Document of
The World Bank

Report No: ICR00003517

IMPLEMENTATION COMPLETION AND RESULTS REPORT
(TF-10251 TF-10252 TF-10253 TF-10254 TF-10263)

ON FIVE GRANTS FROM THE
GLOBAL ENVIRONMENT FACILITY TRUST FUND

IN THE AMOUNT OF US$1.05 MILLION
TO THE LEBANESE REPUBLIC

IN THE AMOUNT OF US$1.05 MILLION
TO THE HASHEMITE KINGDOM OF JORDAN

IN THE AMOUNT OF US$1.05 MILLION
TO THE KINGDOM OF MOROCCO

IN THE AMOUNT OF US$1.05 MILLION
TO THE CENTRE REGIONAL DE TELEDETECTION
DES ETATS D'AFRIQUE DU NORD

IN THE AMOUNT OF US$394,545
TO THE ARAB WATER COUNCIL

FOR A
THE FIRST PHASE OF THE MULTICOUNTRY
REGIONAL COORDINATION ON IMPROVED WATER RESOURCES
MANAGEMENT AND CAPACITY BUILDING PROGRAM

IN A GLOBAL AMOUNT EQUIVALENT TO US$4.59 MILLION

March 29, 2016

Water Global Practice
Middle East and North Africa Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective December, 2015)

Currency Unit = Lebanese Pounds (LBP)
LBP1507.5 = US$1
US$ = SDR 0.7103

Currency Unit = Jordan Dinars (JOD)
JOD0.709 = US$1
US$ = SDR 0.7103

Currency Unit = Egyptian Pounds (EGP)
EGP7.83 = US$1
US$ = SDR 0.7103

Currency Unit = Moroccan Dirham (MAD)
MAD9.74 = US$1
US$ = SDR 0.7103

Currency Unit = Tunisian Dinar (TND)
TND2.027 = US$1
US$ = SDR 0.7103

FISCAL YEAR 2016

ABBREVIATIONS AND ACRONYMS

APL	Adaptable Program Loan
AWC	Arab Water Council
CRTEAN	Centre Régional de Télédétection des Etats d'Afrique du Nord
CRTS	Centre Royal de Télédétection Spatiale
CNT	Centre National de Télédétection
CNRS	Conseil National de la Recherche Scientifique
CQS	Consultant Qualifications
DA	Designated Account
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
FM	Financial Management
FMS	Financial Management Specialist
FO	Financial Officer
IPCC	International Panel on Climate Change
IFR	Interim Financial Report
IBRD	International Bank for Reconstruction and Development

ICB	International Competitive Bidding
ICBA	International Center for Biosaline Agriculture
ICARDA	International Center for Agricultural Research in the Dry Areas
IDA	International Development Association
IPSAS	International Public Sector Accounting Standards
IW	International Waters
GEF	Global Environment Facility
GRACE	Gravity Recovery and Climate Experiment
LCS	Least Cost Selection
LADS	Land Data Assimilation System
MENA	Middle East and North Africa
METAP	Mediterranean Environmental Technical Assistance Program
MODIS	Moderate Resolution Imaging Spectro-radiometer
MOPIC	Ministry of Planning and International Cooperation
MOU	Memorandum of Understanding
MOWI	Ministry of Water and Irrigation
MTR	Mid-Term Review
NARSS	National Authority for Remote Sensing and Space Science
NASA	National Aeronautics and Space Administration
NCB	National Competitive Bidding
NGO	Non-governmental organization
ORAF	Operational Risk Assessment Framework
PDO	Project Development Objective
POM	Project Operations Manual
PMU	Project Management Unit
RPMU	Regional Project Management Unit
QCBS	Quality and Cost Based Selection
QBS	Quality Based Selection
SBD	Standard Bidding Documents
SOE	Statement of Expenditures
SSS	Single Source Selection
TAC	Technical Advisory Committee
TOR	Terms of Reference
UN	United Nations
USAID	United States Agency for International Development
WA	Withdrawal Application
WISP	Water Information System Platform

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THE FIRST PHASE OF THE MULTICOUNTRY REGIONAL COORDINATION ON IMPROVED WATER RESOURCES MANAGEMENT AND CAPACITY BUILDING PROGRAM

CONTENTS

A. Basic Information

Country:	Middle East and North Africa	Project Name:	5M- Regional Coordination on Improved Water Resources Management and Capacity Building in Cooperation with NASA
Project ID:	P117170	L/C/TF Number(s):	TF-10251,TF-10252,TF-10253,TF-10254,TF-10263
ICR Date:	03/30/2016	ICR Type:	Core ICR
Lending Instrument:	APL	Borrower:	GOVT OF LEBANON/JORDAN/ TUNISIA/MOROCOO
Original Total Commitment:	USD 4.59M	Disbursed Amount:	USD 4.48M
Revised Amount:	USD 4.59M		
Environmental Category: C		**Global Focal Area: I**	

Implementing Agencies:
Center for Remote Sensing, CNRS (Lebanon) – Dr. Talal Darwish
Ministry of Water and Irrigation (Jordan) – Dr. Rania Abdel Khaleq
Centre Royal de Télédétection Spatiale (Morocco) – Dr. Driss El Hadani
Centre Régional De Télédétection Des Etats D'Afrique Du Nord ('CRTEAN') (Tunisia) – Dr. El Hadi Gashut
Arab Council – Dr. Mahmoud Abu Zeid

Co-financiers and Other External Partners:

B. Key Dates

Process	Date	Process	Original Date	Revised / Actual Date(s)
Concept Review:	09/15/2010	Effectiveness:		08/15/2011
Appraisal:	12/01/2010	Restructuring(s):		06/19/2014
Approval:	06/09/2011	Mid-term Review:	03/27/2014	04/05/2014
		Closing:	05/31/2015	05/31/2015

C. Ratings Summary

C.1 Performance Rating by ICR

Outcomes:	Satisfactory
Risk to Global Environment Outcome	Moderate
Bank Performance:	Moderately Satisfactory
Borrower Performance:	Satisfactory

C.2 Detailed Ratings of Bank and Borrower Performance			
Bank	**Ratings**	**Borrower**	**Ratings**
Quality at Entry:	Moderately Satisfactory	Government:	Satisfactory
Quality of Supervision:	Satisfactory	Implementing Agency/Agencies:	Satisfactory
Overall Bank Performance:	Moderately Satisfactory	**Overall Borrower Performance:**	Satisfactory

C.3 Quality at Entry and Implementation Performance Indicators			
Implementation Performance	**Indicators**	**QAG Assessments (if any)**	**Rating**
Potential Problem Project at any time (Yes/No):	No	Quality at Entry (QEA):	None
Problem Project at any time (Yes/No):	Yes	Quality of Supervision (QSA):	None
GEO rating before Closing/Inactive status	Moderately Satisfactory		

D. Sector and Theme Codes

	Original	**Actual**
Sector Code (as % of total Bank financing)		
Irrigation and drainage	79	79
Public administration- Agriculture, fishing and forestry	21	21
Theme Code (as % of total Bank financing)		
Regional integration	4	4
Rural services and infrastructure	46	46
Water resource management	50	50

E. Bank Staff

Positions	**At ICR**	**At Approval**
Vice President:	Hafez M. H. Ghanem	Shamshad Akhtar
Country Director:	Franck Bousquet	Jonathan D. Walters
Practice Manager/Manager:	Steven N. Schonberger	Francis Ato Brown
Project Team Leader:	Qun Li	Claire Kfouri
ICR Team Leader:	Qun Li	
ICR Primary Author:	Joseph R. Goldberg	

F. Results Framework Analysis

Project Development Objectives (PDO) and Key Indicators

The Project Development objective was to improve water resources and agricultural management and planning within and across beneficiary countries, based on quantitative and spatial-based decision making tools.

The Global Environment Objective of the Project was to better manage local and regional water resources and reduce the threat of land degradation and climate change to vulnerable agricultural production systems and water resources in and across the project areas while developing options to address land-based pollution affecting the Mediterranean Sea.

Revised Global Environment Objectives (as approved by original approving authority) and Key Indicators and reasons/justifications

(a) GEO Indicator(s)

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
Indicator 1 :	WISP operational (number)			
Value (quantitative or Qualitative)	0	2	4	7
Date achieved	05/30/2015	05/30/2015	05/30/2015	05/30/2015
Comments (incl. % achievement)	% achievement of revised targets: 175. WISP tools to be implemented under the project include the establishment of remote sensing techniques, digital image analysis tools, land surface models			
Indicator 2 :	Number of major water resources decisions made on improved agricultural and land use management taking into consideration outputs of WISP tools			
Value (quantitative or Qualitative)	0	4	8	10
Date achieved	05/30/2015	05/30/2015	05/30/2015	05/30/2015
Comments (incl. % achievement)	% achievement of revised targets: 125. Major water resources decisions have been made across all participating countries to improve the agricultural and land use management			
Indicator 3 :	Regional and country project data portal developed and operational (according to IW: LEARN guidelines)			
Value (quantitative or Qualitative)	0	3	5	5
Date achieved	05/30/2015	05/30/2015	05/30/2015	05/30/2015
Comments (incl. % achievement)	% achievement of revised targets: 100. Regional project data portal has been developed and is operational in all countries			

(b) Intermediate Outcome Indicator(s)

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
Indicator 1 :	WISP Hardware Purchased and Installed			
Value (quantitative or Qualitative)	0	2	50	52
Date achieved	05/30/2015	05/30/2015	05/30/2015	05/30/2015
Comments (incl. % achievement)	% achievement of revised targets: 104			
Indicator 2 :	Total number of WISP tools adapted and models operational			
Value (quantitative or Qualitative)	0	NA	19	23
Date achieved	05/30/2015	05/30/2015	05/30/2015	05/30/2015
Comments (incl. % achievement)	% achievement of revised targets: 121			
Indicator 3 :	Modeling outcomes reported to end users			
Value (quantitative or Qualitative)	0	NA	9	32
Date achieved	05/30/2015	05/30/2015	05/30/2015	05/30/2015
Comments (incl. % achievement)	% achievement of revised targets: 356			
Indicator 4 :	Expected technical and policy plan developed by end-users			
Value (quantitative or Qualitative)	0	NA	6	14
Date achieved	05/30/2015	05/30/2015	05/30/2015	05/30/2015
Comments (incl. % achievement)	% achievement of revised targets: 233			
Indicator 5 :	Number of remote sensing and stakeholder staff trained on use of WISP tools			
Value (quantitative or Qualitative)	0	15	252	439
Date achieved	05/30/2015	05/30/2015	05/30/2015	05/30/2015
Comments (incl. % achievement)	% achievement of revised targets: 174			

Indicator 6 :	Scholarships for advanced study/work experience in environmental remote sensing or other fields as appropriate selected in each beneficiary country			
Value (quantitative or Qualitative)	0	4	17	24
Date achieved	05/30/2015	05/30/2015	05/30/2015	05/30/2015
Comments (incl. % achievement)	% achievement of revised targets: 141			
Indicator 7 :	Local stakeholder training workshop			
Value (quantitative or Qualitative)	0	6	31	35
Date achieved	05/30/2015	05/30/2015	05/30/2015	05/30/2015
Comments (incl. % achievement)	% achievement of revised targets: 113			
Indicator 8 :	Number of regional/international workshops and conferences			
Value (quantitative or Qualitative)	0	NA	20	28
Date achieved	05/30/2015	05/30/2015	05/30/2015	05/30/2015
Comments (incl. % achievement)	% achievement of revised targets: 140			
Indicator 9 :	Number of Regional Workshops held by AWC			
Value (quantitative or Qualitative)	0	5	6	7
Date achieved	05/30/2015	05/30/2015	05/30/2015	05/30/2015
Comments (incl. % achievement)	% achievement of revised targets: 117			
Indicator 10 :	Number of Regional Reports on Impact of Climate Change on Regional Water Resources Published			
Value (quantitative or Qualitative)	0	4	4	7
Date achieved	05/30/2015	05/30/2015	05/30/2015	05/30/2015
Comments (incl. % achievement)	% achievement of revised targets: 175			

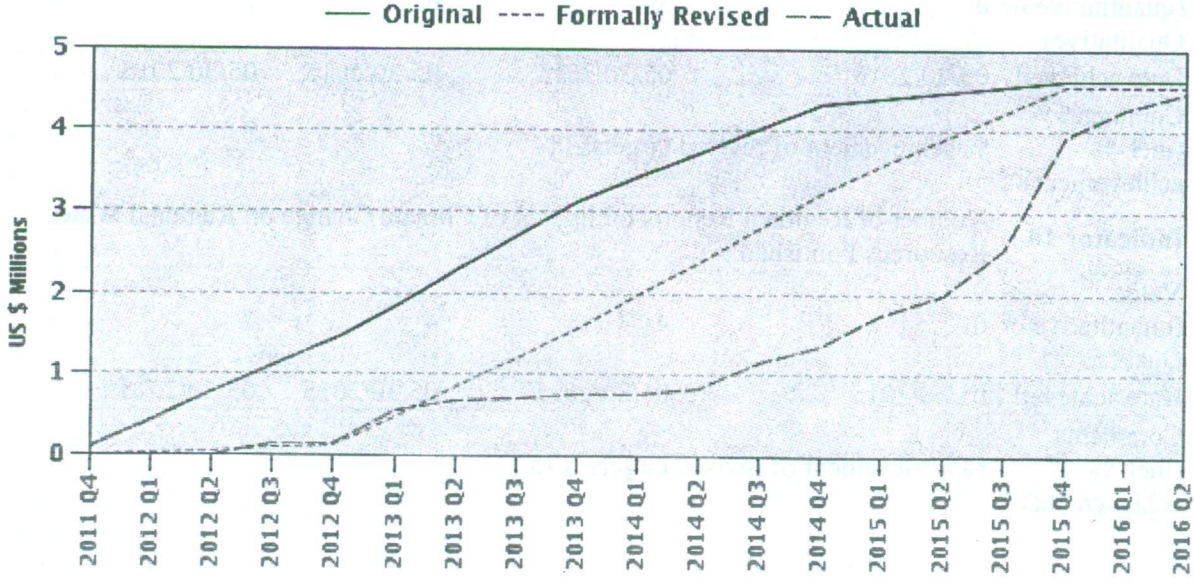
G. Ratings of Project Performance in ISRs

No.	Date ISR Archived	GEO	IP	Actual Disbursements (USD millions)
1	09/09/2011	Satisfactory	Satisfactory	0.00
2	07/01/2012	Moderately Satisfactory	Moderately Satisfactory	0.15
3	05/17/2013	Moderately Satisfactory	Moderately Satisfactory	0.69
4	12/31/2013	Moderately Satisfactory	Moderately Unsatisfactory	0.80
5	06/28/2014	Moderately Satisfactory	Moderately Satisfactory	1.33
6	02/27/2015	Moderately Unsatisfactory	Moderately Satisfactory	2.39
7	05/30/2015	Moderately Satisfactory	Satisfactory	3.27

H. Restructuring (if any)

Restructuring Date(s)	Board Approved GEO Change	ISR Ratings at Restructuring		Amount Disbursed at Restructuring in USD millions	Reason for Restructuring & Key Changes Made
		GEO	IP		
06/19/2014		MU	MS	1.33	

I. Disbursement Profile



1. Project Context, Global Environment Objectives and Design

1.1 Regional Context at Appraisal

1. The scarcity of freshwater in most countries of the Middle East and North Africa (MENA) region is an increasingly acute problem, particularly as populations grow, rapid urbanization continues and the pressure to shift away water from agriculture (which consumes over 84% of the region's water resources on average) as domestic and industrial uses increase. Fourteen of twenty MENA nations are classified as being in water deficit, defined as less than 500 cubic meters (m^3) of renewable water supply per capita per year. The Intergovernmental Panel on Climate Change (IPCC) further reports an expected precipitation decrease over the next century by over 20% for large parts of the MENA region, a likely increase in the frequency and severity of droughts and a reduction in groundwater recharge rates.

