about the mechanism; (iv) the GRM database; (v) tasks assignment; and (vi) reporting system. The progress reports submitted to the World Bank at the end of each semester will also cover the GRM system, describing complaints received (number, type, uptake channel used), the responses given, and delays in handling complaints.

Monitoring and Evaluation

Theory of change

194. Farmers in LSI perimeters are often confronted with collective water management, water distribution on rotation, frequent shut-downs, and unequal access to water. The ORMVAs, responsible for the distribution of surface water, cannot lift these constraints due to the insufficient cost recovery of the water service. These constraints push farmers to make low-risk but low-return choices. Farmers who want to engage in higher value production to achieve higher returns, have to compensate the unreliable water service of the ORMVAs by using water reservoirs and/or tapping into the groundwater (if available), bearing the pumping costs and adding pressure on the already overexploited aquifers.

195. By providing individual, on-demand, reliable, and equitable access to water, the ORMVAs would allow farmers to invest into higher value agriculture. The more reliable access to surface water would reduce the need to tap into the groundwater. The improved water service, coupled with improved irrigation technologies that can be adopted as a consequence, would allow farmers to use water more effectively (better responding to the crop requirements in water and nutrients through a more precise irrigation scheduling) and efficiently (reducing evaporation and percolation losses), thus increasing yields, increasing cropping intensity, and/or changing cropping pattern towards higher value crops. These changes would translate into increase in agricultural water productivity, in both physical and monetary terms, thanks to which farmers would improve their income and livelihood. Satisfied with the service provided by the ORMVAs, farmers would be more inclined to pay the water bill. The individualization of the water service would make water metering more transparent and facilitate taking targeted actions towards farmers who do not meet their water bill. The finances of the ORMVAs would improve, allowing for adequate budgeting of the O&M of irrigation networks, and thus ensuring long term sustainability. In parallel, farmers would reduce the use of groundwater in favor of the cheaper and better quality surface water provided by the ORMVAs, thus contributing to the environmental sustainability.

196. The project will contribute to this long term process by supporting the ORMVAs in providing individual, on-demand, reliable, and equitable access to water to farmers, and by supporting farmers in accessing improved irrigation technologies.

197. The theory of change has been broken up into subsequent steps with a corresponding timeline, based on which intermediate results, PDO, and higher level objectives have been delineated. The project will contribute to this long term process by supporting the ORMVAs in providing individual, on-demand, reliable, and equitable access to water to farmers, and by supporting farmers in accessing improved irrigation technologies. Figure 6 presents the envisioned theory of change.

Project Development Objectives

198. The project development objectives (PDO) are: (i) for the Doukkala ORMVA, the Gharb ORMVA, the Haouz ORMVA and the Tadla ORMVA, to provide an improved water service to farmers; and (ii) for targeted farmers in the Project Area, to have better access to improved irrigation technologies.

199. The project area refers to the irrigated areas under the management of the four ORMVAs targeted by the project.

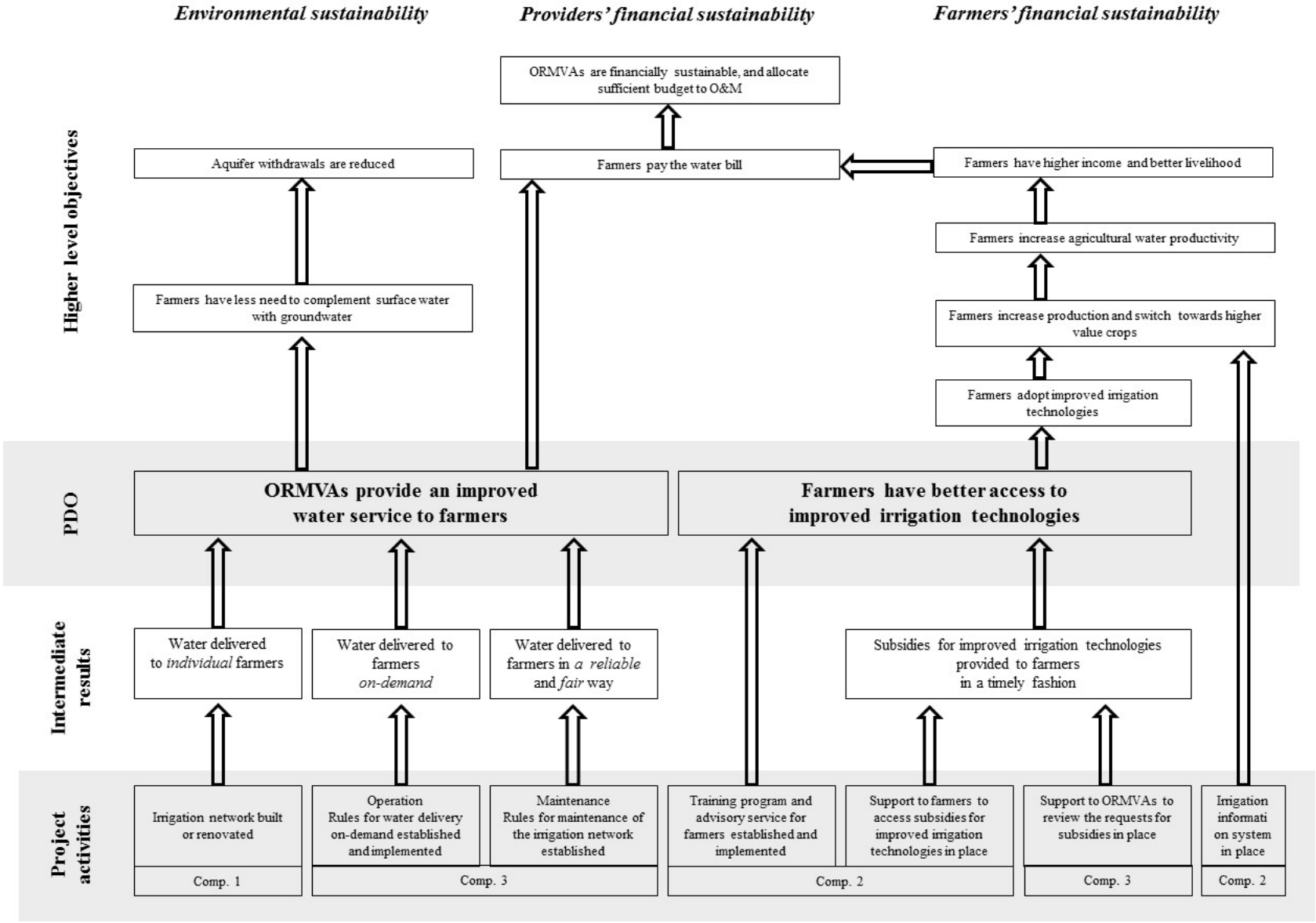
200. The first part of the PDO refers to the targeted ORMVAs of Tadla, Haouz, Doukkala, and Gharb. The quality of the service is defined as individual access (rather than collective), on-demand (rather than on rotation), reliable (in case of shuts-down, service re-established within 1-2 days, rather than 7-10 days), and equitable (optimal flow and pressure throughout the network, rather than with flow and pressure drops in specific areas / time). To achieve this part of the PDO, the project finances: (i) the conversion of gravity networks and the modernization of pressurized networks (Component 1); and (ii) the institutional strengthening of the ORMVAs to improve their capacity in Operation and Maintenance (O&M) of irrigation networks (Component 3).

201. The second part of the PDO refers to the targeted farmers in the selected irrigated areas. Improved irrigation technologies are defined as technologies that – based on the results of demonstration activities carried out under Component 2 – can allow increasing production and/or reducing water use compared to current technologies. To achieve this part of the PDO, the project finances technical assistance to farmers to improve their access to improved irrigation technologies (Component 2). The formulation of this part of the PDO focusing on ensuring "better access" (rather than "adoption") accounts for the fact that the project does not finance on-farm investments, which will be the responsibility of the farmers (benefitting from subsidies from the FDA).