2. Modern advances in technology (including geographic information systems, data assimilation, and modeling techniques among others) and space based remote sensing techniques now enable the collection of accurate water data. Data collected in this manner can provide measurements over areas where no data have otherwise been available and at greatly reduced costs as compared to traditional methods. Such data can also easily be turned into valuable information through modeling tools, maps and graphs that allow stakeholders and water managers to make better and more informed decisions for water management and planning.

3. The Water Information System Platform (WISP) is designed to provide estimates of rainfall, runoff, soil moisture, evapotranspiration, among others at a variety of time and space scales (from 25 km to 1 km and 6 hours to 1 hour) and merges state of the art tools to operationally obtain high quality land surface storages and fluxes. The WISP tool is thus particularly relevant to the MENA region, which is characterized by a lack of traditional water balance data, high temporal and spatial variability in precipitation, large aquifers and intensive irrigation. Furthermore, WISP is able to incorporate in-situ data traditionally collected by local and regional water institutions.

4. The Regional Coordination on Improved Water Resources Management and Capacity Building Program was conceived as two-phase Adaptable Program, with a first phase supporting Jordan, Morocco, Lebanon and Tunisia (APL 1); and a second phase supporting Egypt to be triggered once negotiation conditions were met (APL 2).

5. The Program was developed in close coordination with National Aeronautics and Space Administration (NASA) scientists and affiliated academic partners. NASA made available the open-source WISP and provided technical assistance to participant countries. The United States Agency for International Development (USAID) financed the costs of NASA staff and NASA delivered technical assistance activities.

6. This Implementation Completion and Results Report (ICRR) is for APL 1 (herein the Project), for which the Arab Water Council (AWC) played a critical role as the Regional

Project Coordination and Management Office to coordinate project country activities and implement the regional integration and coordination activities under Component 3. APL 2 is still under implementation and is expected to close by November 30, 2016.

7. The Project was consistent with the national priorities of Lebanon, Jordan, Morocco and Tunisia to improve the sustainability of water resources management. It was also consistent with Centre Régional de Télédétection des Etats d'Afrique du Nord (CRTEAN)'s goals and priorities. Furthermore, the Program formed part of the World Bank Arab World Initiative, which emphasizes cooperative regional solutions to major challenges such as water resource management, food security and climate change nexus. Finally, the Program was fully consistent with the World Bank *"Water Resources Sector Strategy – Sustaining Water for All in a Changing Climate"*, particularly in improving client countries' access to technologies to increase the availability and dissemination of water resources information for results-based decision making.

1.2 Original Global Environment Objectives (GEO)/Project Development Objective (PDO) and Key Indicators

8. The GEO of the Project was to better manage local and regional water resources and reduce the threat of land degradation and climate change to vulnerable agricultural production systems and water resources in and across the project areas while developing options to address land-based pollution affecting the Mediterranean Sea. The Project was in line with both (i) the long-term objective of the GEF's International Waters Focal Area "to foster international, multi-state cooperation on priority water concerns," and (ii) the GEF's Strategic Program for International Waters "to balance overuse and conflicting uses of water resources in surface and groundwater basins that are transboundary in nature."

9. The PDO was to improve water resources and agricultural management and planning within and across beneficiary countries, based on quantitative and spatial-based decision making tools.

10. Achievement of the GEO and PDO were assessed through the following key performance indicators:

- WISP operational in at least 3 of 4 implementing agencies
- Number of major water resources decisions made taking into consideration WISP tools
- Regional project data portal developed and operational (according to GEF International Waters (IW): LEARN guidelines)

1.3 Revised GEO/PDO (as approved by original approving authority) and Key Indicators, and reasons/justification

11. The GEO/PDO and the Project scope as described in PAD remained unchanged. However, during the Mid-Term Review (MTR), key indicators were revised to meet specific needs of each country. Expected target values for all 3 PDOs indicators were increased to reflect the final adjusted and agreed activities, and intermediate indicators

under Components 1 and 2 were added including an indicator to monitor the outcome of identified end-users and capacity building activities.

1.4 Main Beneficiaries

12. The direct beneficiaries of the Project were the local and regional remote sensing institutions and the ministries of water, irrigation, agriculture and planning, regional water stakeholders, local farmers and the citizens of Lebanon, Jordan, Tunisia and Morocco (approximately 136 million people, half of which are estimated to be women), which will benefit from improved access to real-time drought and flood monitoring outputs, improved crop yield monitoring, and local and regional groundwater estimates, among others.

1.5 Original Components

13. The Project had three components that were implemented at the country and regional levels (in Lebanon, Jordan, Morocco, Tunisia and AWC).

Component 1: Improved Local Water Resources and Agricultural Management (US$3.06 million)

14. Component 1 comprised of: (a) the purchase, installation and validation of various WISP tools and other ancillary equipment to remote sensing centers and stakeholder agencies and institutions in each of the project countries; and (b) application of WISP tools to pertinent research issues in local and regional water resources, agricultural, and environmental management.

Component 2: Capacity Building and Project Management (US$1.14 million)

15. Component 2 comprised of: (a) capacity building (workshops and consultants) to implement WISP tools; (b) local workshops to share results with local stakeholders; (c) participation in international conferences and study tours on environmental remote sensing; (d) funding graduate fellowships; (e) development of an online national portal to share data across stakeholder institutions; and (f) project management of the Grant.

Component 3: Regional Integration and Cooperation (US$394,595)

16. Component 3 comprised of: (a) organization of quarterly workshops to share results with regional stakeholders; (b) development of an online regional portal to share regional results; (c) generation of once-yearly regional report on applications of regional significance. These applications were expected to include estimating the recharge rates of regional oversubscribed shared aquifers, optimizing the response to droughts and floods at the regional scale, and encouraging a more coordinated approach to management of transboundary water resources among others.

1.6 Revised Components

17. The Project components remained mainly unchanged.

1.7 Other significant changes

18. To ensure the achievements of the GEP/PDO by the Project closing date, the Bank MTR mission reviewed and discussed the country proposals with all recipient countries and Arab Water Council and USAID/NASA teams, and agreed on the following MTR adjustments: (i) change in results framework and monitoring indicators (see Paragraph 9); (ii) change in component cost estimates, with more focus on end-users and capacity building activities; (iii) changes in reallocation of funds between disbursement categories; (iv) change in procurement; and (v) changes in disbursement estimates.

2. Key Factors Affecting Implementation and Outcomes

2.1 Project Preparation, Design and Quality at Entry

19. The PDO and Project design responded to the government priorities. Strengthening water resources management is a high priority in all participating countries, in particular developing solid management tools to plan and manage scarce water resources. Project design was consistent with the strategic focus areas of all the Bank's Country Assistance Strategies (CASs). Project components were well designed towards achievement of PDO. Remote Sensing (RS) data and products when used in combination with in-situ data can make significant contribution to have a better understanding and management of water allocation, water use/consumption, flood and drought monitoring and climate change impacts.

20. However, the project preparation lacked some important elements of implementation readiness for such a complex and multi stakeholder's project. This resulted in initial implementation delays in the first 18 months. One of the main observations and findings following the 2013 Bank supervision mission, also highlighted in the AWC First Regional Report, was the unclear roles and responsibilities of different Project related agencies, the lack of clear incentives and activities for end-user to participate in Project implementation, and the limited knowledge and capacity on Bank's implementation procedures and policies.

2.2 Implementation

21. Project implementation was initially very slow due to the deficiencies identified in paragraph 20, the delayed project effectiveness in respective countries and the lack of the needed technical capacity for innovative activities. The latter was rectified over the course of implementation through both targeted training and international technical assistance where consultants worked side-by-side with local staff. Indeed, project managers stated that "the international consultants did not work for them, rather worked with them and their colleagues." The most serious deficiency was the initial lack of the detailed implementation plans or an operational manual with associated annual detailed investment, procurement and disbursement plans, and annual physical and financial targets, especially a detailed

training plan identified for each modeling study indicating which agency was responsible for which activity and on what time schedule. This deficiency was only addressed through intensive Bank supervisions, especially during the MTR mission.

22. With a change to more intensive supervision and the MTR adjustments, the implementation progress started to accelerate, through: (a) various developed and conducted training programs, including (i) the hands on training in the field for all country Project Management Unit (PMU) managers and staff on the Bank procurement, disbursement, financial management and project M&E procedures and policies; (ii) the specific technical training for all PMU and end-user expert teams on each modeling study theme with a solid training program arrangement provided by NASA team; and (iii) knowledge sharing and exchange workshops; and (b) the additional new intermediate indicators to enable detailed monitoring of progress by each sub-component. The Bank team emphasized capacity building of end user agencies, for which budget was allocated for end-users' participation in each modeling study as well as the staff of the (RS agencies. This seems to have instilled wider project ownership and more cooperative work within the countries.

23. Project implementation accelerated with intensive support from the World Bank's supervision missions, the timely technical assistant from the NASA and other international remote sensing agencies, and all country scientist and local expert teams' extra hard work with clearer output results and time frame. Training workshops that helped the PMUs to reach solutions to all their issues that were affecting the project implementation were also critical to accelerate implementation. Also the stakeholders' close participation (as the member of each modeling study team) in each country positively affected Project implementation and helped PMUs and end-users to achieve Project targets.

24. A key factor for implementation success was the strong buy-in from the participating countries, as evidenced by the setting up of PMUs in each participating country with sufficient technical staff and counterpart budget allocation. As suggested by the Bank supervision, all PMUs signed Memorandum of Understanding (MOU) with relevant line ministries/end-users for the application of the remote sensing studies, which paved the way for policy changes based on study results and facilitated collaboration with the Bank, NASA/USAID and the other partner organizations.

25. The strong technical support and contributions from international RS agencies, especially from NASA (financed by USAID), were crucial for the transfer of technical resources and RS application tools, which had significantly improved technical capacity in all country implementation agencies. The initial and hands-on-training under each study theme provided by NASA with its external contractors was essential for the success of the Project.

26. It should be noted that the AWC played a pivotal role in the coordination of the project activities with the participating countries. It was very important to select a regional coordination agency with national and regional links and influence, able to ensure support and efficient coordination and to help in knowledge sharing and exchange at the regional level. Workshops and conferences held under the auspice and supervision of the AWC positively affected Project progress and its successful implementation.

27. ***Completion***. Although this was a complex multi-country project with complicated implementation arrangements, two donors and advanced RS technologies, experienced a slow start of implementation, all main components/activities were fully implemented and completed successfully as scheduled (without any extension). All expected outcome and output targets/results had been successfully achieved or exceeded, except the groundwater study in Tunisia, where expected results were not able to be fully achieved due to the limited implementation period and the complications with the transfer of available NASA models. The Project financial account was closed by the original project closing date with a full disbursement. This was 98 % of the total grant, the difference due to changes in the exchange rates in respective countries, and the actual disbursement amount in local currency had been more than the appraisal estimates.

2.3 Monitoring and Evaluation (M&E) Design, Implementation and Utilization

28. A comprehensive M&E framework was set up to keep track of implementation progress of all project activities. Almost on a quarterly basis a regional supervision was organized by AWC in coordination with the Bank, where a comprehensive financial and physical progress report was requested to be submitted by the implementing countries to the Regional Coordination Office (AWC). Information on physical and financial progress for all activities was later assessed and reported based on the content of these reports.

29. The implementation of the M&E framework was adequate and effective and clearly showed that working closely with end-users allowed the PMU to know better their needs, assess their weakness and strengths, and identify the gaps and ways for improving capacity building. The input data from remote sensing and stakeholder's feedback during the local workshops helped fine tuning the national indicators and tailoring the Projects activities to meet the end users' demands.

30. The activities and indicators were adjusted during the supervision missions and MTR. More specific indicators were introduced to meet national needs and monitor the output for each detailed modeling study. The utilization of the M&E results contributed to identifying key implementation issues, recommending adequate remedial actions, and enhancing the physical and the financial implementation progress. All indicators were achieved and some were exceeded, based on the expected targets identified and presented in the Results Framework.

2.4 Safeguard and Fiduciary Compliance

31. ***Safeguard***. The Project was not expected to have any adverse environment or social impacts as it would introduce remote sensing software/hardware and would provide capacity building and technical assistance needed to operationalize these tools. The Project was categorized as Environmental Category C, and no safeguard policy was triggered. Since the PDO and the Project scope remained unchanged, no change in the environmental category was made during the project implementation. The Bank team monitored safeguards compliance during regular supervision missions. Project interventions had been applied for better use of water resources and higher adaptive capacity to climate change, which will have a higher level positive environmental impacts in the participating

countries. At completion, the Project had showed positive social benefits, particularly for local stakeholders, who depend on reliable water data for irrigation management, drought and flood risk management, among others.

32. ***Financial Management***: Financial management system including reporting and auditing arrangements was adequate and satisfactory to the Bank. The Bank financial management specialists were based in the country offices, so the Bank was able to provide timely and efficient support to the PMUs. Supervision of financial management arrangements was carried out semi-annually as part of the Project supervision missions. All Audits were fulfilled according to the World Bank rules, procedures and had unqualified opinions.

33. ***Procurement***: Procurement planning and procedures were in compliance with the Bank policies. Procurement reports were updated and submitted to the Bank after each supervision mission. Procurement supervision was carried out on a timely basis as required by the client. The Bank procurement specialists were based in the country offices, so the Bank was able to provide timely and efficient support to the PMUs.

34. ***Disbursement***: All disbursement procedures were in compliance with the Bank's client connection policies and were presented in a physical and financial progress report that was updated and submitted to the Bank after each supervision mission. Almost all the grants were fully disbursed by the Project closing date, reflecting a remarkable turnaround from the MTR period, with a minor unused balance (2% of the total GEF grant) due largely to exchange rate fluctuations.

2.4 Post-completion Operation/Next Phase

35. Since the Project was successful at the regional and national levels and proved to be an excellent step towards concrete regional cooperation, and given that the all participating countries appreciated and valued the Project, participating countries have expressed a keen interest in a second project in order to continue the transfer and adaptation of cutting-edge technology of RS in water resources management and agriculture management in the MENA region and in extending and upgrading the current Program activities through a follow-up Program.

36. Accordingly, AWC had already requested a second phase Program on behalf of the participating countries. The Bank project team has received country GEF focal point endorsement letters and is seeking funding for this new phase under the GEF-6, particularly the window on International Waters. A draft PCN has already been prepared and reviewed by the Bank GEF coordination office and GEFSEC.

3. Assessment of Outcomes

3.1 Relevance of Objectives, Design and Implementation

37. *Relevance of Objectives (high).* At the time of appraisal, the GEO/PDO were relevant to the MENA region's development strategies and also the national development priorities of the participating countries aiming to improve the sustainability of water resources. This regional Project was part of the World Bank's Arab World Initiative (AWI), which emphasizes cooperative regional solutions to major challenges such as water resource management, food security and climate change nexus.

38. The GEO/PDO still remains highly relevant in the MENA region and is in line with both (i) the long-term objective of the GEF's International Waters Focal Area "to foster international, multi-state cooperation on priority water concerns", and (ii) the GEF's Strategic Program for International Waters "to balance overuse and conflicting uses of water resources in surface and groundwater basins that are transboundary in nature."

39. The project GEO/PDO is still consistent with the Country Partnership Strategy (CPS)/CPF goals and all project countries' national priorities of strengthening local and regional capacities in sustainable water resources management, and also fully consistent with the World Bank "Water Resources Sector Strategy – Sustaining Water for All in a Changing Climate", particularly in improving client countries' access to technologies to increase the availability and dissemination of information for result-based decision making.

40. In addition, the project objective has be in line directly with the new "MNA Regional Water Security Initiative (RWSI)", which has been initiated by the Water Global Practice recently. The RWSI is a Programmatic Approach with two broad pillars: (i) "increasing access to and sharing of technologies and policy options; and (ii) building consensus for action on water security in MENA." This project contributed to the first pillar of the RWSI as it seeks to enhance technical capacity and sharing of information and to the second pillar of RWSI by supporting the development of a regional geospatial database on water that is hosted at the League of Arab States.

41. The rationale for Bank involvement in the program lay primarily in its ability to apply innovative solutions to development challenges in the water sector by collaborating with renowned specialist technical institutions - such as NASA and top academic institutions in the field of remote sensing and hydrology. Furthermore, the Bank has been extensively involved in many of MENA's water resources management-related technical assistance and investment projects and reforms – many of which of transboundary nature.

42. **Relevance of design and implementation (substantial).** The Project design and implementation focused around regional cooperation and technical excellence was and still remains substantially relevant. Nothing could be more relevant to the future development of the most water-stressed area of the populated world, than introduction of a set of low-cost techniques to accurately and quickly measure the presence and usage of water. That is what this project accomplished, and the technical outputs of this effort are listed below and in Annex 2. The first step here had to be the establishment in each country of a strong cadre

of expertise in remote sensing (RS) technologies, some through academic education, but mainly through working with international experts on practical problems, and associated project training. This step has been achieved. The second step has been the application of satellite monitoring to actual water management, here largely irrigation and flood control. The third was the application of RS technology to other areas of high priority to each country, where hydrometric parameters play a key role. Here the results have been remarkable in drought monitoring and guidance of compensation programs (Morocco), guidance of forest fire monitoring and fighting (Lebanon), control of illegal groundwater extraction (Jordan), monitoring and control of locust outbreaks (Morocco). Where more needs to be done is in irrigation management, which will likely take another operation to accomplish. But this will now be possible given the basis established by this project. What has already been achieved testifies to the relevance of the project and its design.

43. Overall: (i) the project PMUs and the Bank Team demonstrated a flexible and programmatic approach that mobilized the international and regional expertise required to operationalize various WISP tools with the valuable technical support from the NASA team (the implementation partners), and allowed interventions to adapt to the changing realities on the ground and the needs of the participating countries; (ii) the fact that project covered four participating countries with some specific activities for each country and a regional component necessitated commensurate implementation arrangements (PMU in each country and AWC to handle the regional component).

3.2 Achievement of the Development Objectives
Rating: Substantial

44. The project achieved its main development objectives. Given the attainment or surpassing of virtually all of the specific PDO outcome and intermediate indicators in general as discussed below in detail (and presented in the Datasheet and Annex 2). The PDO outcomes is assessed as substantially achieved within a relatively short implementation period (about 3.5 years implementation period, especially with a slow start at the early stage of the implementation).

45. The project development objective was to improve water resources and agricultural management and planning within and across beneficiary countries, based on quantitative and spatial-based decision making tools. Recipient countries were supposed to benefit from the expected project outcome of enhanced capacity in remote sensing and would be able to better:

- Operationalize various WISP tools and validate output data on water availability and compile past and current water conditions to inform improved water policy decisions;
- Generate crop/irrigation/ET maps and estimates of irrigation water requirements and water use for large scale agricultural productivity assessments and planning;
- Estimate current water storage conditions in the uplands of river basins to improve river flow predictions, and provide water balance data to identify short and long term trends in water anomalies;
- Monitor and forecast extent and severity of droughts and flood with climate change impacts; and

- Evaluate potential increases/decreases in irrigation water requirements under various climate change scenarios to inform the planning of agricultural policies.

46. But the various countries went beyond assimilation of new analytical techniques based on new remote data sources. They actually applied them to a wide range of issues and problems of high priority to them. In Morocco the two novel and unpredicted areas were locust control and estimation of drought damages to farmers for compensation purposes. Various types of locusts breed in southern Morocco, and occasionally morph from the solitary to the gregarious state, such stages triggered by parameters captured by project technology, particularly soil moisture and temperature. Once the Moroccans realized this connection, and their new ability to keep track of these parameters in virtually real time, they turned this into a strong technical protocol (including production of bi-weekly maps) to monitor the locust populations. These now guide field teams to areas of high probability for the massing of locusts prior to the migrations across the whole of North Africa, which have devastated regional agriculture since antiquity. The teams then have the task of ground truthing the presence of swarms and destroying them. The second novel application came from formation of a Comprehensive Drought Index, developed under the project with the help of the U.S. Drought Mitigation Center at the University of Nebraska. The novel use of this was to guide Morocco's very large compensation program for drought-afflicted farmers, an objective and accurate approach far removed from political trading. In Lebanon, similar project-generated hydrometric data was used to guide forest fire monitoring and control teams, as well as thorough flood forecasting for the entire country In Jordan ET monitoring in large areas without surface water, was used to pinpoint violations of regulations on groundwater extraction, and then to write a new Groundwater Law. These applications created by the countries themselves are a testament to the efficacy of the project, in creating critical masses of expertise, of supplying those units with effective new tools, and in providing the right international expertise to speed them on their way in applying them.

47. At the Project completion, the expected benefits were achieved in the participating countries with each country's own emphasis areas. Also, with the attainment or surpassing of all of the PDO and intermediate indicators, outcomes are assessed as substantially. The details are as follows:

Original PDO1: WISP operational in at least 3 of 4 implementing agencies

48. The expected PDO outcome was exceeded since 7 WISP or 175% of original and 125% of the MTR target were established (Lebanon: 1; Jordan: 2; Morocco: 2; and Tunisia: 2). WISP tools to be implemented under the project include the establishment of remote sensing techniques, digital image analysis tools, land surface models, and the land data assimilation system (LDAS) or other relevant software developed and widely used by NASA and its partners. The main themes under WISP tools included: (a) several common application areas: (i) identification of flood and drought prone areas and related forecasting and monitoring, (ii) crop, irrigation and ET mapping, (iii) climate change impact estimates to inform water and agriculture management decisions; and (b) special country priorities which were differed widely between countries, such as (i) Lebanon essentially treated the project as the basis for their disaster management programs, focusing on using project data for forest fire and flood forecasting, both on a continuous national basis; (ii) Morocco used the

data to provide guidance to locust survey teams, through maps on a bi-weekly basis, since the locust breeding and metamorphosis stages are largely dependent on soil moisture and temperature, which continue to allow early detection and disruption of outbreaks which have plagued not only Morocco but all of North Africa for millennia; (iii) Tunisia has used their data to forecast floods upstream of the Bisri Dam and also work on the estimation of groundwater fluxes.

49. **Original PDO2: Number of major water resources decisions made taking into consideration WISP tools,** which directly supported the achievement of PDO and the improvement of local water resources and agriculture management.

50. The major water resources decisions have been made to improve the agricultural and land use management "taking into consideration the outputs of WISP tools" (by 125% of the target value). These decisions were divided by countries as follows:

Lebanon: (2 decisions)

- The Sustainable Management of natural Resources and Early Warning Platform (SuNaR) was developed by the project and launched in September, 2014 in the Ministry of Agriculture. The Disaster Risk Management Unit at the presidency of council throughout its connection with the SuNaR is now using the outputs of the SuNaR for the National Response Plan. The SuNaR Platform provided real time forecasting and monitoring information and maps showing hot spots for flood risk and forest fire prevention to enhance decision making and national preparedness.

- A decision was made by the Ministry of Water and Energy to start the standardizing, harmonizing and sharing policy in climatic and hydrological data. Similarly, the Ministry of Environment MoE started updating the "Adaptation to Climate Change Strategy" in the water sector based on the project results under the Climate Change component in May 2015.

Jordan: (3 decisions)

- In Jordan, the Parliament issued an amendment to the groundwater law following the recommendation of the Ministry of Water and Irrigation (MWI) that was based on the research results of the ET and Crop mapping components for selected pilot areas. The amendment indicated that remote sensing tools will be used for calculating groundwater abstractions and irrigation requirements. RS is now authorized as an official source for verification and uncovering violations and estimating water consumption in amended "Water Authority Law No. (2) of 2014" issued in May 2014.
- Another decision made by the Ministry of Water and Irrigation was to start using the WISP tools that were installed as part of this project to calculate the Water Balance in the entire ministry upcoming research studies for irrigation optimizations and water resources management and monitoring. Finding from the project were included in the National Water Strategy, which was recently developed for the time horizon (2016-2025) and released in March 2016, used information obtained through project products of crop map and estimated water used in agriculture as a main inputs.

- Reference was made to the output report of the Climate Downscaling component of the project in the recently published "Climate Change Policy for a Resilient Water Sector"- (March 2016): Abdulla (2015): 21st century projections for precipitation and temperature change in Jordan.

Morocco: (4 decisions)

- The decision made by the Ministry of Agriculture and Marine Fisheries on the large drought compensation program for farmers - the current agricultural campaign (2015-2016), used the real time drought monitoring data from the Drought Study Component. This program in the amount of 5 million MAD was to face the drought socio-economic impacts, proposed to cope with the ongoing drought season, and support the farmers for crop loss.
- For the Locust component, the National Center for Combatting Locust decided to use the project RS outputs from the Locust Component to start prospecting campaigns in areas with probability of locust presence and launch an operational/prevention plan in the field to fight locust. Concerning the locust the system helped to better guide the field campaigns on the ground since early 2015.
- For the Climate Change component, the Ministry of Water and Agriculture decided to use the project output results as a baseline in implementing the national plan for climate change adaptation.
- The outputs of the LIS platform and the Water Balance Study have been used by the Ministry of Water and Agriculture used as a baseline in reforming the current national water strategies plan. The national water plan will be updated and is already at the parliament level for negotiations and will be voted in 2016.

Tunisia: (2 decisions)

- The project outputs on Climate Change high resolution projection (for future trends) helped the Ministry of Agriculture, Water resources and Fisheries in Tunisia in understating the climate variability and supported in developing mitigation actions in July 2015 to adapt olive production to future changes and to build adaptive strategies, in order to reduce the socio-economic impacts of these changes.
- For flood forecasting, the results of the simulation models for the Medjerda River watershed were satisfactory by 89% and contributed to the Floodplain Management Plan in October 2015.

51. It is also to be noted that all country PMUs have been working closely with all related ***end-user agencies*** to generate the practical modeling results for the possible applications in agriculture and water sectors, especially to improve the existing development strategy, policy and planning based on the various scientific study outputs in each country. More information about this is shown Annex 2.

Original PDO3: Regional project data portal developed and operational (according to GEF International Waters (IW): LEARN guidelines)

52. Regional project data portal developed and operational in all countries (according to IW: LEARN guidelines), a total of 5 Portals were developed and are operational against the target of 5 Portals or 100% achievement (1 in each countries and 1 by the AWC).

Output by Component

53. *Under Component 1*, the following output targets were achieved: (i) WISP hardware was purchased (100 percent of target value), but some of expected output targets were delayed mainly because of NASA DisAlexi model that was still under development at that stage and could not be transferred by NASA team as initially planned. However, the alternative plans were being implemented by all country PMUs to work on the ET and drought monitoring studies, although that caused the delayed implementation, but eventually completed' and (ii) 23 WISP tools were acquired and were operational (121% of the targets, with the implementation of the alternative plan for the groundwater, ET and drought monitoring studies).

54. *Under Component 2*, the following output targets were achieved: (i) WISP hardware was purchased, and the output targets of the number of research fellow/scholarship selected was reached by 124%, that is because all PMUs had used more research assistants and consultants, but not the formal research fellow/scholarship as needed for each modeling study; (ii) total number of remote sensing stakeholders and staff trained is 257 (by 148% of the targets); (iii) about 61 experts and PMU managers had participated in the international and regional workshops/conferences (achieved by 153% of the expected target); and (iv) about 18 international and regional conferences and workshops had been conducted and participated by the project PMUs (achieved by 95% of the targets). All country PMUs had organized the necessary trainings/workshops at local and regional levels and worked actively on sharing knowledge between countries (e.g. between Tunisia/Morocco and Lebanon/Jordan).

55. *Under Component 3*, the following output targets as agreed in MTR in 2014 were fully achieved. The regional technical coordination had been strengthened by increased number of regional and country workshops and country PMU's active involvement in the field. By May 2105, 7 regional knowledge sharing and exchange workshops had been organized by AWC (117% of the targets), and participated by officials and experts from all country PMUs and technical line ministries to enable the regional knowledge transfer and capacity building on WISP tools and project management; and also 7 regional reports completed (175% of the targets) on local and regional study results, and outputs of the workshops.

56. ***Achievement of the GEO***. According to the overall project achievements discussed above, the project had contributed to the achievement of **the GEO**, which had better managed local and regional water resources and reduced the threat of land degradation and climate change to vulnerable agricultural production systems and water resources in and across the project countries, through (i) the developed country crop/irrigation and ET mapping for better measurement, monitoring and management of the irrigation water, to

reduce inefficiency water use and agriculture water consumptions at the irrigation district and on-farm levels, which will increase the freshwater flows and reduce the agriculture non-point pollutions entering the Mediterranean sea; (ii) the established measurement and monitoring system for the flood forecasting and drought resilience, with improved adaptation capacity to the extreme events for all beneficiaries; (iii) the CC impact study on water and agriculture production, which improved land degradation and enhanced climate smart agriculture production; and (iv) further strengthened regional integration and cooperation with the established regional project data base/platform, which supported the decision making and planning in the respective country.

57. Changing the management of a country's water resources, with real aggregate savings of water as the outcome, is a long-term plan. But this small software project did lay the groundwork for such an achievement, if the countries remain committed to saving water in agriculture, increasing clean flows to the Mediterranean, and satisfying expanding needs for other uses, particularly human direct consumption. The project did improve irrigation management in pilot areas, with real water savings. Jordan estimates that 80 million cubic meters were saved over the past three years, of which 20 million m3 (worth about $1/m3) may be ascribed directly to remote sensing means, largely due to this project. The other countries, with much more water and agriculture, probably saved more. So while national irrigation systems have not yet been refocused, enough has been achieved on a pilot basis to justify this project many times over. This is in addition to the non-irrigation benefits of all the other work done by the countries. Achieving the lofty environmental goals on a national basis, will require a series of projects, eventually in each country.

58. Although the development objectives were achieved on at least a pilot basis, all PDOs outcome results were fully achieved or exceeded as indicated above and important goals were achieved outside the project projections. Thus this achievement should be rated Substantial (S) given that full achievement of project objectives will likely require far more time and far greater expenditure than the appraisal document projected.

3.3 Efficiency

59. The project, consistent with other technical assistance, was not amenable to standard quantifiable rate of return or cost/benefit analysis due to the difficulty of attribution. In this case, however, the benefits of the application programs do appear to be significantly greater than the relatively small project costs. For example, past locust outbreaks are estimated to have cost Moroccan agriculture from $50 - $100 million, while the project financing for the locust control activity in Morocco only about $300,000 hundred thousand. Similar comparisons of very high estimated benefits relative to the project costs were identified for flood forecasting in Tunisia and Lebanon, cessation of groundwater overdraft in Jordan, and improved forest fire mitigation in Lebanon, and equitable drought compensation in Morocco (see Annex 3). All of these were direct beneficiaries of the project's activities, and together they have been worth many times the cost of the project to the countries concerned.

60. Beyond the economic benefits resulting from the applications, the remote sensing technology also allowed for significant savings relative to traditional terrestrial investigation approaches. For example, in the absence of using satellite imagery, SUV caravans were required to cross the desert to monitor the few observation wells, or suspected locust breeding sites, and teams had to walk through forests to assess dryness of vegetation and quantities of fire fuel, or undertake visits to farms to assess drought impacts or water usage. In addition to being more economical, remote sensing often provided improved accuracy and timeliness of observations.