Higher level objectives

202. By improving the water service, and by providing better access to improved irrigation technologies, the project will create the enabling conditions for farmers to improve their farming choices. It will be possible for them to adopt improved agronomic practices, increase yield, increase cropping intensity, change cropping pattern switching to high value crops, and thus increase agricultural water productivity, income, and overall their livelihood. In parallel, the improved quality of the water service will reduce the need for farmers to rely on groundwater resources, in favor of surface water provided by the ORMVAs which is of lower cost and better quality. However, increase in agricultural water productivity and reduction in groundwater withdrawals are expected to occur over a longer timeframe than that of a World Bank project, due to the time required for the off-farm infrastructure completion (three to four years), the introduction of improved irrigation technologies (about 18 months), followed by the time to observe behavioral change of the farmers in using the new equipment and changing their farming practices accordingly. At the same time, the investments under the project are justified only if these long-term changes take place. As a consequence, the project will track the progress towards the higher level objectives. To this end, the project will use remote sensing on an experimental basis.

Figure 6: Theory of change.



Indicators

203. Table 12 presents the list of indicators, and Annex 1 the corresponding baselines and targets. The duration of the off-farm works (three to four years) typical of modernization in LSI perimeters, does not allow for observing progress on outcomes for the first few years of project implementation. Therefore, output indicators have been included to track progress towards outcomes.

204. Quantification of the project beneficiaries requires clear definitions. In 1969 the Code for Agricultural Investment was passed to avoid land fragmentation, precluding land transactions resulting in farms smaller than 5 ha in irrigated areas. This resulted however in a disconnection between the cadastral information and the situation on the ground, where widespread joint ownership among co-heirs is proving equally problematic. Each ORMVA has been dealing with this situation differently. Where conflicts among co-owners for water use are limited, the ORMVA has built its list of clients based on the cadastral information. On the ground, the client plays the role of delegate of the co-owners, ensuring that water is shared and fees are collected proportionally. In case of co-owners do not manage to organize themselves informally in the use of water, the ORMVA has chosen to recognize some co-owners as clients, to facilitate collection of the water fee. As no official information is available on the number of farmers, the project beneficiaries are defined as the ORMVAs' clients, recognizing that this number is lower than the number of farmers cropping the land.

205. To ensure that the M&E system is functioning and adequate by the time off-farm works are completed, the system will be tested by monitoring one irrigation sector already modernized per ORMVA starting at project launch. This will allow revising the M&E system by the mid-term review (planned about 36 months after the Effectiveness Date), should any adjustment be necessary.

206. Table 13 presents indicators related to the higher level objectives, for which no targets will be set.

Table 12: Description of PDO level and intermediate results indicators.

Name	Objective	Description
PDO level indicators		
Direct project beneficiaries [number], of which female [%]		The World Bank core sector indicator measures the number of ORMVAs' clients who benefit from the off-farm works, thus potentially receiving an improved water service. The ORMVAs' clients refer to physical persons (regardless of whether they are owners of the land or co-owners) who receive a water bill. The indicator is disaggregated by gender. A second WB core sector indicator will be tracked for corporate purposes "Water users provided with new or improved irrigation and drainage service (number)", corresponding to the same number.
Area with access to water on-demand in peak period [%]	Progress towards achieving the PDO on improved water service	The indicator measures the share of the area targeted by the project with access to water on a daily basis (contrary to the previous access to water on rotation). The peak period refers to the period of higher flow in the irrigation network. As it varies in function of the cropping pattern and the weather conditions, the peak period changes by sector and year. The choice of the indicator is justified by the fact that the

		resort to rotation is commonly the first sign of decrease in service quality in LSI perimeters. It is expected that the whole area will have access to water on-demand. This indicator will be tracked on a sample of farms through a survey.
Area with a request for improved irrigation technologies approved [hectare]	Progress on the PDO on better access to improved irrigation technologies by farmers	The indicator measures the area targeted by the project for which a request for FDA subsidy for improved irrigation technology (drip irrigation, microsprinkler, or sprinkler irrigation) has been approved. It is expected that not all farmers will submit a request and switch to improved irrigation systems. The selection criteria for irrigation sectors to be part of the project is to have 70 percent of agricultural land committed to the project. This threshold is reflected in the indicators' target values.
Intermediate Result Indicators		
Component 1: Improving irrigation network infrastructure		
Progress of works on irrigation network [%]	Output	This indicator measures the progress in works on the irrigation network. It is calculated by dividing the cost of works achieved by the total cost amount of the works contracts. It measures the expenses already spent to complete works on the irrigation network as share of total cost determined in the works' contracts.
Clients per metering system [number]	Individual access to water	This indicator measures the number of client codes divided by the number of metering systems. The client code differs from the client (as physical person) in case the ORMVA provides multiple codes to the same physical person having dispersed plots within the irrigation system (thus receiving multiple water bills). In case the same client code is provided to a physical person having dispersed plots within the irrigation system, clients and client codes match. For the baseline, in case of gravity system, the last flow control device on each plot is taken as a reference.
Outlets with flow in line with technical specifications in peak period [%]	Equitable access to water	This indicator measures the share of outlets with flow within a 5 percent range of the nominal flow as defined in the technical specifications. The indicator is measured on a statistically representative sample of outlets across the network. The peak period refers to the period of higher flow in the irrigation network. As it varies in function of the cropping pattern and the weather conditions, the peak period changes by sector and year.
Component 2: Supporting farmers' access to improved irrigation technologies		
Client days of training provided, gender-disaggregated [number]	Output	This World Bank core sector indicator measures the number of farmers who attended a training session multiplied by the duration of the session expressed in days. Training should relate to the use and management of improved irrigation technologies (in-door training, visit of demonstration plots, workshops, etc.). It is assumed that each client receive at least four days of training during the project lifetime.
Clients that have formalized their request for improved irrigation technologies [%]	Access to financing	This indicator measures the number of clients (physical persons) who have formalized a joint request to the FDA for improved irrigation technology through a WUA.
Clients using the irrigation information system [%]	Proxy for improvement in irrigation scheduling	This indicator monitors the share of clients (physical persons) using the irrigation information system provided by the ORMVA to take irrigation scheduling decisions.

Component 3 - Supporting the project implementing entities to manage the irrigation network and to implement the project		
Client days of training provided, gender-disaggregated [number]	Output	This World Bank core sector indicator measures the number of staff of the MAPM and the ORMVAs who attended a training session multiplied by the duration of the session expressed in days. Training should relate to project management or O&M of the irrigation network.
Clients having signed a delivery agreement with the ORMVA [%]	Sustainability of the water service	This indicator measures the share of clients (client codes) having signed an agreements with the ORMVA clarifying mutual engagements (water supply, maintenance of the off-farm and on-farm irrigation systems, rules of billing, payment methods, etc.).
Interruptions in water service in peak period exceeding 48 hours [number]	Reliable access to water	This indicator measures the number of interruptions of the water service in peak periods which exceed 48 hours. The peak period refers to the period of higher flow in the irrigation network. As it varies in function of the cropping pattern and the weather conditions, the peak period changes by sector and year. Each shut-down exceeding 48 hours will be located on the network and the affected area recorded.
Average time required for treating grievances related to water service [day]	Citizens' engagement	The indicator measures the average number of days it takes the ORMVAs to respond to grievance related to water services. This indicator measure the transparency and accountability mechanisms established by the ORMVAs so that target participants have trust in the process and are willing to participate. This indicator requires that a grievance redress mechanisms is in place in each ORMVA - either created or strengthened by the project.

Table 13: Description of higher-level objectives indicators.