3.4 Justification of Overall Outcome Rating

Rating: **Satisfactory**

61. Overall, the project implemented the intended project objectives, met and exceeded all implementation outcome targets, as such the project can be considered as successful in reaching all of its PDOs indicators. In addition, the project objectives and design were and continue to be highly relevant to the participating countries' priorities and needs in agriculture and water sector development and management. Even though the project, like all technical assistance projects, was not amenable to standard quantifiable rate of return or cost/benefit analysis, examples of the benefits of applying such technologies, as well as avoidance of large costs does present a case of efficiency gains. Thus, a satisfactory rating is proposed for the overall outcome.

3.5 Overarching Themes, Other Outcomes and Impacts

(a) Poverty Impacts, Gender Aspects, and Social Development

62. Although the project was not targeting an impact on poverty; improving the water monitoring process through new sources of information and WISP models to better characterize water resources conditions is crucial for implementing the countries' National Water Strategies and the Green economy Plans that are widely focusing on sustainable socio-economic development at the country level.

(b) Institutional Change/Strengthening

63. The overall project TA and technical training plan had been fully implemented as expected by all country PMUs and AWC. The various international and regional technical training workshops and conferences had been fully conducted, and the total number of trainees from the stakeholders and end-users has reached approximately 439 persons which exceeded the target with about 174%, while the number of local training workshops that were organized for the end-users and stakeholders exceeded more than 35 workshops and approximately 113% of the original target. All country PMUs and AWC had organized the necessary technical and stakeholder trainings/workshops at local and regional levels and worked actively on sharing knowledge between countries (e.g. between Tunisia, Morocco, Lebanon and Jordan), which strengthened technical and institutional capacity for all project PMUs and the end-users/line ministries in all project participated countries.

(c) Other Unintended Outcomes and Impacts

64. *Morocco-Decision Support Platform*. The dissemination of that platform aimed to provide users, project's partners and the scientific community, with a powerful infrastructure, that offers easy access to geo-spatial data, results and tools developed in the framework of LDAS-MOROCCO Project, as well as, a user friendly access to set of online "geo-services". More details are shown in Annex 2.

65. *Lebanon- SuNaR Plateform.* The National Disaster Risk Management Unit was launched on May 30, 2015, which adopted *SuNaR Plateform as technical arm for the DRMU.* The *SuNaR* system provided the real time monitoring information on the forestry fire and flood in Lebanon. The system can be accessed by all end-users/line ministries, project's partners and the scientific community, with a powerful infrastructure. Predicting forest fire and flood potentiality was crucial in reducing damages. A good example was the fires that took place last May 2015. Around 53 fires took place between 19-20 May 2015, where the humidity dropped 15% and the temperature reached the 40 C. The SuNaR system issued a fire weather warning and reduced significant economic losses.

66. *AWC Regional Portal.* In 2014, AWC launched the project regional portal to serve as a repository of programmatic tech info and events for the project (i.e. reports, case studies, snapshots of national results, training schedules and material, news on upcoming workshops). On the national level also, update their own information and results directly through country accounts created under the project, and a technical manual was provided to all countries. Portal Link: http//www.rciwrm-awc.org.

3.6 Summary of Findings of Beneficiary Survey and/or Stakeholder Workshops

67. N/A for Beneficiary survey.

4. Assessment of Risk to Development Outcome

Rating: **Moderate**

68. The project risks, which were identified at appraisal, mostly centered on weak technical capacity in remote sensing and an anticipated unfamiliarity with Bank procurement and financial management guidelines. The overall project risks were rated Medium - Low Impact, and were considered manageable with mitigation measures in place. At project completion, each country had a good cadre of staff (mainly centered in the PMUs, their host agencies, and end-user agencies) knowledgeable in remote sensing technologies and their applications in various aspects, and indeed in new developments in the field. This is in large part due to the project itself, but it was helped by the general rise in higher education standards in the countries involved, and the return of people from higher study abroad. The countries seem capable of continuing sufficient budgeting of the relevant agencies and teams, and willing to do this as long as they see concrete applications with useful results. Thus contributions of these technologies to practical policy-making and investment programs should increase over time, especially if a follow-up project consolidates the achievements and focuses on implementation of their use in agriculture and environmental management. Therefore, the risk to project outcome is rated Moderate.

5. Assessment of Bank and Borrower Performance

Rating: **Satisfactory**

5.1 Bank

(a) Bank Performance in Ensuring Quality at Entry

Rating: **Moderately Satisfactory**

69. The project identified the key sector issues and aligned the project objectives with country priorities. It also incorporated lessons from good practices, strengthened the focus on regional cooperation, promoted innovative design and flexibility to adapt to country needs. The right issues were targeted, with good technical solutions. Teams in each country were also well chosen and motivated. However, given the complexity of such a multi-stakeholder project, the Bank should have done more to ensure that institutional coordination and readiness issues were addressed during preparation, including a detailed project implementation plan and adoption of an agreed operational manual. On balance therefore, the rating of the Bank performance at entry can be considered **Moderately Satisfactory**.

(b) Quality of Supervision

Rating: **Satisfactory**

70. During supervision missions, the WB staff acted in an efficient and proactive way and worked closely with NASA team, the PMUs and end-users to detail project activities and their cost estimates as well as adjustment and review of PDOs target to confirm to the needs and priorities of each of the participating countries. The MTR was a good chance to discuss and agree on those adjustment and revisions which enabled the PMUs to complete successfully all project activities by the original project closing date. Accordingly the Bank performance can be considered **Satisfactory**.

(c) Justification of Rating for Overall Bank Performance

Rating: **Moderately Satisfactory**

71. The overall rating of the design, implementation and outcome of the project is satisfactory. With the efficient and effective supervisions, the project was completed successfully and achieved or even exceed its original expected PDO and intermediary outcome and output targets. The rating can be considered **Moderately Satisfactory**.

5.2 Borrower

(a) Government Performance

Rating: **Satisfactory**

72. Ministry of Finance in all countries provided complete support during the project design and implementation phases. Other ministries (MoA, MoWE) endorsed the project objectives and expected outputs. Based on the achieved results, the performance can be considered as **Satisfactory**.

(b) Implementing Agency or Agencies Performance
Rating: **Satisfactory**

73. All implementing agencies actively supported participated in the project design and implementation and created the PMUs and national steering committee. The Government also provided in kind contribution to support the involvement of the national experts in the project implementation. Based on the achieved results, the Implementation Team performance can be considered **Satisfactory**.

(c) Justification of Rating for Overall Borrower Performance
Rating: **Satisfactory**

74. The borrowers were committed to the project objectives and design and continued to provide financial support in order to maintain different project applications which would secure the sustainability of the established national systems. The borrower implementation teams provided support to national institutions and end-users and continued the production of recent maps for most applications after the project closure. Accordingly, the rating for the borrower performance can be considered **Satisfactory**.

6. Lessons Learned

75. Some of the key lessons learned are as follows:

- **Where problems are shared, try to design a regional operation**. On balance, the fact that the project handled a group of countries rather than a single one was probably a strong positive factor in its success. The countries excelled in various aspects of the project, and thus they could truly learn from each other. This is an important element in assimilating new technologies. Workshops and training courses were also more efficient for four countries than they would have been for one, and probably also higher quality from the interaction point of view. In this case, the countries all spoke the same language, and shared many common geographical problems. The latter was probably more important than the former (although the shared culture was probably a plus), as would be the case for example in typhoon forecasting and protection in Southeast Asia (5-6 languages) or the same for hurricanes in the West Indies (3 languages). Thus a regional approach should probably be pursued where possible.

- **Even TA projects should follow project management disciplines.** Project performance, and its marked improvement from the initial stage to the later, shows the importance of applying World Bank protocols during project preparation, so that the project starts well and quickly. This includes proposing detailed project implementation plans (especially the specific training plan for a quick initial implementation for this type of capacity building project) with specific budget allocation and timeline, and possibly an operational manual, holding procurement and disbursement training for staff designated to perform this task, and a project launch workshop immediately after project approval to ensure all staff know required tasks for the first 3-6 months of the project implementation.

- **Do not build long education courses into short focused TA projects.** For projects other than specifically education or training projects, fellowships for very long courses of study (e.g. PhD programs) should not be a major project component. All project-related education and training should be related to project execution, with perhaps a maximum term of six months so that valuable (or necessary) staff are not taken away from the project. Other, perhaps more research-oriented operations may include long-term capacity building, but with suitable length of project duration to accomplish this.

- **A good coordinating body can be extremely useful, particularly for a regional project.** Part of the success of the project was due to the coordination by the Arab Water Council, which a played pivotal role in coordinating with all participating countries (with trained and improved capacity on the Bank project implementation procedures and policies) on the project procurement, disbursement and implementation plan preparation, project physical and financial progress and M&E monitoring, and identifying risks and action plans for the overall regional project. They had led the country PMUs in improved implementation, and organized and conducted regional knowledge dissemination and exchange among project countries. For future projects of this type, the lesson probably should be to select a coordinating body without an agenda of its own, that would be trusted by the various countries, and then to train them as well as the country units in project implementation procedures and tool.

- The capacity enhancement efforts supported by the NASA and international science teams to train and strengthen national teams are also worth highlighting. Capacity enhancement that can quickly impact the quality of support to local decision and policy making is often an early outcome relative to other desired outcomes.

7. Comments on Issues Raised by Borrower/Implementing Agencies/Partners

(a) Borrower/implementing agencies

76. Each of the participating countries submitted its own ICR and the AWC compiled all these reports in one Report (on files).

(b) Co-financiers

N/A

(c) Other partners and stakeholders
(e.g. NGOs/private sector/civil society)

N/A

Annex 1. Project Costs and Financing

(a) Project Cost by Component (in USD Million equivalent)

COMPONENTS	APPRAISAL ESTIMATE (USD MILLIONS	MTR REVISED	ACTUAL/LATEST ESTIMATE (USD MILLIONS)	PERCENTAGE OF MTR (%)
	(USD million)			
COMPONENT 1: IMPROVED LOCAL WATER RESOURCES AND AGRICULTURAL MANAGEMENT	2.45	2.58	2.62	123
1-A- Climate Change Modeling Study	0.57	0.47	0.73	155
1-B- Drought Modeling Study	0.30	0.25	0.30	121
1-C- Groundwater Modeling Study	0.02	0.07	0.01	15
1-D- Flood Modeling Study	0.12	0.10	0.06	66
1-E- Crop & Irrigation & ET Mapping	0.99	0.84	0.94	112
1-F- Locust Study	0.08	0.00	0.09	120
1-G- Forest Fire Modeling Study	0.11	0.11	0.11	100
COMPONENT 2: CAPACITY BUILDING AND PROJECT MANAGEMENT	1.75	1.62	1.47	90
2-A: Capacity building (workshops and consultants) to implement WISP tools on local level	0.38	0.65	0.56	86
2-B: Participation in international conferences and study tours on environmental remote sensing	0.19	0.31	0.29	93
2-C: Funding graduate fellowships	0.31	0.18	0.09	51
2-D: Development of an online national portal to share data across stakeholder institutions	0.19	0.19	0.16	81
2-E: Project management of the Grant	0.55	0.52	0.53	103
COMPONENT 3: REGIONAL INTEGRATION & COOPERATION	0.39	0.39	0.39	100
Total Project Costs	4.59	4.59	4.48	98

(b) Financing

SOURCE OF FUNDS	TYPE OF FINANCING	APPRAISAL ESTIMATE (US$ MILLION)	ACTUAL ESTIMATE (US$ MILLION)	PERCENTAGE OF APPRAISAL %
IBRD (GEF Grant) APL-1	GEF Grant	4.59	4.48	
Total Bank Financing		**4.59**	**4.48**	**98.00**

Notes:

(i) Actual disbursements were a total of US$4.468 million, compared to US$4.594 million at appraisal, with the difference due to the exchange rate difference in the respective countries, and the actual expenditures in local currency had disbursed more than the appraisal estimates;

(ii) The total Bank financing (GEF grant) estimated in the PAD was US$5.644, including APL-1 (US$4.594), and APL-2 (US$1.05). This ICR is only for APL-1 (for Morocco, Tunisia, Jordan, Lebanon and AWC subprojects). Therefore, the above cost and financing tables were included only in the APL-1 project information;

(iii) At project completion, total local counterpart funds for APL-1 from all participating countries is about US$645,000, which was is not reflected in the above table, as it was not included in the original financing table of the PAD;

(iv) The actual total USAID co-financing estimated at project completion was US$988,152, which financed the WISP TA activities provided by NASA team and its external contractors; and

(v) The total project financing at project completion was about US$6.11 million for APL-1.

Annex 2. Outputs by Component

Table 2.1: Output Results Achieved by Component

Component/Subcomponent	PAD Target		MTR Target		MTR Budget Completed At ICR		MTRBudget Completed At ICR%
	Quantity	Amount	Quantity	Amount	Quantity	Amount	
Component 1: Improved Local Water Resources and Agricultural Management		**2,447,839.00**		**2,576,616.19**		**2,614,218.77**	**101.46**
Lebanon	37	691,839.00	19	788,616.19	36	788,580.19	100.00
Jordan	n/a	680,000.00	4	740,000.00	4	739,587.00	99.94
Morocco	13	610,000.00	13	561,000.00	13	588,573.98	96.49
Tunisia	13	498,000.00	13	487,000.00	4	497,477.60	102.15
Component 2: Capacity Building and Project Managemer		**1,752,161.00**		**1,623,383.81**		**1,477,652.80**	**91.02**
Lebanon	8	358,161.00	4	261,383.81	60	260,984.73	99.85
Jordan	n/a	370,000.00	n/a	310,000.00	n/a	254,650.00	82.00
Morocco	71	440,000.00	105	489,000.00	105	397,265.61	90.29
Tunisia	134	542,000.00	131	563,000.00	159	564,752.46	100.31
Component 3: Regional Integration & Cooperation (AWC)	10	**394,545.00**	**10**	**394,545.00**	**10**	**394,502.72**	**99.99**
TOTAL		**4,594,545.00**		**4,594,545.00**		**4,486,374.29**	**97.65**

Output by Component

- ***Under Component 1***, covered all specialized and country specific research studies. Under this component, the role of NASA team and other research institutions was significant in providing technical support to the selected stakeholders on the application of WISP tools and capacity building activities to pertinent research issues in local and regional water resources, agricultural, and environmental management for decision making and societal benefits. By the end of the project, all countries has already purchased the required equipment and completed the research study for this component, this component has reached up to 101.46 % of total implementation by the end of the project. The following output targets were achieved: (i) WISP hardware was purchased (100 percent of target value), but some of expected output targets were delayed mainly because of NASA DisAlexi model that was still under development at that stage and could not be transferred by NASA team as initially planned. However, the alternative plans were being implemented by all country PMUs to work on the ET and drought monitoring studies, although that caused the delayed implementation, but eventually completed' and (ii) 23 WISP tools were acquired and were operational (121% of the targets, with the implementation of the alternative plan for the groundwater, ET and drought monitoring studies).

- ***Under Component 2***, the overall project TA and technical training plan had been fully implemented as expected by all country PMUs and AWC. The various international and regional technical training workshops and conferences had been conducted, including for example: (i) the irrigation mapping, crop mapping, ET mapping and flood forecasting and management modelling studies organized by NASA team in US; (ii) the regional training workshop on CC downscaling conducted in Dubai, and the hands on trainings for the transferred and installed LIS model for Morocco PMU, with the technical assistance from ICBA team in the field; and (iii) the regional and local training workshops on the groundwater, the drought and ET monitoring and modelling studies arranged/conducted by each country, and jointly participated by all other. This component has reached up to 91.02 % of total implementation by the end of the project. The following output targets were achieved: (i) WISP hardware was purchased, and the output targets of the number of research fellow/scholarship selected was reached by 124%, that is because all PMUs had used more research assistants and consultants, but not the formal research fellow/scholarship as needed for each modeling study; (ii) total number of remote sensing stakeholders and staff trained is 257 (by 148% of the targets); (iii) about 61 experts and PMU managers had participated in the international and regional workshops/conferences (achieved by 153% of the expected target); and (iv) about 18 international and regional conferences and workshops had been conducted and participated by the project PMUs (achieved by 95% of the targets). All country PMUs had organized the necessary trainings/workshops at local and regional levels and worked actively on sharing

knowledge between countries (e.g. between Tunisia/Morocco and Lebanon/Jordan).

- ***Under Component 3***, the expected output targets in 2015 have been fully achieved for Component 3. The regional technical coordination has been strengthened by increased number of regional and country workshops and country PMU's active involvement in the field. By May 2015, 7 regional knowledge sharing and exchange workshops had been organized by AWC (117% of the targets), and participated by officials and experts from all country PMUs and technical line ministries to enable the regional knowledge transfer and capacity building on WISP tools and project management; and also 7 regional reports completed (175% of the targets) on local and regional study results, and outputs of the workshops. AWC also issued a regional report that discussed the national outcomes of the drought application on all counties and on the regional level. The main objectives of the drought study was the development of a methodology that is based on analysis drought indicators at national scale, and assess the possibility of using it to build a regional system. The regional report outcomes indicated that The use of metrological data and remote sensing for monitoring drought and for building drought early warning systems is essential and that remote sensing could be considered a very strong tool, but at the meantime all discussed approaches still requires butter utilization of the used data and on-line source for providing daily data, This component has reached up to 100% of total implementation by the end of the project.

Output by Participation Countries

The following are the main output achievements by participating countries:

Morocco:

- The relevance of the development of NASA LIS system was largely checked by the goal of acquiring new technologies developed by academic centers and renowned institutions, able to significantly increase the frequency, relevance, consistency and water data collection applications (satellite receiving stations, numerical analysis software maps, surface models of the earth, and land data assimilation systems.
- The integration of Earth observation data, in situ data and models of land for the production of key hydrological parameters to better characterize and optimize the use of water resources.
- Improved management of changes in the availability of water resources capabilities including surface water, groundwater and changes in land use associated with them.
- Contribution to the estimation of the water used by irrigated agriculture for better planning and assessment of water productivity.
- The contribution to the evolution and determination of the main trends in terms of climate change impacts and consolidation of existing knowledge.
- Strengthening national capacities for operational use of the possibilities offered by new information technologies.

Jordan

- Compile past and current water conditions to inform improved water policy decisions;
- Generate maps of soil wetness and estimates of irrigation water use for large scale agricultural productivity assessments and planning;
- Provide water balance data for a regional and temporal perspective to identify local, short term and long term trends in water usage anomalies;
- Monitor extent and severity of droughts;
- Estimate current water storage conditions in the uplands of river basins to improve river flow predictions and;
- Evaluate potential increases/decreases in irrigation water requirements under various climate change scenarios to inform the planning of agricultural policies;

Lebanon

- The hydrological data for the entire Lebanon was collected and investigated, and thus illustrations for stream flow in rivers and springs have been established;
- Previous crop statistical analysis in Lebanon were investigated and showed inaccurate and discontinuous results based on ground surveys;
- A large part of farmers' plots limits are created from very high resolution images;
- Crop yields were estimated with the help of evapotranspiration
- Evapotranspiration maps were provided by NASA with resolution of 3 kilometers for the past years. Evapotranspiration maps from Alexi could be used for monitoring drought and other purposes. To fit the conditions of small countries, Alexi product can be downscaled;
- An automated system for SPI and VHI was developed using precipitation generated by climatic stations from TRMM satellite and MODIS sensor;
- Drought maps published, on a monthly basis, were published through its geoportal funded by the project;
- Performing hydrological modeling using two different distributed hydrological models: CREST, and Continuum;
- Flood Plain Delineation using Earth Observations;
- Implementation of the Hydrological Model in the DEWETRA platform;
- A national forest fire database was created by the project where 134,000 fire event was recorded since 2003 including forests, grass, shrubs, and fruit trees;
- The project improved the current RISICO model by using satellite images and implemented RISICO system within DEWETRA.

Tunisia

- Understanding the climate variability and assessing its future impacts on regional and local scale will allow end users mainly the Ministry of Agriculture, Water Resources and Fisheries and the Ministry of Environment to assess the vulnerability of their activities to such changes.
- Establishing reliable models for flood forecasting of Medjerda major hydrometric stations and to set-up methodologies of flood mapping based on Remote sensing techniques using free radar and optical images

- Validation of evapotranspiration maps provided by NASA: and development of evapotranspiration maps by the METRIC model:
- Provide reliable and easily exploitable information characterizing spatial and temporal extension of drought (duration, intensity, scale, etc.) and drought impact.
- Development and calculation of Vegetation monitoring indicators (standardized vegetation index, vegetation condition index, temperature condition index, vegetation health index, vegetation drought index, water stress vegetation index)
- Soil moisture prediction using radiometric signal changes of terrestrial surface temperature
- Conducted by DGRE a study on evaluation of groundwater withdrawals in Kebili aquifers (South of Tunisia).

Annex 3. Economic and Financial Analysis

Under this project, several operational applications were developed using remote sensing data and products, which provide more timely and comprehensive information than through the use of conventional monitoring methods, and more importantly, less costly analysis than traditional approach involving the processing of survey data. The economic and financial benefits have been estimated based on the possible information collected from some pilot cases in Jordan and Lebanon as below:

In the case of Jordan: the project was able to generate accurate and timely crop/irrigation/ET maps to identify the groundwater use. They are critical for assessing water demand in the agricultural sector, and monitor water over-extraction. In the past, the Ministry of Water used to rely on data collected through questionnaires and farmers' interviews (estimated cost of JD240,000 per year). Data accuracy was depended on answers provided by farmers, which tended to be biased. As a result of the project, the Ministry of Water is able to generate high accuracy crop maps with limited human errors that are produced in record time, because less time is needed to analysis the data and prepare the maps. Furthermore, maps can be prepared more frequently – from annual maps to semi-weekly maps. More frequent maps in turn support close monitoring of water used by farmers, in particular identification of illegal use of groundwater. Similarly, the Ministry of Water incurs a substantial amount of its budget in groundwater monitoring (estimated cost of JD1,000,000 per year). Based on the assumptions that the remote sensing techniques will allow the Ministry of Water to save 40 percent of the actual annual survey and monitoring costs, estimated at US$351,600, and the cost of the project was US$1,260,000 including 10 percent of operational costs on an annual basis, then the project was able to generate an internal rate of return 12 percent. This is a conservative estimate since it does not put a higher value on more accurate and timely data. The additional cost saving could be also generated through the reduced labor, energy and replacement of materials due to the reduced groundwater pumping costs (reduced groundwater over-extraction based on the updated national water law).

In Lebanon case: the project supported the establishment of the SuNar platform, which provides the real time forecasting, monitoring and measuring information, the flood and forestry fire risk early warning, assessment and evaluation. The system can be accessed by all end-users/line ministries, project's partners and the scientific community, with a powerful infrastructure. Predicting forest fire and flood potentiality were crucial in mitigating risks and reducing damages. Based on the information collected by Lebanon PMU on the application of the SuNar platform on flood monitoring, the total damage cost of a 10-year flood in the agricultural sector is estimated at US$82 million. Several measures could be implemented with early warning information provided by SuNar platform that could result in economic gains of US$78.1 million. This is equivalent to expected annual gains of US$7.81. This is about seven time the investment cost in Lebanon (the total project investment was only about US$1 million for the Lebanon project). The application of the SuNar platform on forestry fire monitoring also generated significant economic impacts. A good example was the fires that took place last May 2015. Around 53 fires took place

between 19-20 May 2015, where the humidity dropped 15% and the temperature reached the 40 ^{0}C. The SuNaR system issued a fire weather warning in advance, and all related stakeholders took the risk mitigation actions according to the early warning information, which contributed and reduced significant economic losses directly.

Another interesting application in Lebanon was the piloting of water applications based on remote sensing evapotranspiration in a 5,000 ha potato farm. This resulted in energy savings due to reduction of pumping, with a monetary value between US$2.0-2.5 million per year. This is twice the level of investment in Lebanon. In addition, the farmer was able to improve fertilization and save 1,500,000 cubic meter of water. The environment also benefitted with reduction of greenhouse gas emissions and chemical contaminants flowing to water bodies.

Overall, while the project, consistent with other technical assistance, was not amenable to standard quantifiable rate of return or cost/benefit analysis due to the difficulty of attribution, the benefits do appear to be significantly greater than the relatively small project costs.

Annex 4. Bank Lending and Implementation Support/Supervision Processes

(a) Task Team members

Names	Title	Unit	Responsibility/ Specialty
Lending/Grant Preparation			
Claire Kfouri	Senior Water and Sanitation Specialist	GWA06	Task Team Leader
Julie Rieger	Senior Counsel	LEGAM	Legal
Jean Charles De Daruvar	Senior Counsel	LEGAM	Legal
Anjum Rosha	ET Consultant	LEGAM	Legal
Ignacio Jauregui	Senior Counsel	LEGLE	Legal
Sergio Margulis	Program Manager	MNSEN	Environment
Kanta Rigaud	Lead Environmental Specialist	GCCPT	Environment
Edwin Engman	Senior Technical Consultant	MNSSD	
Song Li	ET Consultant	MNSEN	Environment
Sanne Agnete Tikjoeb	ET Consultant	MNSEN	Environment
Samia Al Duaij	Safeguards Specialist	MNSEN	Safeguards
Zaileen Rahim	Consultant	MNSSD	
Magalie Pradel	Language Program Assistant	GFM01	Country Team Assistant
Shahid Habib	Project Manager and Overall Coordination	NASA	Project Management
David Toll	Deputy Project Manager	NASA	Project Management
Matt Rodell	Hydrology and Subterranean Water Expert	NASA	
John Bolten	Land Surface Modeling and Assimilation	NASA	
Anthony Bigio	Peer Reviewer	FEU	
Maged Hamed	Peer Reviewer	MNSEN	
Parameswaran Iyer	Peer Reviewer	MNSWA	
Raja Iyer	Consultant/Operations Adviser	MNSSD	Operations
Heba Yaken Aref Ahmed	Operations Analyst	GWA05	Operations
Dambudzo Muzenda	Young Professional	GWA05	
Ahmedou Ahmed	Lead Procurement Specialist	GGO05	Procurement
Salim Benouniche	Lead Procurement Specialist	GGODR	Procurement
Sepehr Fotovat	Senior Procurement Specialist	GGO05	Procurement
Lina Fares	Senior Procurement Specialist	GGO05	Procurement
Mikael Mengesha	Senior Procurement Specialist	GGO05	Procurement
Badr Kamel	Procurement Specialist	GGO05	Procurement
Walid Dhouibi	Procurement Specialist	GGODR	Procurement

Georgine Badou	Program Assistant	GWAGS	Country Team Assistance
Jocelyne Jabbour	Program Assistant	MNCLB	Country Team Assistance
Angeline Mani	Language Program Assistant	GEE05	Country Team Assistance
Rima Abdul-Amir Koteide	Senior Financial Management Specialist	GGO23	Financial Management
Mona El Chami	Senior Financial Management Specialist		Financial Management
Anas Abou Al Mikias	Senior Financial Management Specialist		Financial Management
Wael Eshanrawy	Financial Management Specialist		Financial Management
Rock Jabbour	Financial Management Analyst	GGO23	Financial Management
Jad Raji Mazahreh	Financial Management Specialist	GGO23	
Moez Makhlouf	Financial Management Specialist		Financial Management
Laila Moudden	Financial Management Analyst	GGO23	Financial Management
Hyacinth Brown	Manager	WFALS	Loan Systems
Hassine Hedda	Finance Officer	WFALS	Loan Systems
Ghada Shaqour	Consultant	GSU05	

(b) Supervision/ICR

Qun Li	Senior Agriculture Economist	GFA05	TTL
Heba Yaken Aref Ahmed	Operations Analyst	GWA05	Operations
Sally Zgheib	Water Supply and Sanitation Specialist	GWADR	Water Specialist
Liping Jiang	Senior Irrigation Engineer	GWA02	Water/Irrigation Specialist
Lina Fares	Sr. Procurement Specialist	GGO05	Procurement
Jad Raji Mazahreh	Financial Management Specialist	GGO23	Financial Management
Badr Kamel	Procurement Specialist	GGODR	Procurement
Abdoulaye Keita	Sr. Procurement Specialist	GGO05	Procurement
Laila Moudden	Financial Management Analyst	GGO23	Financial Management
Rock Jabbour	Financial Management Analyst	GGO23	Financial Management

Jocelyne Jabbour	Program Assistant	MNCLB	Country Team Assistance
Walid Dhouibi	Procurement Specialist	GGODR	Procurement
Usaid I. El-Hanbali	Consultant	GWADR	Senior Water Specialist
Joseph goldberg	Consultant		ICR Author

(b) Staff Time and Cost

Stage of Project Cycle	Staff Time and Cost (Bank Budget Only)	
	No. of staff weeks	USD thousands (including travel and consultant costs)
Lending		
FY10		51,180.61
FY11		124,423.60
FY12		64,310.05
FY13		0.00
FY14		0.00
FY15		0.00
FY16		0.00
Total:		239,914.26
Supervision/ICR		
FY10		0.00
FY11		0.00
FY12		0.00
FY13		161,603.51
FY14	28	125,994.26
FY15	29	101,491.66
FY16	4	17,389.68
Total:	61	406,479.11

Annex 5. Beneficiary Survey Results

(N/A)

Annex 6. Stakeholder Workshop Report and Results

During the project implementation, various stakeholder workshops had been conducted at the country and regional levels, including the technical training on remote sensing technologies and related applications in each study theme, the knowledge sharing and exchange workshops among countries, the results dissemination workshops for all end-user stakeholders, etc. The detailed workshop reports and results from each country program had been presented as follows:

LEBANON

During the implementation of the project the following training workshops and sessions were organized:

- Training workshop on the usage of the remote sensing techniques and modeling approach in the planning and management of irrigation.
- National Council for Scientific Research Headquarter, Beirut-Lebanon, 9-11 December 2014.
- Training Manual for Cultivated Area and Crop Type Mapping With Remote Sensing Dr. Mutlu Ozdogan, April 14, 2014.
- Update of National Adaptation Plan to Climate Change of Water Sector in Lebanon Dr. Nadim Farajalla, December 12, 2014.
- Establishment of Sustainable Natural Resources Management Platform and Early warning system Between the National Council for Scientific Research and CIMA Research Foundation – Centro Internazionale in Monitoraggio Ambientale, July 8, 2014.
- Main research themes conducted at the CNRS Remote Sensing Center that feed into agriculture and rural development, August 10, 2014.
- Regional scale yield data variability for potato and wheat crops in Lebanon Wim Bastiaanssen, May 2014.
- Remarks updated crop classification Spring 2014 crops Bekaa Valley, Wim Bastiaanssen, 14 July 2014.