Name	Objective	Definition
Farmers' financial sustainability		
Area equipped with drip irrigation [%]	Adoption of improved irrigation technologies by farmers	This indicator measures the share of the area targeted by the project equipped with drip irrigation.
Increase of agricultural production [%]	Proxy to the contribution of the project to increase in agricultural water productivity	This indicator measures the percentage increase in agricultural production, by crop. The indicator will be monitored through a survey, on a sample of farms (selected so to reflect the farm model typical of each irrigation sector) throughout project implementation.
Area under high value-added crops [%]		This indicator measures the share of the area targeted by the project cropped with high value crops. The list of high-value crops is to be defined for each ORMVA. The indicator will be monitored through a survey, on a sample of farms (selected so to reflect the farm model typical of each irrigation sector) throughout project implementation.
Water productivity per unit of irrigation water delivered (DH/m^3)		This indicator measures the monetary value of the agricultural production at farm level per unit of surface water delivered and of groundwater used. The indicator will be monitored through a survey, on a sample of farms (selected so to reflect the farm model typical of each irrigation sector) throughout project implementation. The groundwater volume will be collected either through metering on the private well (if available) or through approximations.
Providers' financial sustainability		

Cost recovery rate, excluding amortization [%]		This indicator measures the rate between water revenues and O&M costs, with and without amortization, at the level of the whole ORMVA.
Cost recovery rate, including amortization [%]		
Environmental sustainability		
Volume of groundwater consumed [m^3]	Impact of the improved irrigation systems on groundwater abstraction	The indicator is measured as through a water balance using remote sensing, as Gw = ETa-P-sw, accounting for groundwater (Gw), actual evapotranspiration (ETa), precipitation (P), and water stored in the soil (sw).

207. *Survey* - To improve the service to farmers by the ORMVAs the point of view of the client has to be taken into account. The project will finance a survey to collect clients' perception of the water service at three stages: prior to the modernization, the first year following the introduction of the improved service, and during the last year of the project implementation.

208. *Groundwater* - The project will carry out groundwater monitoring using two approaches: (i) under Component 2, direct measures, by installing meters on a sample of wells prior voluntary agreement with farmers; and (ii) under Component 3, estimation of a water balance before / after project, through the use of remote sensing.

209. *Responsibility* - The ORMVAs will be responsible for monitoring the results of the project in their areas. As part of the progress reports at the end of each semester of the calendar year, the MAPM (DIAEA) will consolidate information on progress on indicators as received by the ORMVAs. The ORMVAs will receive the same simple computerized application to enter and process data from relevant departments/services in charge of different components implementation, and calculate output and intermediate results indicators set in the monitoring and evaluation plan. The project will finance technical assistance to help DIAEA and ORMVAs to design and implement a M&E system and training on "results-based project management" for project staff.

Annex 4: Implementation Support Plan
MOROCCO: Large Scale Irrigation Modernization Project

Strategy and Approach for Implementation Support

210. The World Bank will support the implementation of the project through a combination of fiduciary, technical supervision, monitoring and evaluation (M&E), and coordination. Teams composed of World Bank staff and consultants will support the project's implementation. The strategy for implementation support takes into consideration the technical and institutional capacity of the MAPM and the ORMVAs**,** and the number and complexity of the contracts that will need to be procured.

Implementation Support Plan

211. The World Bank team will include a Task Team Leader; and specialists in: procurement, financial management, safeguards; and technical experts (engineers, agronomists, agro-economists, etc.). Support will involve supervision missions conducted on a semester basis, in addition to exchanges by email, audio, and video as needed. Procurement and financial management training may be provided in the first months of project implementation. Fiduciary support will be provided primarily by the World Bank's procurement and financial management specialists based in the World Bank Country Office in Rabat. In addition to biannual supervision missions, these specialists will be available on an ad hoc basis to provide support as required to the project implementing entities. Safeguards staff will coordinate with ORMVAs technical staff to oversee monitoring of environmental and social impacts and ensure that the ORMVAs are satisfactorily executing the EMPs. Table 14 summarizes the focus of implementation support at various stages of the project.

212. A mid-term review is expected to take place about 36 months after the Effectiveness Date, by when all of the off-farm infrastructures are expected to be completed, and the on-farm equipment launched. By then, the accrued experience of the ORMVAs in the irrigation sectors modernized under the first tranche of the PNEEI will allow revising the M&E more realistically.

Table 14: World Bank implementation support.

Time	Focus	Skills Needed
First 12 months	Establishment of project implementation arrangements. Procurement of works and technical assistance supervision contracts.	Technical support for procurement and consultant mobilization.
12-48 months	Project supervision and quality assurance. Monitoring effectiveness.	Hydraulic engineer, irrigation engineer, agronomist, agro-economist, safeguards, procurement, financial management
Other	Ensuring consistency with the PNEEI and the PMV.	Project management and outreach

Skills Needed	Number of Staff Weeks	Number of Trips
Technical (Hydraulic engineer, irrigation engineer, agronomist, agro-economist)	6 weeks / year	2 per year
Procurement	3 weeks / year	2 per year
Financial management	2 weeks / year	2 per year
Safeguards	2 weeks / year	1 per year

Annex 5: Economic and Financial Analysis
MOROCCO: Large Scale Irrigation Modernization Project

213. The project's principal economic and financial benefit will be an increase in the value-added of production in the project area. The improved water service, coupled with improved irrigation technologies that can be adopted as a consequence, would allow farmers to use water more effectively and efficiently. The increase in agricultural water productivity will comprise three main components:

- The yield component: Farmers will have greater control over the volume and timing of water applications, which will allow them to better match crop water requirements over sensitive stages of the crop cycle, as well as crop demand in nutrients, and thus obtain higher yields for the same amount of irrigation water.
- The cropping intensity component: Farmers will be able to use water more efficiently by reducing evaporation and percolation losses, increasing the number of cultivations per year on a given hectare and for the same amount of irrigation water.
- The cropping pattern component: Farmers will have more flexible and reliable access to water, which will give them the confidence to move away from lower-value crops towards higher-value, but more water-sensitive crops.

214. The feasibility studies carried out by the ORMVAs included economic and financial analyses. Returns were estimated by constructing standard without- and with-project farm models. Cropping patterns and yields were derived from field observations taken from project areas and areas that have already undergone conversion to drip irrigation. The water requirements of the with-project cropping pattern scenario were tested against water availability forecasts. A non-participation rate of 30 percent of the project area was assumed.

Economic analysis

215. The economic viability of the investments was confirmed based on the economic cost-benefit analysis carried out in the feasibility studies. The EIRR was calculated considering investments costs, which include both off-farm (financed under the project) and on-farm (financed by the farmers with up to 100 percent subsidy from the FDA) costs; the technical assistance; and correcting prices for taxes and subsidies. The achievement of full benefits was assumed to occur four years after the completion of the off-farm works. During project preparation, the studies were updated to reflect more recent information in terms of unit costs and estimation of benefits. For Tadla, Doukkala, and Gharb, this update was carried out by the World Bank team, while for Haouz it was carried out by the firm commissioned by the ORMVAH to carry out the feasibility study. Details on estimated costs and benefits are illustrated below by ORMVA.

216. In the irrigation sectors M10-M18 and G13-G18, Tadla (Table 15):

- Yield: Increase is expected to be observed mainly for barley (more than double), sugarbeet (~60 percent), and tree crops (~50 percent).
- Cropping pattern: The current farming system is dominated by annual crops (36 percent cereals, 26 percent forage crops, 9 percent vegetables, and 8 percent industrial crops), with

only one fifth of the surface cropped with perennials (15 percent olive trees, 4 percent citrus). Area under vegetable crops, sugarbeet, and citrus trees is expected to more than double, and a tenfold increase in forage maize is estimated. In parallel, area allocated to cereals is expected to be reduced (with overall production partially compensated by increase in yield). Assumptions of the original studies for cropping pattern were modified during project preparation, to assume more modest increase in citrus crop (to account for the fact that the target of the *Plan Maroc Vert* for citrus crop for the region is almost achieved) and a more important increase in vegetable crops (to account for ongoing aggregation projects in the project area, in particular for industrial tomato).

- Cropping intensity: More efficient use of irrigation water is expected to allow an increase in cropping intensity by 21 percent (from 12,300 to almost 15,000 ha cropped).
- Costs: Reduction in labor cost (for irrigation, fertilization, treatments) is estimated at 14 percent, while reduction in the cost of agricultural inputs at seven percent.

217. In the irrigation sector Bouida, Haouz:[5]

- Yield: Increase is expected to be observed for olive trees (~127 percent), and for vegetable crops and cereals (~60 percent).
- Cropping pattern: The current farming system is dominated by cereals (cultivated on half of the surface) and olive trees (cultivated on 30 percent of the surface). The change in cropping pattern is expected to lead to new olive tree plantations (achieving half of the surface), the introduction of new forage crops (mainly maize) and vegetables (~15 percent each), while halving the cereal and alfalfa cultivation.
- Cropping intensity: More efficient use of irrigation water is expected to allow an increase in cropping intensity by 10 percent (from 3,200 to more than 3,500 ha).
- Cost: A reduction in labor cost and in the cost of agricultural inputs is expected (but not quantified at this stage).

218. In the irrigation sectors Z0 (Table 16) and Extension Faregh (Table 17), Doukkala:

- Yield: Increase is expected to be observed across crops, with increases ranging between ~50 percent and more than double.
- Cropping pattern: The current farming system is dominated by cereals (cultivated on half of the surface) and sugarbeet (cultivated on one fourth of the surface). The change in cropping pattern is expected to be modest, with an expansion of forage crops (essentially maize) to reach one fourth of the surface, in parallel with a decrease in cereal production (partially compensated by increase in yield).
- Cropping intensity: More efficient use of irrigation water is expected to allow an increase in cropping intensity by 15 percent (from 6,200 to 7,200 ha cropped in Z0; and from 2,000 to 2,300 ha in Extension Faregh).
- Costs: Reduction in labor cost (for irrigation, fertilization, treatments) is estimated at 18 percent, while reduction in the cost of agricultural inputs at eight percent.

[5] No table is available as the update of the study was carried out by the firm contracted by the ORMVAH and information was provided in different format.

219. In the irrigation sectors N3 (Table 18) and N4 (Table 19), Gharb:

- Yield: Increase is expected to be observed for melon (~35 percent), tomato (~45 percent), sugarbeet and sugarcane (between 40 and 55 percent).
- Cropping pattern: The current farming system is dominated by cereals (cultivated on one third of the surface), sunflower, and some vegetable crops (mainly watermelon). The change in cropping pattern is expected to be important, with an expansion of industrial crops (increase in sugarcane by four times, double for sugarbeet), expansion of vegetable crops (melon by three times) with the introduction of new crops (artichoke and forage crops), and a correspondent decrease in cereal cultivation.
- Cropping intensity: More efficient use of irrigation water is expected to allow an increase in cropping intensity by 29 percent (from 3,400 to 4,400 ha cropped in N3; and from 1,600 to 2,100 ha in N4).
- Costs: Reduction in labor cost (for irrigation, fertilization, treatments) is estimated at 22 percent, while reduction in the cost of agricultural inputs at nine percent.

220. Based on these assumptions and revisions, the EIRR results as follows:

- Tadla: 18.8 percent;
- Haouz: 11.6 percent;
- Doukkala: 17.1 percent in Z0 and 17.5 percent in Extension Faregh; and
- Gharb: 32.2 percent in N3 and 23.7 percent in N4.

Table 15: Tadla - Economic analysis.

	Cropping pattern (ha)		Increase in yield (%) *					Labour cost (DH/ha)			Cost of inputs (DH/ha)		
Crops	**Without proj.**	**With project**	**YR5**	**YR6**	**YR7**	**YR8**	**Cumulated**	**Without proj.**	**With project**	**Δ (%)**	**Without proj.**	**With project**	**Δ (%)**
Wheat (durum)	876	590	1.03	1.07	1.10	1.10	1.33	996	852	14%	5,317	4,611	13%
Wheat (soft)	2,729	1,885	1.04	1.07	1.10	1.10	1.35	996	852	14%	5,317	4,606	13%
Barley	742	494	1.10	1.15	1.30	1.30	2.14	480	636	**	512	4,082	**
Maize	72	58	1.05	1.10	1.20	1.20	1.66	462	462	0%	462	462	0%
Bersim	187	152	1.02	1.03	1.05	1.05	1.16	714	538	25%	4,095	3,680	10%
Alfalfa	2,459	1,230	1.00	1.04	1.05	1.10	1.20	2,814	2,378	15%	6,933	6,569	5%
Maize (forage)	210	2,057	1.03	1.05	1.06	1.10	1.26	390	226	42%	3,455	3,150	9%
Barley (forage)	273							330	196	41%	2,314	2,062	11%
Other forage	55							396	232	41%	3,780	3,480	8%
Sugarbeet	1,022	1,947	1.04	1.15	1.15	1.15	1.58	5,640	4,920	13%	9,333	8,860	5%
Sesame	96	231	1.05	1.15	1.15	1.15	1.60	4,560	4,440	3%	1,297	3,292	**
Vegetables (winter)	418	981	1.03	1.04	1.05	1.07	1.20	2,880	2,620	9%	8,042	7,792	3%
Vegetables (summer)	702	1,755	1.00	1.02	1.02	1.03	1.07	2,850	2,676	6%	6,539	6,289	4%
Olive	1,915	2,420	1.05	1.11	1.15	1.15	1.54	1,320	1,256	5%	5,421	5,101	6%
Citrus	546	1,092	1.00	1.12	1.15	1.15	1.48	5,520	4,703	15%	8,066	7,346	9%
Total	**12,302**	**14,893**											

* Starting in year 5, following the completion of off-farm works

** Increase due to irrigation

Table 16: Z0, Doukkala – Economic analysis.

	Cropping pattern (ha)		Increase in yield (%) *					Labour cost (DH/ha)			Cost of inputs (DH/ha)		
Crops	**Without proj.**	**With project**	**YR5**	**YR6**	**YR7**	**YR8**	**Cumulated**	**Without proj.**	**With project**	**Δ (%)**	**Without proj.**	**With project**	**Δ (%)**
Wheat (durum)	1,887	1,863	1.12	1.08	1.22	1.06	1.56	996	851	14%	4,927	4,175	15%
Wheat (soft)	786	765	1.14	1.10	1.24	1.07	1.66	996	852	14%	4,927	4,170	15%
Barley	179	93	1.15	1.23	1.33	1.07	2.01	480	645	**	512	3,399	**
Maize	415	313	1.08	1.06	1.16	1.05	1.39	462	317	31%	3,676	3,665	0%
Other forage	9	0						396	232	41%	3,168	2,868	9%
Bean (Fève)	31	0						600	600	0%	666	666	0%
Bersim	457	0						714	538	25%	3,570	3,154	12%
Alfalfa	215	0						2,814	2,378	15%	4,485	4,121	8%
Maize (forage)	198	1,781	2.00	1.37	1.90	1.14	5.93	390	226	42%	2,930	2,624	10%
Sugarbeet	1,509	1,719	1.10	1.07	1.21	1.05	1.50	5,640	4,920	13%	8,477	8,005	6%
Vegetables (winter)	266	328	1.22	1.13	1.40	1.08	2.08	2,880	2,620	9%	7,673	7,422	3%
Vegetables (summer)	266	328	1.22	1.13	1.40	1.10	2.12	2,880	2,620	9%	6,170	5,919	4%
Total	**6,218**	**7,190**											

* Starting in year 5, following the completion of off-farm works

** Increase due to irrigation and inputs

Table 17: Extension Faregh, Doukkala – Economic analysis.