Figure 1: Number of training days and participants in international and regional conferences per country

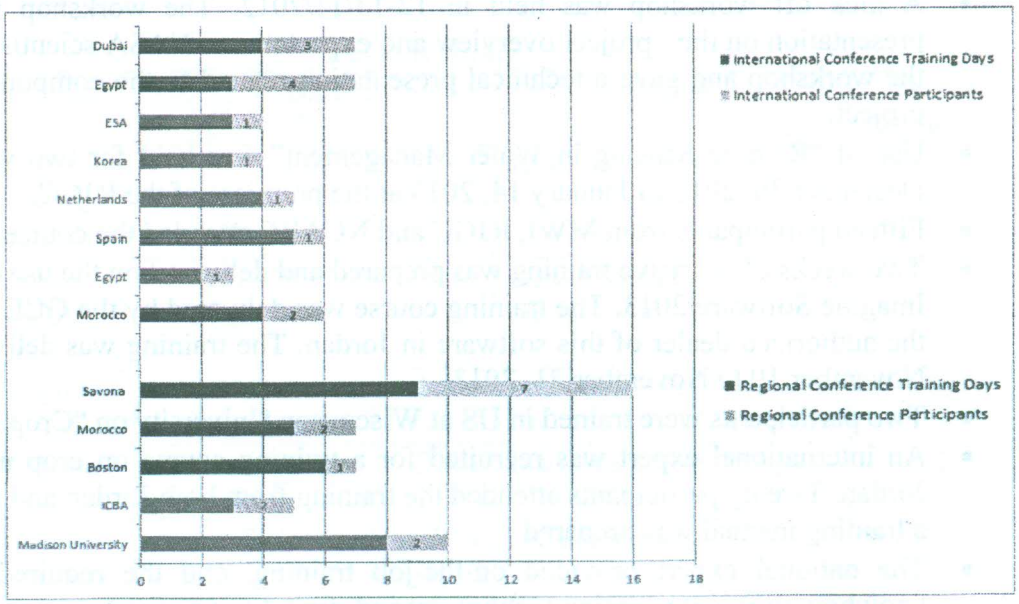
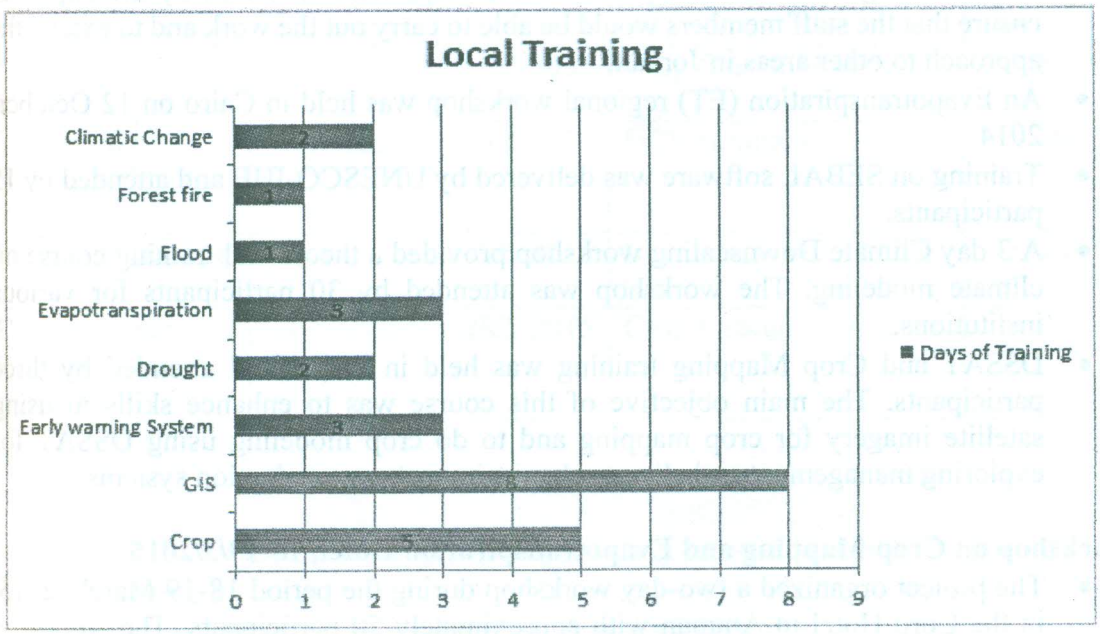


Figure 2: Number of local training days according to the topic discussed



JORDAN

During the implementation of the project the following training workshops and sessions were organized:

- A kick off workshop was held in 12-13/11/2012. The workshop included a presentation on the project overview and expectations. NASA scientists attended the workshop and gave a technical presentation related to the components of the project.
- Use of "Remote Sensing in Water Management" was held for two weeks from December 30, 2012 to January 14, 2013 at the premises of the RJGC.
- Fifteen participants from MWI, RJGC and NCARE attended the course.
- Two weeks of intensive training was prepared and delivered on the use of ERDAS Imagine Software 2013. The training course was delivered by the GCE Company, the authorized dealer of this software in Jordan. The training was delivered from November 10 to November 21, 2013.
- Two participants were trained in US at Wisconson University on "Crop Mapping."
- An international expert was recruited for a training course on crop mapping in Jordan. Twenty participants attended the training from both Jordan and Egypt, and a training manual was prepared.
- The national expert provided on-the-job training, and the required technical knowhow in remote sensing technology and digital image processing required for cropping mapping and estimating evapotranspiration for agricultural areas.
- Also, training manuals were provided and steps were followed by the expert to ensure that the staff members would be able to carry out the work and to extend the approach to other areas in Jordan.
- An Evapotranspiration (ET) regional workshop was held in Cairo on 12 October, 2014
- Training on SEBAL software was delivered by UNESCO-IHE and attended by 15 participants.
- A 3 day Climate Downscaling workshop provided a theoretical training course on climate modeling. The workshop was attended by 30 participants for various institutions.
- DSSAT and Crop Mapping training was held in Dubai and attended by three participants. The main objective of this course was to enhance skills in using satellite imagery for crop mapping and to do crop modeling using DSSAT for exploring management and climate change impacts on production systems.

Workshop on Crop Mapping and Evapotranspiration Hotel, 18-19/3/2015

- The project organized a two-day workshop during the period 18-19 March, 2015, in the Corp Hotel in Amman with approximately 50 participants. The workshop included several presentations on Crop mapping for Mafraq-Azraq using remote sensing and geospatial techniques, and drought assessment for Mafraq area using high-temporal resolution remote sensing data:
  - Hyperspectral remote sensing: future tools for crop mapping
  - Several training sessions we held on using equipment procured. This included training on GPS, hyperspectral instruments

- Project closing workshop at the Dead Sea
- Project dissemination to farmers

Workshops and Capacity Building

Local training

Workshop Title	Date	Place	No of attendees
First National Workshop- Kick off workshop	12+13/11/2013	Kempinski Hotel	40
Use of Remote Sensing in Water Management	30/12/2013-14/1/2014	Royal Jordanian Geographic Centre	15
ERDAS Imagine Software Training	10/11/2014-21/11/2014	GCE company	15
Arc GIS software Training	2014	Info Graph Company	5
Regional training on crop mapping- Mutlu Ozdogan	15/6/2014 to 21/6/2014	GCE company	20
Climate Downscaling workshop	14/12/2014 – 16/12/2014	Crop Executive Hotel	30
Crop Mapping and Evapotranspiration	18-19/3/2015	Crop Executive Hotel	50
Training on SEBAL software- Wim	19/4/2015 to 23/4/2015	GCE company	20
Closing Workshop	6+7/5/2015	Movenpick Hotel-Dead Sea	45
Dissemination Workshop for farmers	28/5/2015	Crop Executive Hotel	80

MOROCCO

To ensure an efficient and sustainable capacity building process, several actions have been undertaken; namely:

- Group-training activities at the CRTS run by national and international experts for the project teams and expanded to other national institutions that have the same focal interest.
- Training sessions in international institutions for the project teams.
- The CRTS annual training program was open to participants from the project partners' institutions.

- National workshops gathering potential users, researchers and the scientific community.
- Participating in regional workshops to help exchange of expertise among the countries involved in the regional LDAS projects, namely, Lebanon, Tunisia Egypt and Jordan.
- Participation in international conferences.

Capacity Building Dispensed in LDAS Project

ACTIVITY	SUBJECT	NUMBER OF PARTICIPANTS	
National Workshops	Land Data assimilation	12	
	Remote sensing for Environment	19	
	Soil Moisture mapping	16	
	Remote sensing for Drought	12	
	CREST	5	
	Irrigation mapping	5	
	Composite Drought Index	34	
	Risk locust	4	
	Soil Moisture mapping	16	123
Regional Workshops	ET Mapping / Egypt	2	
	Ground Water / Tunusia	2	
	Agriculture Statistics / ICBA	4	8
		S/Total	131
Training / Project components	LIS /JHU	2	
	CREST / NASA	2	
	Drought / Maryland University & NDMC	2	
	Irrigation mapping / Wisconsin University	4	
	ET mapping / Wisconsin University	2	
	Soil Moisture mapping / Vienna Technical University	3	15
Conferences and Study tours	China Study Tour	2	
	Gespatial World forum	2	
	FAO / Locust Unit	3	
	Arab Water Forum / Egypt	2	
	World Water Forum	1	
	Final Regional Workshop	8	18
		160	164
Kick off Seminar			70
Final Seminar			130

Training Workshops

The themes that the training sessions dealt with in the Capacity Building component are related to remote sensing domain and modeling applied to water resources and agriculture. Various international institutions specializing in these fields have participated in these training sessions, both in Morocco and abroad.

In addition to our project partners such as DRPE, DIAEA, CNLAA and ABHBC, many other national institutions have benefited from the training sessions offered. Among these institutions were the Hydraulic Basin Agency, ORMVA, DMN, Fire Department, Department of environment, universities, etc.

These training sessions have allowed 131 participants to acquire the basic notions and practical methods for image processing of terrestrial physical modeling.

Number of Persons Trained by Topic

DESIGNATION	Hydro				Irrigation		Sécheresse				Humidité	Risque Locust	Total
	LISau Maroc	LISNASA	CRESTNASA	CREST Maroc	A l'étranger	Par expert / CRTS	Par experts/ CRTS*	F groupe 1	F groupe 2	A l'étranger			
Département de l'eau	2	2	2	2				1	2		2		13
Agences de Bassin	2	1	2	3			3	1					12
Direction de l'Irrigation					1	3	3	2	3	1	2		15
ORMVs						2	4	2					8
Direction Stratégie /MA											2		2
HCEFLCD							6						6
Direction de la Météorologie							2	2	2		1		7
CNLA/MI											2	1	3
ANDZOA							4						4
INRA							4						4
Protection Civile/ MI											1		1
Département de l'Environnement								2					2

L'Université	3			1			3	3			1		1
CRTS	5	2	1	1	2	6	5	6	5	2	5	3	4
Total	*12*	5	5	7	3	11	34	19	12	3	16	4	13

TUNISIA

Workshop on Determination of CREST Model Parameters Values

Tunis, June 11-12 2014

I. Purpose of Workshop

The objective of this workshop is to define the parameter values of CRSET model used to predict floods Medjerda.

II. Workshop Participants

Workshop participants included specialists from:

1. National Center of Mapping and Remote Sensing (CNCT),
2. General Directorate of Water Resources (DGRE),
3. Regional Department of Agriculture (Kef, Jendouba, Beja, Siliana and Manouba),
4. The National Institute of Meteorology (INM),
5. General Directorate of dams and main hydraulic works (DGBGTH),
6. National Institute of Research on Rural Engineering,
7. Water and Forests (INRGREF), and
8. The National Institute of Agronomy of Tunisia (INAT).

III. Overview of CREST Model

After the presentation of LDAS project by Mr Sinan BACHA, Engineers Ahmed EZZINE (CNCT) and Aymen LAZREG (DGRE) presented the CREST model applied in the flood axis. Indeed CREST is a hydrological model developed jointly by the University of Oklahoma and NASA SERVIR. It is constructed for:

- providing real-time regional and global hydrological forecast by executing simultaneously on multiple basins with relatively cost effective computing efficiency; it is also very applicable for small to medium-sized high-resolution basins.
- simulating the spatial and temporal variation of surface and underground water flows and storage, cell by cell simulation.

The CREST model requires hydrometric and rainfall data in addition to map data. To run the model, the values of the following 12 parameters have to be estimated.

Module	Symbol	Designation
Initial conditions	W0	initial value of soil moisture
	SS0	initial value of overland reservoir
	SI0	initial value of interflow reservoir
Physical parameters	Ksat	soil saturate hydraulic conductivity
	RainFact	multiplier on the precipitation field
	WM	Mean Water Capacity
	B	exponent of the variable infiltration curve
	IM	Impervious area ratio
	KE	The factor to convert the PET to local actual
	coeM	overland runoff velocity coefficient
Conceptual parameters	expM	overland flow speed exponent
	coeR	multiplier used to convert overland flow speed to channel flow speed
	coeS	multiplier used to convert overland flow speed to interflow flow speed
	KS	Overland reservoir Discharge Parameter
	KI	Interflow Reservoir Discharge Parameter

IV. Discussion of Model Parameters

The discussion of the parameters of the CREST model was moderated by Professor Hamadi Habaieb (INAT).

At the end of this workshop, the CREST model parameter values were defined and tested by simulation of the flood of January 2010. Following this workshop, the team is able to work on simulation and calibration of the CREST model.

Workshop/Training on Flood Mapping by Remote Sensing and Impact of Climate Changes

Tunis, January 27-30, 2015

I. Purpose of Workshop

This workshop was organized for the benefit of partners and end users in order to transfer their know-how on the following topics:

1. Introduction to remote sensing;
2. Flood Mapping optical imaging;
3. Flood Mapping radar imagery;
4. Impact of climate change.

II. Workshop Participants

Workshop participants included specialists from:

1. National Center of Mapping and Remote Sensing (CNCT),
2. General Directorate of Water Resources (DGRE),
3. Regional Department of Agriculture (Kef, Jendouba, Beja, Siliana and Manouba),
4. The National Institute of Meteorology (INM),
5. General Directorate of dams and main hydraulic works (DGBGTH),
6. National Institute of Research on Rural Engineering,
7. Water and Forests (INRGREF), and
8. The National Institute of Agronomy of Tunisia (INAT).

III. Workshop Contents

1. The physical basis of remote sensing
2. Exercises: Flood Mapping
    - Downloading Landsat image
    - Getting Started with ENVI software
    - Flood mapping by optical image
    - Flood mapping by radar image
3. Impact of climate change

IV. Results

- This workshop brought together around thirty managers from institutions specializing in the field of management and flood forecasting of Medjerda. This workshop allowed exchanges on new approaches to flood management using remote sensing as a decision support tool. It focused the attention of developers/researchers on the needs of developing research and data exchange to better meet the challenges of monitoring and evaluation of flood risk in the Medjerda watershed.
- Flood mapping from optical and radar imagery is a valuable aid to the decision tool. They enable bearing the information gap and to better know the environment, even

in areas difficult to access, the extremely harsh natural conditions. The exploration potential of the cartographic radar images has a significant advantage over optical imaging not be disturbed by the cloudiness.

- Climate change has a direct impact on the water cycle and hence on extreme events. The methods of statistical and dynamic adaptation have been studied and discussed by the participants to better mitigate the risk of flooding in the Medjerda watershed.

Workshop/Training on Flood Modeling and Forecasting by Remote Sensing

Tunis, February 17-19, 2015

I. Purpose of Workshop

This workshop was organized for the benefit of partners and end users in order to transfer their know-how on the following topics:

1. Hydrological modeling
2. Methods of flood forecasting: Muskingum and regressions
3. Flood management in Tunisia
4. The CREST model
5. Flood forecasting

II. Workshop Participants

Workshop participants included specialists from:

1. National Center of Mapping and Remote Sensing (CNCT),
2. General Directorate of Water Resources (DGRE),
3. Regional Department of Agriculture (Kef, Jendouba, Beja, Siliana and Manouba),
4. The National Institute of Meteorology (INM),
5. General Directorate of dams and main hydraulic works (DGBGTH),
6. National Institute of Research on Rural Engineering,
7. Water and Forests (INRGREF), and
8. The National Institute of Agronomy of Tunisia (INAT).