	Cropping pattern (ha)		Increase in yield (%) *					Labour cost (DH/ha)			Cost of inputs (DH/ha)		
Crops	**Without proj.**	**With project**	**YR5**	**YR6**	**YR7**	**YR8**	**Cumulated**	**Without proj.**	**With project**	**Δ (%)**	**Without proj.**	**With project**	**Δ (%)**
Wheat (durum)	530	528	1.16	1.10	1.31	1.07	1.79	996	851	14%	4,927	4,175	15%
Wheat (soft)	229	245	1.12	1.08	1.25	1.06	1.60	996	852	14%	4,927	4,170	15%
Barley	111	121	1.17	1.11	1.33	1.07	1.85	480	645	**	512	3,399	**
Maize	156	59	1.06	1.04	1.14	1.03	1.29	462	317	31%	3,676	3,665	0%
Other forage	3	-						396	232	41%	3,168	2,868	9%
Bean (Fève)	11	-						600	600	0%	666	666	0%
Bersim	155	-						714	538	25%	3,570	3,154	12%
Alfalfa	44	-						2,814	2,378	15%	4,485	4,121	8%
Maize (forage)	76	560	1.15	1.10	1.30	1.07	1.76	390	226	42%	2,930	2,624	10%
Sugarbeet	474	434	1.08	1.06	1.20	1.05	1.44	5,640	4,920	13%	8,477	8,005	6%
Vegetables (winter)	48	155	1.30	1.17	1.49	1.10	2.49	2,880	2,620	9%	7,673	7,422	3%
Vegetables (summer)	163	207	1.24	1.15	1.43	1.09	2.22	2,880	2,620	9%	6,170	5,919	4%
Total	**2,000**	**2,309**											

* Starting in year 5, following the completion of off-farm works

** Increase due to irrigation and inputs

Table 18: N3, Gharb – Economic analysis.

	Cropping pattern (ha)		Increase in yield (%) *					Labour cost (DH/ha)			Cost of inputs (DH/ha)		
Crops	**Without proj.**	**With project**	**YR4**	**YR5**	**YR6**	**YR7**	**Cumulated**	**Without proj.**	**With project**	**Δ (%)**	**Without proj.**	**With project**	**Δ (%)**
Wheat (durum)	169	96	1.02	1.03	1.08	1.09	1.24	420	240	43%	3,133	2,858	9%
Wheat (soft)	1,102	288	1.03	1.05	1.12	1.14	1.38	420	240	43%	3,133	2,858	9%
Maize	154	190	1.05	1.10	1.23	1.27	1.80	3,240	2,280	30%	3,761	3,486	7%
Bean (Fève)	19	75	1.06	1.10	1.25	1.29	1.88	600	660	**	3,325	3,050	8%
Bean (Févrole)	161	61	1.06	1.10	1.25	1.29	1.88	600	660	**	3,325	3,050	8%
Sugarbeet	287	500	1.04	1.07	1.17	1.20	1.56	9,300	8,760	6%	5,484	4,934	10%
Sugarcane	212	848	1.03	1.05	1.12	1.14	1.38	4,140	2,820	32%	6,576	5,476	17%
Sunflower	644	279	1.04	1.07	1.17	1.20	1.56	1,260	1,140	10%	2,913	2,528	13%
Bersim	259	132	1.05	1.10	1.23	1.27	1.80	2,580	2,100	19%	2,927	2,652	9%
Maize (forage)	60	102	1.05	1.10	1.23	1.27	1.80	1,380	1,020	26%	3,563	3,288	8%
Citrus	0	245	1.04	1.07	1.17	1.20	1.56	7,260	4,500	38%	8,985	8,435	6%
Watermelon	343	1,045	1.03	1.04	1.11	1.13	1.34	4,920	4,320	12%	4,945	4,670	6%
Artichoke	0	161	1.07	1.12	1.28	1.33	2.04	7,920	4,620	42%	7,947	7,562	5%
Tomato	18	402	1.03	1.06	1.14	1.17	1.46	4,860	4,140	15%	10,395	9,845	5%
Total	**3,428**	**4,424**											

* Starting in year 4, following the completion of off-farm works

** Increase due to irrigation and inputs

Table 19: N4, Gharb – Economic analysis.

	Cropping pattern (ha)		Increase in yield (%) *					Labour cost (DH/ha)			Cost of inputs (DH/ha)		
Crops	**Without proj.**	**With project**	**YR4**	**YR5**	**YR6**	**YR7**	**Cumulated**	**Without proj.**	**With project**	**Δ (%)**	**Without proj.**	**With project**	**Δ (%)**
Wheat (durum)	70	62	1.02	1.03	1.08	1.09	1.24	420	240	43%	3,133	2,858	9%
Wheat (soft)	567	145	1.03	1.05	1.12	1.14	1.38	420	240	43%	3,133	2,858	9%
Maize	45	89	1.05	1.10	1.23	1.27	1.80	3,240	2,280	30%	3,761	3,486	7%
Bean (Fève)	6	29	1.06	1.10	1.25	1.29	1.88	600	660	**	3,325	3,050	8%
Bean (Févrole)	34	44	1.06	1.10	1.25	1.29	1.88	600	660	**	3,325	3,050	8%
Sugarbeet	197	282	1.04	1.07	1.17	1.20	1.56	9,300	8,760	6%	5,484	4,934	10%
Sugarcane	159	437	1.03	1.05	1.12	1.14	1.38	4,140	2,820	32%	6,576	5,476	17%
Sunflower	139	50	1.04	1.07	1.17	1.20	1.56	1,260	1,140	10%	2,913	2,528	13%
Bersim	207	126	1.05	1.10	1.23	1.27	1.80	2,580	2,100	19%	2,927	2,652	9%
Maize (forage)	66	131	1.05	1.10	1.23	1.27	1.80	1,380	1,020	26%	3,563	3,288	8%
Citrus	65	103	1.04	1.07	1.17	1.20	1.56	7,260	4,500	38%	8,985	8,435	6%
Watermelon	70	362	1.03	1.04	1.11	1.13	1.34	4,920	4,320	12%	4,945	4,670	6%
Artichoke	0	91	1.07	1.12	1.28	1.33	2.04	7,920	4,620	42%	7,947	7,562	5%
Tomato	10	151	1.03	1.06	1.14	1.17	1.46	4,860	4,140	15%	10,395	9,845	5%
Total	**1,635**	**2,102**											

* Starting in year 4, following the completion of off-farm works

** Increase due to irrigation and inputs

221. A sensitivity analysis (Table 20 for Tadla; Table 22 for Doukkala, Table 24 for Gharb) and a switching values analysis (Table 21 for Tadla; Table 23 for Doukkala, Table 25 for Gharb) was carried out to assess how the EIRR changes in function of the main elements it depends upon, namely: (i) decrease in projected yields; (ii) increase in investment costs; and (iii) delay in the concretization of the benefits.

Table 20: Tadla - Sensitivity analysis.

	Baseline scenario	Decrease in projected yield		Increase in investment costs		Delay in the realization of the benefits	
		By 10%	By 20%	By 10%	By 20%	By 1 year	By 2 years
EIRR	18.8%	14.6%	10.6%	16.5%	14.7%	16.0%	14.0%

Table 21: Tadla - Switching values.

	Decrease in projected yield	Increase in investment costs	Delay in the realization of the benefits
EIRR = 12%	16.3%	37.2%	3.5 years

Table 22: Doukkala - Sensitivity analysis.

	Baseline scenario	Decrease in projected yield		Increase in investment costs		Delay in the realization of the benefits	
		By 10%	By 20%	By 10%	By 20%	By 1 year	By 2 years
EIRR Z0	17.1%	11.7%	5.4%	15.1%	13.4%	14.7%	13.0%
EIRR Ext F	17.5%	11.6%	4.6%	15.5%	13.7%	15.1%	13.3%

Table 23: Doukkala - Switching values.

	Decrease in projected yield	Increase in investment costs	Delay in the realization of the benefits
EIRR = 12%, Z0	9.4%	28.6%	3.0 years
EIRR = 12%, Ext Faregh	9.3%	30.9%	3.0 years

Table 24: Gharb - Sensitivity analysis.

	Baseline scenario	Decrease in projected yield		Increase in investment costs		Delay in the realization of the benefits	
		By 10%	By 20%	By 10%	By 20%	By 1 year	By 2 years
EIRR N3	32.2%	26.6%	20.7%	28.5%	25.6%	25.6%	21.6%
EIRR N4	23.7%	18.9%	13.7%	20.9%	18.6%	19.6%	16.9%

Table 25: Gharb - Switching values.

	Decrease in projected yield	Increase in investment costs	Delay in the realization of the benefits
EIRR = 12%, N3	33.0%	104.0%	7.8 years
EIRR = 12%, N4	22.9%	59.8%	5.0 years

222. The sensitivity analysis proves that the economic viability of the project depends strongly on achieving the projected increase in yields under the new cropping pattern. This is particularly evident in Doukkala, where a decrease in 20 percent of the projected yield makes the EIRR drop to four and to six percent. Technical assistance in support of farmers (Component 2) to ensure access, use, and management of the improved irrigation technologies is thus critical to ensure the

economic viability of the project. Building sufficient capacity to manage the new on-farm system calls for a seven-year project duration, to ensure that the technical assistance has at least two agricultural campaigns to train farmers in using the irrigation system once installed in their farms.

223. For Bouida, Haouz, the sensitivity analysis was not made available. In qualitative terms, there is a risk of increase in costs (the EIRR was calculated excluding contingencies, and with a lower cost of outlets which amounts to about half of what was used for the other irrigation sectors) could result in a decrease of the EIRR by up to two percentage points. The risk of delay in the realization of benefits is considered to be lower in this case, due to the lower share of micro-farms compared to the other irrigation sectors (in Bouida, more than half of the farms are medium-sized, between 2 and 10 hectare), which are typically found to take up on-farm modernization at a faster pace than the small-scale farmers.

224. Overall, the economic analysis reveals that the economic justification is the most robust in Gharb and Tadla, thanks to the projected increase in cropping intensity combined with the introduction and/or expansion of high value crops. The EIRR is higher in Gharb, due to the lower conversion costs of the network which is already pressurized compared to the gravity network of Tadla; and the higher water availability than in Tadla which allows for the introduction of high value crops like melon, artichoke, and tomato. The current low water demand in Gharb can be explained by the poor quality of the water service, which can only be positively impacted by the project. In Doukkala, the conversion costs are low (similar to Gharb), but returns are expected to be lower than in other areas targeted by the project as only limited change in the cropping pattern is expected. The economic justification in Haouz is the weakest, which was to be expected due to the low water availability coupled with the high conversion costs of the gravity system. However, the EIRR is based on average values, and does not incorporate the benefits in terms of increased resilience of farmers to interannual variability. Farmers in Haouz receive low rainfall of 270 mm/year on average, which is the lowest among the project targeted areas. As in all areas with low rainfall, impact of variability is strong, and it will be even more so with climate change. Surface water allocation from the ORMVA is limited, and groundwater is scarcely available in Bouida to complement it. Without the modernized irrigation systems which allow a more efficient use of the scarce water, interannual variability would push farmers towards low-risk and low-return agriculture, negatively impacting their livelihood, with social implications related to poverty and migration. Scarce water resources accentuate conflicts among farmers, degrading the social capital. By maximizing the benefits from the limited surface water available, the project would reduce farmers' vulnerability over the long term.

Financial analysis

225. The project's viability depends upon the participation of a critical mass of farmers, which in turn will depend on farmers receiving an adequate return upon their investment in on-farm drip irrigation equipment, which is estimated to cost US$3,900 per hectare. However, the subsidy provided under the FDA, which results in the fact that farmers do not have to bear the cost of the on-farm investments, make the project *de facto* financially advantageous to farmers.

226. The financial analysis has been carried out taking the net benefit per hectare as a proxy for the farmers' income. The increase in net benefit is twofold in Haouz, threefold in Tadla and Doukkala, and up to six times in Gharb (Table 26).

Table 26: Increase in net benefit (DH/ha).

	Without project	With project	Δ
Tadla	8,150	28,780	20,630
Haouz	5,174	13,722	8,548
Doukkala, Z0	7,820	24,070	16,250
Doukkala, EF	7,640	25,060	17,420
Gharb, N3	6,880	34,560	27,680
Gharb, N4	4,800	24,250	19,450

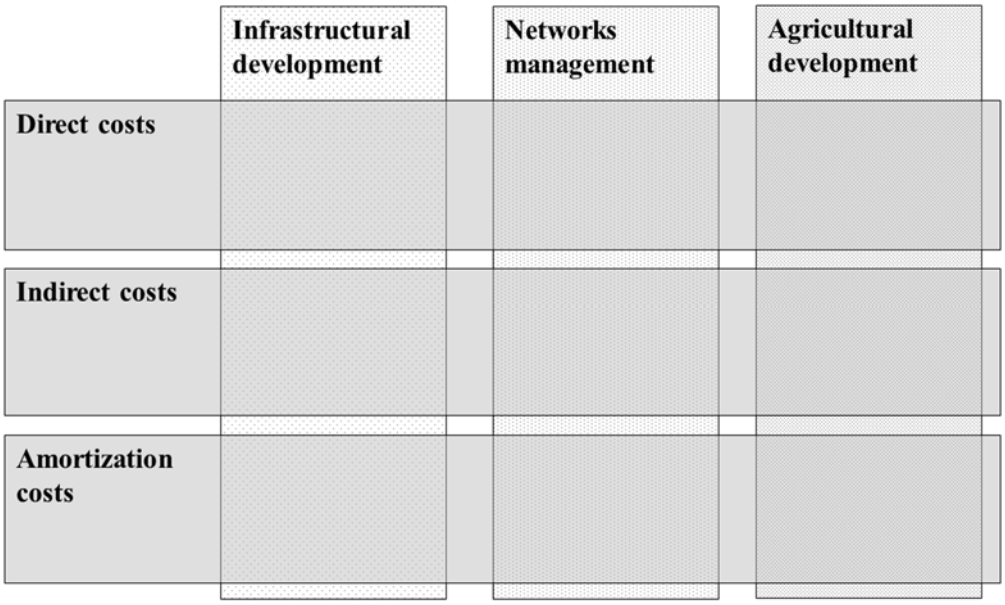
227. The financial analysis confirms that the project will be financially attractive to all categories of farmers. The distribution of financial benefits will however be skewed, partly because land distribution is highly uneven and partly because different farming systems will benefit differently. The skewed incidence of project benefits does not undermine the viability of the project, but it underlines the importance of paying attention to the specific needs of smallholders in implementation and impact monitoring. In terms of distribution of the benefit, it should also be noted that the large-scale farmers in Gharb and Tadla, who have access to groundwater, largely started converting to drip irrigation equipment already, even without the collective projects. Therefore, the majority of project beneficiaries are *de facto* farmers who, for technical and financial reasons, could not individually access the drip irrigation technology. Thus, the project would have a positive impact on equity.

228. A potential financial benefit will be the switching from higher-cost groundwater irrigation to lower-cost surface water irrigation (groundwater costs to farmers indicatively double than surface water). Since surface water availability is currently constrained by the rotation system, some farmers - especially those wishing to grow high-value, but more water-sensitive crops – have invested in wells and pumps as back-up supplies. By improving the flexibility and reliability of surface water service, the project will enable such farmers to save on pumping costs. However, the expected reduction in the fuel cost of groundwater pumping was considered too difficult to quantify for inclusion in the analysis, as groundwater use is not declared nor monitored.

Financial impacts upon the public sector

229. The ORMVAs have two major sources of funds: water revenues and transfers from the Government. Major costs are related to: constructing new irrigation schemes, and rehabilitating and modernizing existing ones (under the responsibility of the Infrastructure Development Department); ensuring Operation and Maintenance (O&M) of irrigation and drainage facilities (under the responsibility of the Networks Management Department); and providing extension services to farmers (under the responsibility of the Agricultural Development Department). Direct, indirect, and amortization costs can be identified under each category (Figure 7). To be financially sustainable, the ORMVAs should have water revenues covering at least the direct and indirect costs of the O&M, and possibly amortization.