III. Workshop Contents

- Methods of flood forecasting
- Flood management in Tunisia: the case of the February 2012 flood
- Hydrological modeling
- Presentation of the CREST model
- Flood forecasting by the expert system method

IV. Results

M. John L. David from SSAI/NASA presented the CREST model. This workshop allowed exchanges on new approaches to flood forecasting using modeling as a decision support tool. He focused the attention of developers/researchers on the needs of developing

research and data exchange to better meet the challenges of monitoring and evaluation of flood risk in the watershed Medjerda. Participants were familiarized with the modeling and the different methods of flood forecasting. CREST, a model of regional and global prediction was simulated and stalled, and flood forecasting by the expert method was applied.

The participants expressed that the duration of the workshop was not enough to become familiar with the CREST model and recommended the organization of a training session in order to simulate and calibrate the model with events observed in the watershed of Medjerda.

Advanced Training on Modeling and flood forecasting by remote sensing

Tunis, May 7-8, 2015

I. Purpose of Workshop

This workshop was organized for the benefit of partners and end users in order to simulate and calibrate the model with events observed in the watershed of Medjerda.

II. Workshop Participants

Workshop participants included specialists from:

1. National Center of Mapping and Remote Sensing (CNCT),
2. General Directorate of Water Resources (DGRE),
3. Regional Department of Agriculture (Kef, Jendouba, Beja, Siliana and Manouba),
4. The National Institute of Meteorology (INM),
5. General Directorate of dams and main hydraulic works (DGBGTH),
6. National Institute of Research on Rural Engineering,
7. Water and Forests (INRGREF), and
8. The National Institute of Agronomy of Tunisia (INAT).

III. Contents

- Presentation of the CREST model
- Simulation and calibration of the CREST model with events observed in Medjerda.

Training Workshop on Monitoring of Irrigated Crop by Remote Sensing

Tunis, March 30 - April 02, 2015

I. Purpose of Workshop

This workshop is organized for the benefit of partners and end users in order to transfer their know-how on the following topics:

1. To promote newest technologies with Tunisian researchers on the crop and the irrigated state mapping using Remote Sensing.
2. To produce regional crop mapping along the phenological state of crops to allow monitoring of irrigated areas and optimize crop water use.
3. To exchange experiences and ideas based on lessons learned from different national services and researchers working in the field of remote sensing and in agriculture administrators.

II. Workshop Participants

Workshop participants included specialists from:

1. National Center of Mapping and Remote Sensing (CNCT),
2. General Directorate of Agricultural Prodcution (DGPA),
3. Regional Department of Agriculture (Jendouba, Kairouan, Nabeul),
4. The National Institute of Meteorology (INM),
5. General Directorate of Rural Engineering and Water Use (DGGREE), and
6. The National Institute of Agronomy of Tunisia (INAT).

III. Results

This workshop allowed exchanges around new technologies on the crop and the irrigated state mapping using Remote Sensing. Participants are now able to produce regional crop maps along the phenological state of crops to allow monitoring of irrigated areas and optimize crop water use.

Workshop on Geomatics for Ecosystem based Adaptation in the Dry Areas of North Africa

Djerba, Tunisia, June 22-24, 2014

1- Presentation

The workshop had more than 60 participants who were experts, specialists and PhD students from the following countries: Morocco, Algeria, Tunisia, Libya, Sudan, France, Italy, Romania, and OSS - OSS (Attachment 1 list of attendees).

2- Objectives and Themes of the Session

1. Proposals for modern applications and experiences of countries in the field of ecosystems adapted to dry areas using Geomatics.
2. Exchange experiences and learn about working in this area networks.

The course included the opening ceremony, four specialized sessions with five keynote speakers, discussion and conclusion about the prospects for the optimal exploitation of Geomatics in the field of development in general, and in particular to fight against desertification efforts. The sessions, were in accordance with the following themes:-

- land and departments degradation.
- vegetation and crop monitoring.
- drought and water sources.
- integrated decision-making tools.

3- Recommendations

After the completion of the four sessions, the closing session and extensive scientific discussions, the following recommendations were suggested:

- Focus on capacity building and support the exchange of visits by specialists for the benefit of all the Arab region programs.
- The participants stressed on the grounds of scientific culture development and dissemination of research results among all segments of society, a strategic objective and called on the Federation of Arab Scientific Research Councils in cooperation with the Regional Center for Remote Sensing of the North African States to embrace this issue and offer programming demonstrations and training courses in purpose to achieve this goal.
- The recommendation to hold such specialized courses and private use of space applications and other sciences, including research and meeting the requirements of those interested in the various environmental and developmental areas, regional and international.
- Invite the Regional Center for Remote Sensing of the North African States and centers and the National Institutes concerned, to share the same concern for the environment and water at the level of North Africa and other Arab countries with

specialized regional projects, and to meet the aspirations of development in this region and contribute to shared appropriate scientific proposals Using modern space technology and science Upstream to overcome the phenomenon of water scarcity and drought.

- Valuation of local knowledge in the fight against desertification, especially in the field of rainwater harvesting, and organizing a workshop for the subject matter during 2015, in cooperation with the Regional Center for Remote Sensing of countries North Africa States.

AWC Regional Workshops

- **Project Kickoff Meeting (October 19-21, 2011)**

USAID funded a three day workshop through ICBA in Dubai. The focus of the workshop was to share the results of ICBAS's work in remote sensing to help participating countries kick off their own World Bank funded project.

- **1st Regional Workshop (May 7-9, 2013)**

The Arab Water Council launched its first regional workshop in Dubai, May 7-9, 2013. The main objective of this workshop was mainly to discuss the current implementation plans of each country (Egypt, Lebanon, Jordan, Tunisia, and Morocco); learn about the running activities, current constraints, and reach out an agreement for follow-up actions among implementing agencies.

Representatives from each participating country were present during the workshop presenting their country and the implementing agency working on this project. Also present were the World Bank Team, NASA representatives as well as representatives from ICBA-UAE (International Center for Biosaline Agriculture), who are considered the backbone for implementing this project.

Number of Participants: 38

- **Regional Financial & Procurement Training (December 11, 2013)**

The Arab Water Council (AWC) organized a Procurement and Financial Training in coordination with the World Bank on December 11, 2013 in Amman-Jordan. The main objective of this training was to enhance the Project Management Units' (Composed of 5 Countries: Egypt, Jordan, Lebanon, Morocco and Tunisia) capabilities in handling the project's procurement and financial issues according to the World Bank's policies and procedures to ensure a solid and efficient follow up on all PMUs project documents and processes.

Number of Participants: 13

- **Evapotranspiration (ET) Regional Workshop (October 12-14, 2014)**

The main objective of this workshop was to review current practices for ET measurements and ET modelling across the MENA region.

Number of Participants: 53

- **3rd Arab Water Forum (Project Session: Integration of Space Technology and Remote Sensing for Water Management- December 10, 2014)**
  The objective of this session was to present the achievements of this project and to share the knowledge and experience of the use of remote sensing techniques in water resources management to end-users and interested parties, as well as to present the technical and administrative efforts of the WB, NASA, USAID, AWC and PMUs to achieve efficient and sustainable outcomes. Also, this session aimed at drawing the attention of more donors and institutions to support and sponsor projects/programs related to this topic/field.

  This session was held during the 2nd day of the 3rd Arab Water Forum to shed the light on the latest remote sensing technologies used in Water Resources Management and to share the knowledge and experience of the use of this technology in defining national and regional strategies.

  The session helped in creating a link between scientists and regional policy makers as they further develop their strategic planning, highlighting recent research advances in conceptual thinking and regional modeling using remote sensing and coordinating regional responses needed to face the expected impacts.

- **Ground Water Regional Workshop (April 6-8, 2015)**
  The objective of this workshop was to review current practices for ground water modeling, storage, quality indicators and monitoring technologies which are common to the region and related to water resource management. It has also shed light on the importance and high sensitivity of groundwater management, particularly in the period of extreme phenomena, such as droughts, and floods by using the latest advanced remote sensing and space technologies in Hydrological investigations and Hydrological maps applications.
  Number of Participants: 37

- **Regional project Completion Workshop (May 16-18, 2015)**
  The main objectives of this Project Completion Workshop was to present the final technical study results and the overall project implementation completion status and agree on specific actions to complete all remaining works by the project closing date, with all project implementation parties. It also discussed the overall achievements of the target output and outcome results and impacts, and exchanged and shared the project implementation experience of the application of the remote sensing technologies and modeling study results by the end-users, and lessons learned in implementing the Regional Coordination on Improved Water Resources Management Project (P117170), among all project countries. The workshop also included brainstorming session and discussing further cooperation with the World Bank in supporting national priorities in agriculture and water sectors that might be included in a possible follow up Project (PHASE 2).
  Number of Participants: 46

Annex 7. Summary of Borrower's ICR and/or Comments on Draft ICR

Regional Coordination on Improved Water Resource Management and Capacity Building Program
Summary of Countries' ICR Report

Project Context, Global Environment Objectives and Design

Regional Context at Appraisal

The scarcity of freshwater in most countries of the Middle East and North Africa (MENA) region is an increasingly acute problem, particularly as populations grow, rapid urbanization continues and the pressure to shift water from agriculture (which consumes over 84% of the region's water resources on average) to domestic and industrial uses increases. Fourteen of twenty MENA nations are classified as being in water deficit, defined as less than 500 m^3 of renewable water supply per capita per year. The Intergovernmental Panel on Climate Change further reports an expected precipitation decrease over the next century by over 20% for large parts of the MENA region, a likely increase in the frequency and severity of droughts and a reduction in groundwater recharge rates.

Under this project, various WISP tools were transferred and implemented in each of the remote sensing agencies and/or water ministries of Lebanon, Jordan and Morocco. The CRTEAN, an international organization headquartered in Tunisia[1] with the mandate to further the use of remote sensing across North African States, has furthermore partnered with the Tunisian Ministry of Agriculture and Hydraulic Resources, and Tunisian National Center for Remote Sensing, to apply the regional WISP tools (such as NASA's GRACE Satellite outputs) to assess regional water resources management issues on shared regional aquifers.

The program was consistent with the national priorities of each of Lebanon, Jordan, Egypt, Morocco and Tunisia to improve the sustainability of water resources management. It was also consistent with CRTEAN's goals and priorities. The program formed part of the World Bank Arab World Initiative, which emphasizes cooperative regional solutions to major challenges such as water resource management, food security and climate change nexus. Finally, the project was fully consistent with the World Bank *"Water Resources Sector Strategy – Sustaining Water for All in a Changing Climate"*, particularly in improving client countries' access to technologies to increase the availability and dissemination of information for results-based decision making.

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[1] The CRTEAN was established as an international organization pursuant to the October 6, 1990 constitutive act by five North African states of People's Democratic Republic of Algeria, Socialist People's Libyan Arab Jamahiriya, Kingdom of Morocco, Islamic Republic of Mauritania and Republic of Tunisia.

Original Global Environment Objectives (GEO) and Key Indicators (as approved)

The GEF Global Objective of the proposed project was to better manage local and regional water resources and reduce the threat of land degradation and climate change to vulnerable agricultural production systems and water resources in and across the project areas while developing options to address land-based pollution affecting the Mediterranean Sea. The project was in line with both (i) the long-term objective of the GEF's International Waters Focal Area: "to foster international, multi-state cooperation on priority water concerns" and (ii) with GEF's Strategic Program for International Waters "to balance overuse and conflicting uses of water resources in surface and groundwater basins that are transboundary in nature".

PDO Level Results Indicators

Achievement of the development objective were assessed through the following key performance indicators:

- WISP operational in at least 3 of 4 implementing agencies
- Number of major water resources decisions made taking into consideration WISP tools.
- Regional project data portal developed and operational (according to GEF International Waters (IW): LEARN guidelines).

Main Beneficiaries

The direct beneficiaries of the proposed program are the local and regional remote sensing institutions and the ministries of water, irrigation, agriculture and planning, regional water stakeholders, local farmers and the citizens of each of Lebanon, Jordan, Egypt, Tunisia and Morocco (approximately 136 million people, half of which are estimated to be women) which will benefit from improved access to real-time drought and flood monitoring outputs, improved crop yield and local and regional groundwater estimates among others.

Original Components

The Regional Coordination on Improved Water Resources Management and Capacity Building Program consisted of three components described below and implemented in Lebanon, Jordan, Morocco, AWC and CRTEAN under Phase 1 (APL1) and Egypt in Phase 2 (APL2).

Component 1: Improved Local Water Resources and Agricultural Management (US$3.06 million)

Component 1 comprised of: (a) the purchase, installation and validation of various WISP tools and other ancillary equipment to remote sensing centers and stakeholder agencies and institutions in each of Lebanon, Jordan, Morocco and the CRTEAN and its partners; and (b) application of WISP tools to pertinent research issues in local and regional water resources, agricultural, and environmental management.

Component 2: Capacity Building and Project Management (US$1.14 million)

Component 2 comprised of: (a) capacity building (workshops and consultants) to implement WISP tools; (b) local workshops to share results with local stakeholders; (c) participation in international conferences and study tours on environmental remote sensing; (d) funding graduate fellowships; (e) development of an online national portal to share data across stakeholder institutions; and (f) project management of the Grant. APL1 covered activities under Components 1 and 2 for each of Lebanon, Jordan, Morocco and CRTEAN. APL2 covered the same activities under Components 1 and 2 for Egypt.

Component 3: Regional Integration and Cooperation (US$394,595)

Component 3 comprised of: (a) organization of quarterly workshops to share results with regional stakeholders; (b) development of an online regional portal to share regional results; (c) generation of once-yearly regional report on applications of regional significance. These applications were expected to include estimating the recharge rates of regional oversubscribed shared aquifers, optimizing the response to droughts and floods on a regional scale, and encouraging a more coordinated approach to management of transboundary water resources among others.

Key Factors Affecting Implementation and Outcomes

Project Preparation, Design and Quality at Entry

The project preparation phase didn't live up to the level of preparations required for such a complex multi stakeholder's project. This resulted in severe implementation delays at the first year. One of the main observations and finding following the first supervision mission that were also highlighted in AWC 1st regional report was the Unclear roles and responsibilities of different project related agencies in the project and the Lack of clear incentives and activities for end-user to participate in the project implementation.

Implementation

With the implementation of the project, the WB staff was very responsive to all national needs and notably during the MTR meeting in Cairo where we were supported to make some adjustments and restructuring of the budget.

The project implementation process developed and accelerated during the project last year and a half due to the World Bank support as well as the several supervision missions and workshops that helped the PMUs to reach solutions to all their issues that were affecting the project implementation. Also the stakeholders' participation in several workshops positively affected the project implementation and helped PMUs to reach great results with end-users and achieve the project targets.

Monitoring and Evaluation (M&E) Design, Implementation and Utilization

Monitoring and Evaluation (M&E) of the project activities took place at regular intervals by AWC, the regional Coordination office according to the M&E frameworks that was developed at the beginning of the project by the Arab Water Council in coordination with the World Bank.

The M&E study showed that PMUs reached great results in one of their adjusted indicators which is the "technical impact and the development of policy implementation plans by end-users". (Examples in Lebanon, CNRS launched their SUNAR platform and for Jordan the development of new water policy by the Jordanian Parliament.)

The M&E clearly showed that working close with end-users allowed the PMU to know better their needs, assess weakness and strengths and identify the gaps and way for improved capacity building. The input data from remote sensing and stakeholder's feedback during the local workshops helped fine tuning the national indicators and tailoring the projects activities to meet the end users' demands.