Figure 7: ORMVA cost structure.



230. In Tadla, water revenues are sufficient to cover the O&M costs, including amortization (Table 27). In Haouz, Doukkala, and even more in Gharb, water revenues are insufficient to cover the O&M costs, excluding and including amortization. In Gharb, this is due to a combination of low water tariff and low volume of water sold compared to potential, and further affected by the low collection rate.

Table 27: Assessment of ORMVAs' financial sustainability (2013).

	ORMVAT	ORMVAH	ORMVAD	ORMVAG
O&M costs (direct + indirect), excluding amortization (M DH) (a)	101.5	127.4	179.6	279.9
O&M costs (direct + indirect), including amortization (M DH) (b)	103.7	224.9	276.4	456.0
Water charged (Mm^3) (c)	525.8	388.6	417.3	274.0
Water revenues (M DH) (d)	147.2	106.9	139.5	74.7
Average water tariff (DH/m^3) (e=d/c)	0.28	0.28	0.33	0.27
Average unit O&M costs, excluding amortization (DH/m^3) (f=a/c)	0.19	0.33	0.43	1.02
Average unit O&M costs, including amortization (DH/m^3) (g=b/c)	0.19	0.58	0.66	1.66
Δ, excluding amortization (DH/m^3) (h=e-f)	+0.09	-0.05	-0.10	-0.75
Δ, including amortization (DH/m^3) (i=e-g)	+0.09	-0.30	-0.33	-1.39

231. Regarding the project, the ORMVAs will receive the investment as a grant from the GoM and will not be involved in servicing the World Bank Loan. Potentially, the project can have a long-term impact on the ORMVA's finances (and consequently on the Government budget), and in particular on water revenues (in relation to water tariffs and collection rates) and O&M costs.

232. The project will not have a direct impact on irrigation water tariffs, as there is currently no plan to increase tariffs after the farmers' protests in 2010. Following those protests, the GoM, with support from the World Bank and other donors, carried out a Political Economy analysis of the irrigation sector reform (June 2012), with a comprehensive consultation process within the ORMVAs of Gharb, Loukkos, and Tadla. The study revealed that there is typically no problem with the capacity to pay, but that generally farmers demand an improvement of the service quality in association with the water tariff increase. The study recommended refocusing the reform process to first improve the water service delivery, efficiency, and accountability of the ORMVAs. The project, by focusing on the improvement of the water service, is expected to prepare the ground for the institutional reform of the ORMVAs, which will touch also their financial sustainability, by narrowing the gap between the water revenues and the O&M costs.

233. The project is expected to increase ORMVAs' collection rates in irrigation sectors currently served by sprinkler systems, where collective water management at block level has prevented the ORMVAs to take targeted actions whenever some farmers failed to pay the water bill. Over the years, low collection rates have generated important arrears. In the Extension Faregh, Doukkala the ORMVA cut the water service in 2006. The individualization promoted under the project, with the introduction of individual outlets equipped with meter at the farm gate, will increase accountability. The modernization is thus an important opportunity for irrigation sectors with high debts. At the same time, the success of the project depends on farmers accepting to repay their debts.

234. The project is expected to have an impact on O&M costs, but whether it will result in an increase or decrease of overall costs remains debatable. Operation costs should in principle be reduced, as access to water on-demand reduces the need for staff to manage the distribution on rotation. However, the introduction of remote control systems to monitor meters will be crucial in terms of staff requirement to manage the system on-demand. Maintenance costs might decrease following the modernization, as one of the selection criteria for irrigation sectors was to have networks in need of repair. However, there is currently an under-budgeting for maintenance of the irrigation networks: should maintenance be properly budgeted following modernization so to ensure the long term sustainability of the investments, an increase in maintenance costs will be likely observed. For example, in the case of Tadla, where conversion from gravity to pressurized networks will occur on 12,000 ha, the overall O&M costs are expected to almost double following modernization, as:

- Operating costs are expected to be cut by half, passing from about DH2 million (30 technicians at DH6,000/month) to about DH1 million (two staff at DH12,000/month and eight technicians at DH6,000/month); and
- Maintenance costs are expected to double, passing from about DH3 million (which denotes an under budgeting) to about DH7 million (1 percent of the investment costs).

235. From the Government perspective, expanding the proposed approach nationwide over the 220,000 ha of LSI perimeters to be modernized would have fiscal implications. As noted above, the financial benefits to farmers from the proposed investments would be in principle sufficient to permit an increase in water tariffs, which could mitigate the fiscal impact of the modernization. In addition to direct costs for investments, the change in cropping patterns and the increase in yields

consequent to modernization can lead to additional costs for the Government, which are related to additional farm subsidies. The GoM subsidizes up to 100 percent of the cost of drip irrigation equipment, up to 60 percent of sprinkler irrigation equipment, the production of some crops (sugar beet, sugarcane), and various items of farm equipment.

Annex 6: Greenhouse Gas Accounting
MOROCCO: Large Scale Irrigation Modernization Project

Background and Methodology

236. In its 2012 Environment Strategy, the World Bank adopted a corporate mandate to conduct greenhouse gas (GHG) emissions accounting for investment lending. The quantification of GHG emission is an important step in managing and ultimately reducing GHG emission, and is becoming a common practice for many international financial institutions.

237. To estimate the impact of agricultural investment lending on GHG emission and carbon sequestration, the World Bank has adopted the Ex-Ante Carbon-balance Tool (EX-ACT), which was developed by the Food and Agriculture Organization of the United Nations (FAO) in 2010. EX-ACT allows the assessment of a project's net carbon-balance, defined as the net balance of CO_2 equivalent GHG that were emitted or sequestered as a result of project implementation compared to a without project scenario. EX-ACT estimates the carbon stock changes (emissions or sinks), expressed in equivalent tonnes of CO2 (tCO2-eq) per hectare and year.

Application of EX-ACT

238. **Project boundaries.** The GHG accounting considers the installation of on-farm irrigation equipment, which is a consequence of the construction and modernization of the off-farm irrigation networks, and the subsequent changes in agricultural activity. The project area covers approximately 30,000 ha.

239. **Data source.** As for the Economic and Financial Analysis in Annex 5, the feasibility studies carried out by the ORMVAs were used as main data source for the analysis. The studies provide, amongst others, a detailed assessment of current agricultural activities regarding crop and livestock production, and employ standard farm models to project changes in agricultural activity as a consequence of the irrigation modernization. Inputs to EX-ACT are provided in Table 28.

240. **Basic assumptions**. Morocco has a warm temperate climate and dry moisture regime. The dominant soil type is High Activity Clay soil. The project implementation phase is seven years and the capitalization phase is assumed to be 13 years, which indicates the longevity of the on-farm irrigation infrastructure. The 20 years implementation period is standard in the use of EX-ACT. The "without project scenario" is assumed not to differ from the "initial scenario". This default assumption is deemed reasonable as changes in agricultural activity crucially depend on the technology available, which is a contribution of the project. The analysis further assumes the dynamics of change to be linear over the duration of the project. Existing irrigation techniques (surface and sprinkler) are assumed to be replaced by drip irrigation on the entire project area.

241. **Crop production.** A large share of cultivated land is under annual crops. The adoption of drip irrigation allows the adoption of "improved water management" and "improved nutrient management", which are accounted for in EX-ACT. With the introduction of drip irrigation, a change in cropping patterns and an increase in cropping intensity is assumed. Whenever cropland is more intensely used, we indicate in EX-ACT that additionally "improved agronomic practices"

are employed. All management options are available in the EX-ACT module "Crop production". The introduction of drip irrigation is expected to influence the evolution of area under annual crops differently in each sector (Tables 15-19):

- The irrigation sectors M10-M18 and G13-G18 in Tadla cover 12,309 ha agricultural land, of which 80 percent are under annual crop production, including amongst others wheat, alfalfa, sugar beets, forage crops, and 20 percent under perennial crops, i.e. olive and citrus trees. With the project, the cropping intensity is expected to increase by 21 percent, equivalent to 1,539 ha of land for annual crop production.
- The irrigation sector Bouida in Haouz covers ca. 3,552 hectares, of which currently 93 percent are under cultivation. Of the agricultural land, 70 percent is under annual crops, mainly cereals, and 30 percent under olive trees. With project, an increase in cropping intensity by 10 percent is expected, leading to new olive tree plantations of ca. 609 hectare.
- The irrigation sector Doukkala, Extension Faregh and Z0 cover 8,218 hectares, of which 100 percent are under annual crop production. The current farming system is dominated by cereals and sugar beet. With project, cropping intensity is expected to increase by 15 percent, equivalent to 1,281 ha of cropland, with an increase in forage crops and a decrease in cereals.
- The irrigation sectors N3 and N4 in Gharb cover 5,063 hectares of which only 3 percent, or 65 hectares, are under perennials. The area is dominated by cereal cultivation, sunflower and some vegetable crops. With project, the cropping intensity could increase by 29 percent, equivalent to 1,180 hectares.

242. **Land use change**. With the introduction of drip irrigation, the cropping intensity is expected to increase and cropping patterns are expected to change. This may imply a more intense cultivation on existing tree farming plantations as well as a conversion from crop land or other lands to perennials. In Tadla, olive and citrus trees are projected to be more intensely cultivated on 2,461 hectares and additional 1,054 hectares will be converted from cropland to olive and citrus trees. In Haouz, olive trees have covered an area of around 30 percent of agricultural land in the last years. With project, new olive tree plantations of ca. 609 hectare will be planted. It is assumed that 338 hectares will be converted from fallow land and 271 hectares from previously agricultural land. In Doukkala, there are no perennial plantations with or without project. In Gharb, drip irrigation allows an increase in the cultivation of citrus trees from 65 hectares to 348 hectares, which will be converted from land previously under crop production. Overall, perennials will be improved on 3,552 and newly planted on 1,943 hectares land.

243. **Livestock**. The introduction of drip irrigation allows an increase in fodder corn production, decreasing the need to import feed. This provides incentives for farmers to increase the number of livestock, in particular cattle. In Tadla, cattle is expected to increase by 14 percent in G13-G18 and M10-M18; in Doukkala, by 71 percent in Extension Faregh, and by 85 percent in Z0; in Gharb, by 23 percent in N3 and by 30 percent in N4. The number of sheep remains unchanged in Tadla and Doukkala, and decreases by 44 and 26 percent in Gharb N3 and N4, respectively. The project is not expected to introduce improved feeding and breeding practices. Thus, the increased number of livestock is expected to constitute a significant source of emission.

244. **Agricultural inputs**. Regarding the use of nitrogen fertilizer contrasting effects are expected. As the amount of fertilizer can be more precisely tuned to the needs of the crop with drip irrigation, the quantity of fertilizer applied is expected to decrease. On the other hand, the increase in cropping intensity could imply an increased use in nitrogen fertilizer. Without precise data that validates either effect, fertilizer consumption is not included in the analysis. Pressurized water is received at the farm-gate: while pumping stations require electricity, electricity is not needed to irrigate on-farm. The electricity needed for the pumping station to serve the on-farm drip irrigation schemes is assumed to be equivalent to that serving the surface or sprinkler schemes. Further, as pumping stations belong to off-farm equipment, they are not considered in the GHG accounting. The input data to EX-ACT is summarized in Table 28.

Table 28: Land use and inputs to EX-ACT organized by activity and sector.

Activities and project scenarios	Tadla	Doukkala	Haouz	Gharb	Total
Annual crop management (ha)					
Without project scenario	9,841	8,218	2,189	4,998	**25,246**
Project scenario: Improved water and nutrient management	9,841	8,218	1,918	4,998	**24,975**
Project scenario: Improved water, nutrient management, and agronomic practices	1,539	1,281	0	1,180	**4,000**
Perennial crops (ha)					
Without project scenario	2,461	0	1,026	65	**3,552**
Project scenario: Converted to perennials or intensified cultivation	1,051	0	609	283	**1,943**
Area under drip irrigation (ha)					
Without project scenario	0	0	0	0	**0**
Project scenario	12,302	8,218	3,553	5,063	**29,136**
Cattle (number)					
Without project scenario	12,053	7,268	0	1,435	**20,756**
Project scenario	13,747	13,228	0	1,830	**28,805**
Sheep (number)					
Without project scenario	36,789	5,897	0	1,350	**44,036**
Project scenario	36,789	5,897	0	864	**43,550**

Results

245. **Net carbon balance.** The net carbon balance quantifies GHGs emitted or sequestered as a result of the project compared to the without project scenario. Over the project duration of 20 years, the project constitutes a carbon sink of 599,858 tCO_2-eq. This is largely due to the improvements in crop management as consequence of the adoption of drip irrigation. The improved practices lead to a carbon sink of 477,304 tCO_2-eq, and the planting of perennials adds to the sink with 249,957 tCO_2-eq. The installation of drip irrigation is found to be a net carbon source of 9,070 tCO_2-eq. The increase in cattle due to improved forage production is found to be the major carbon source with 137,291 tCO_2-eq. Per hectare, the project provides a sink of 20 tCO_2-eq, which is 1.0 tCO_2-eq each year (Table 29).

Table 29: Results of the ex-ante GHG analysis in tCO_2-eq.

				Share per GHG of the Balance					Results per year		
Project activities	**Without project scenario**	**Project scenario**	**Balance**	**CO_2, Biomass**	**CO_2, Soil**	**Other**	**N_2O**	**CH_4**	**Without project scenario**	**Project scenario**	**Balance**
Land conversion to perennials	0	-18,958	-18,958	20,661	-39,619	0	0	0	0	-948	-948
Improvement of annual crop production	0	-477,304	-477,304	0	-477,304	0	0	0	0	-23,865	-23,865
Perennial growth over project period	-23,443	-273,400	-249,957	-239,378	-10,580	0	0	0	-1,172	-13,670	-12,498
Changes in number of livestock	671,245	808,537	137,291	0	0	0	48,911	88,380	33,562	40,427	6,865
Adoption of drip irrigation systems	0	9,070	9,070	0	0	9,070	0	0	0	453	453
Total	647,802	47,944	-599,858	-218,717	-527,502	9,070	48,911	88,380	32,390	2,397	-29,993
per hectare	21	2	-20.0	-6.8	-17.2	0.3	1.6	2.9			
per hectare per year	1.1	0.1	-1.0	-0.3	-0.9	0.0	0.1	0.1	1.1	0.1	-1.0

246. **Carbon sources and sinks**. The main carbon sources and carbon sinks are soil carbon sequestration, due to the improvement of agricultural practices and biomass growth, due to the planting of perennials. Livestock causes the CH_4 and N_2O emission (Figure 8).

247. **Sensitivity analysis**. The selection criteria for sectors is that farmers commit 70 percent of the agricultural land to the project. In this case, the project would still constitute a notable carbon sink of 507,416 tCO_2-eq. The improved practices would lead to a carbon sink of 323,540 tCO_2-eq, and the planting of perennials would add to the sink with 301,415 tCO_2-eq. The installation of drip irrigation remains a net carbon source of 5,837 tCO_2-eq. The number of livestock is assumed to remain the same. Per hectare, the project would provide a sink of 18 tCO_2-eq, which is 0.9 tCO_2-eq each year.

Figure 8: GHG emission and carbon sequestration in tCO_2-eq, as well as net carbon balance per project activity and the entire project as well as the share of emission sources and carbon sinks in tCO_2-eq for the entire project.