Assessment of Outcomes

Relevance of Objectives, Design and Implementation

The program was consistent with the national priorities of each of Lebanon, Jordan, Egypt, Morocco and Tunisia to improve the sustainability of water resources management. This regional initiative was part of the World Bank's Arab World Initiative (AWI), which emphasizes cooperative regional solutions to major challenges such as water resource management, food security and climate change nexus, is consistent with the Bank's *"Water Resources Sector Strategy – Sustaining Water for All in a Changing Climate"*, particularly in improving client countries' access to technologies to increase the availability and dissemination of information for results-based decision making

Achievement of Global Environmental Objectives

Project results comprise outputs, outcomes and impacts. At the end of the last year of the project implementations, it was clear that the project has achieved a remarkable progress towards the project development objectives (PDOs) that were indicated in the PAD.
Also a remarkable number of direct projects outputs were achieved and presented during the workshop including (installation of WISP tools, reports, training events, end-users capacity building workshops etc.....).For the project outcomes, several policy decisions were made by the end-users and line ministries based on the project research results that aimed to improve water resources and agricultural management and to optimize water allocated to improve the efficiency of irrigation.

For the project impacts, for some of the projects activities it was clear during the last ICR presentations that some of them could be seen clearly since some of the project studies were fully completed. Also special type of results monitoring under the RCIWRM project

is related to activities that were jointly coordinated between the implementing agencies and the end users. All these results are captured in Annex 1 **"Physical Progress Table."**

Efficiency N/A

The whole purpose of using remote sensing technologies through this project was to cut off the terrestrial costs and achieve cheaper and higher quality, and that in particular shall have an impact on social and economic returns. Therefore the Project outputs allowed obtaining great performance results in terms of efficiency, time saving and cost reduction compared with the use of "traditional methods."

Justification of Overall Outcome Rating

Rating: Satisfactory

Overall at the completion, the project implemented the full intended project objectives, met and exceeded all implementation targets, the project can be considered as successful in reaching all of its PDOs indicators. Because of that, the overall outcome is rated Satisfactory.

Overarching Themes, Other Outcomes and Impacts

(a) Poverty Impacts, Gender Aspects, and Social Development

Although the project was not targeting an impact on poverty; improving water monitoring process through new sources of information and WISP models to better characterize water resources conditions was crucial for implementing the countries' National Water Strategies and the Green economy Plans that are widely focusing on sustainable socio-economic development at the countries level.

Ten major water resources decisions have been made to improve the agricultural and land use management "taking into consideration the outputs of WISP tools" (by 125% of the target value). These decisions were divided by countries as follows:

Lebanon: (2 decision were made)

1. A decision was made by the Ministry of Water and Energy to start the Standardizing, harmonization and sharing policy in climatic and hydrological data.
2. Another decision was taken by the Ministry of Environment MoE to startUpdating the "Adaptation to Climate Change Strategy" in the water sector based on the project results under the Climate Change component.

Jordan: (2 decision were made)

1. In Jordan, the ministry of water and irrigation MWRI has issued an amendment to the groundwater law based on the research results of the ET and Crop mapping components for selected pilot. The amendment indicated that remote sensing tools will be used for calculating groundwater abstractions and irrigation requirements.
2. Another decision that was also made by the Ministry of Water and Irrigation was to start using the WISP tools that were installed as part of this project in calculating

the Water Balance in the entire ministry upcoming research studies for irrigation optimizations and water resources management and monitoring.

Morocco: (4 decision were made)

- For the Climate Change component, the Ministry of Water and Agriculture decided to use the project output results as a baseline in implementing the national plan for climate change adaptation.
- For the drought and forest fire component, the high Authority of Forest and Water Affairs decided to use the project results in updating the delineation of vulnerable areas to prevent possible incidents and to update their mitigation measures against Forest fire.
- For the Locust component , the National Center for combatting locust of the Ministry of Internal Affairs, decided to use the project outcomes to start prospecting campaigns in areas with probability of locust presence and in to start an operational/ prevention plan in the field to fight locust.
- For the LIS platform and the Water balance study, the Ministry of Water and Agriculture decided to use the project results as a baseline in reforming the current national water strategies plan.

Tunisia: (2 decision were made)

1. The production of Climate Change high resolution projection future trends helped the Ministry of Agriculture, Water resources and Fisheries in Tunisia in understating the climate variability and helped them in developing some mitigation actions to adapt olive production to future changes and to build adaptive strategies to reduce as much as possible the socio-economic impacts of these changes.
2. For Flood forecasting, the results of the Simulation models for the Medjerda River watershed were satisfactory by 89% and contributed to the Floodplain Management Plan.

Institutional Change/Strengthening

The overall project TA and technical training plan had been fully implemented as expected by all country PMUs and AWC. The various international and regional technical training workshops and conferences had been fully conducted, and the total number of trainee from the stakeholders and end-users has reached approximately 439 persons which exceeded the required target with about 174%, while the number of local training workshops that were organized for the end-users and stakeholders exceeded more than 35 workshops and approximately 113% of the original target. At this stage, all country PMUs are organizing the necessary trainings/workshops at local and regional levels and worked actively on sharing knowledge between countries (e.g. between Tunisia/Morocco and Lebanon/Jordan).

Under this component also the number of research fellow/scholarshipwas reached by 59%,that is because all PMUs have used more research assistants and consultants, but not the formal research fellow/scholarships as needed for each modeling study, also some

contracts are still on-going for the time being, and not finally accounted; (i) total number of remote sensing stakeholders and staff trained is 257 (by 148% of the targets); (ii) about 61 experts and PMU managers had participated in the international and regional workshops/conferences (achieved by 153% of the expected target); and (iii) about 18 international and regional conferences and workshops had been conducted and participated by the project PMUs (achieved by 95% of the targets). At this stage, all country PMUs are organizing the necessary trainings/workshops at local and regional levels and worked actively on sharing knowledge between countries (e.g. between Tunisia/Morocco and Lebanon/Jordan).

Assessment of Risk to Development Outcome

The project risks, centered mostly on weak technical capacity in remote sensing and an anticipated unfamiliarity with Bank procurement and financial management standards, is mitigated by the extensive capacity building anticipated under the project. The overall project risks are rated Medium - Low Impact, and are considered manageable with mitigation measures in place. Potential risks and mitigation measures are summarized in the Operational Risk Assessment Framework.

Lessons Learned

- The Project represented a unique model in the Arab region which emphasized the Importance of the regional coordination and communications role, in exchanging knowledge, identifying common issues, discussing regional solutions, coordination between on-going regional initiatives and enhancing capacity building.
- The project really proved the advantages of having a regional project, in strengthening the regional scientific applied activities, bringing the focus on data gaps, knowledge needs and regional information required to provide effective mechanisms towards sustainable developments and risk reductions/ Management.
- The Organizations of regional events and training workshops really helped the countries in identifying new technologies and comparing between different techniques, therefore they were able to select the best technologies and achieve the best results based on each countries' requirements and based on the required resolution for each applications. Therefore it was always very important during this project, to leave the door opened for the world's leading organizations in this domain and not to narrow done the selection on just one or two organizations.
- The project contributed in raising awareness on the use of such advanced technology in the water sector by the line ministries, and in building the link between the scientific research and the real life applications for water.
- The project showed the importance of using new products to guide the farmers to a better management of water use and higher water productivity in Agriculture by pointing out where there is deficit or excess in water use.
- The Project emphasized the importance of having a defined training plan for such advanced technologies at the national and regional level during the project preparations and prior to the start date of the project, which really helped the countries in building capacities and in getting up to speed with the implementation requirements to successfully achieve the project results on time.

Annex 8. Comments of Cofinanciers and Other Partners/Stakeholders

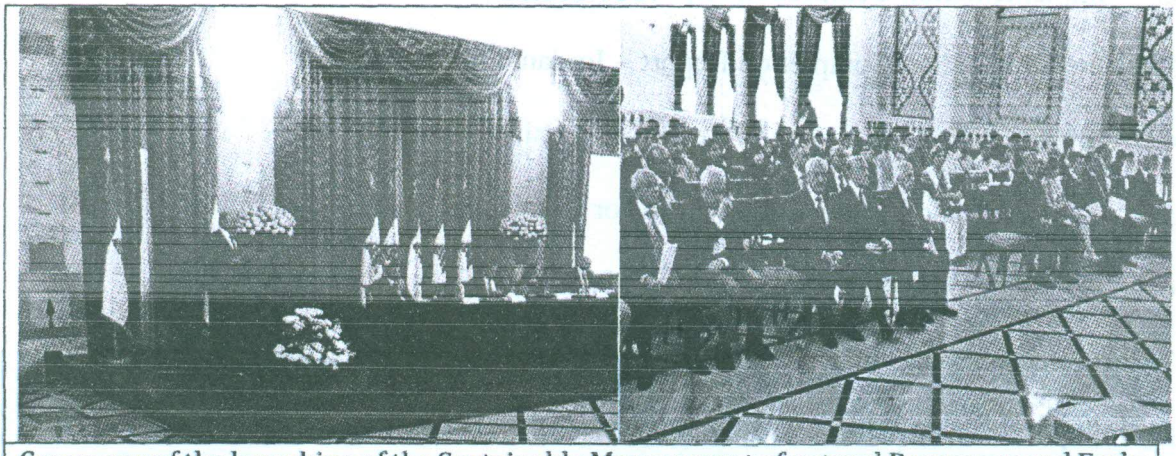
N/A

Annex 9. List of Supporting Documents

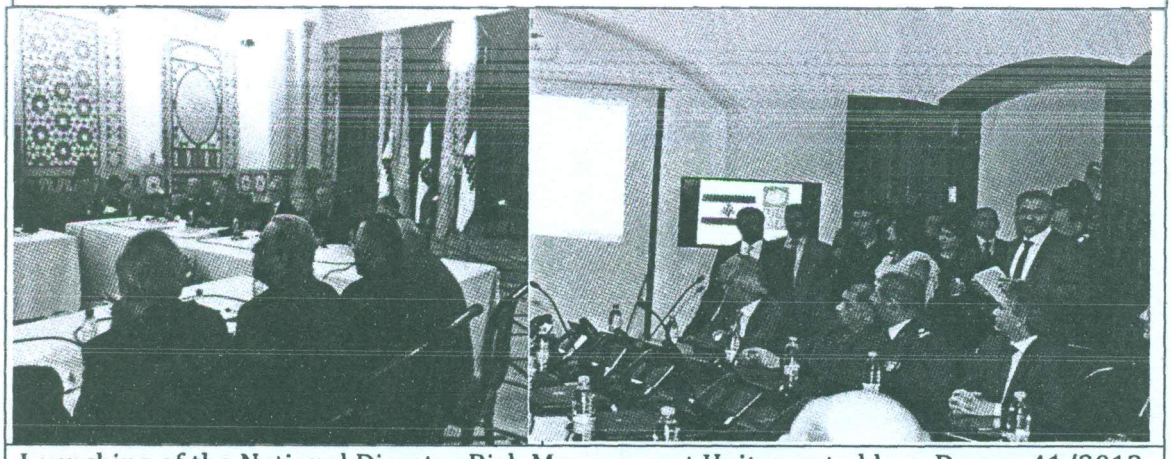
1. Implemcntation Completion Report – Lebanon, February, 2016
2. Implementation Completion Report – Morocco, February 2016
3. Implementation Completion Report – Jordan, February 2016
4. Implementation Completion Report – Tunisia, February 2016
5. Implementation Completion Report for Overall Project – AWC, February 2016
6. Project Appraisal Document – May 18, 2011
7. Project ISRRs
8. Supervision Missions' Aide Memoires

Annex 10: Project Photos

LEBANON

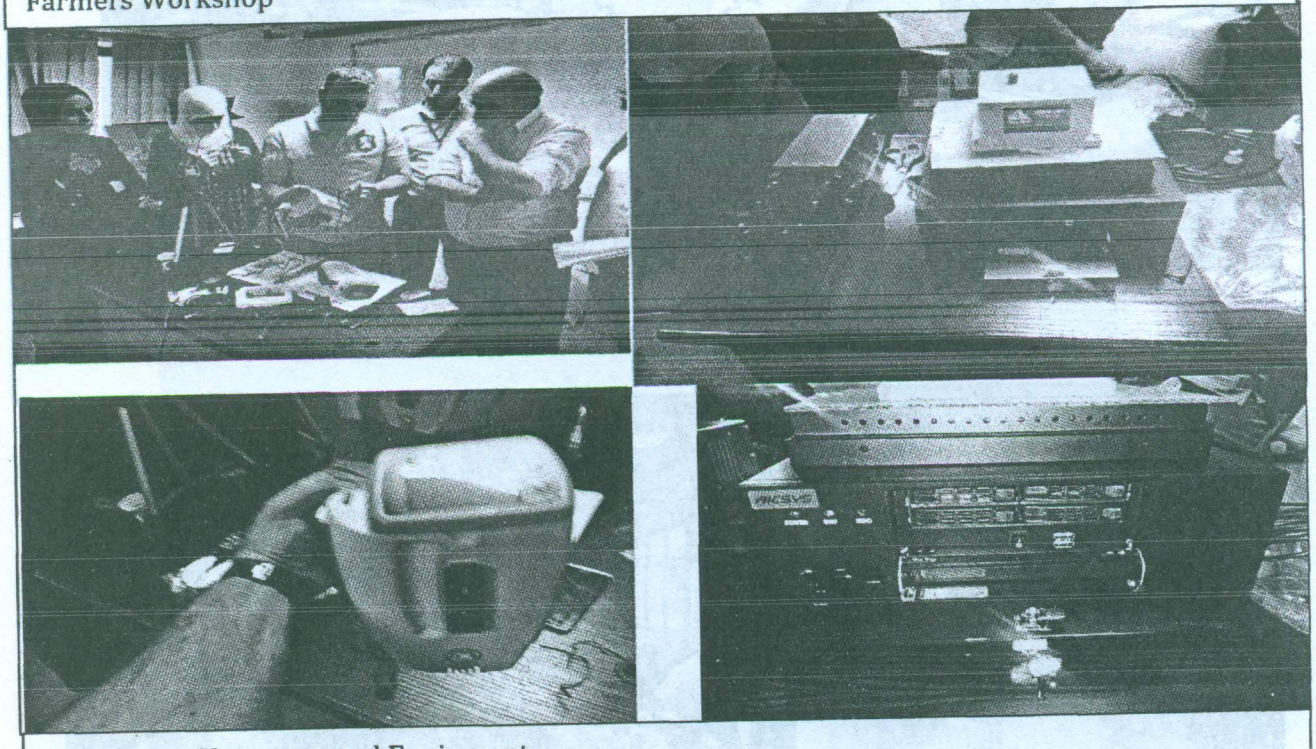


Ceremony of the launching of the Sustainable Management of natural Resources and Early Warning Platform "SuNaR" by CAPWATER Project at the Grand Serail on September 30, 2014 under the patronage of Mr Akram Chehayeb, the Minister of Agriculture.



Launching of the National Disaster Risk Management Unit, created by a Decree 41/2013, at Grand Serail on May 30, 2015. Dr Chadi Abdallah from the Lebanese Project Management Unit presenting the Sustainable Management of Natural Resources and Early Warning Platform SuNAR system in front of Mr. Tammam Salam, the Prime Minister, Dr Mohamad Machnouk, the Minster of Environment, Mr. Rachid Derbas, the Minister of Social Affairs, Mr. Ramzi Joreige, the Minister of Information, Deputy Mohammad Qobbani, Ambassadors, UN Agencies, Director Generals, Civil Defense and Media. He demonstrated on the SuNaR Platform and the built by the project technical capacities to interact and provide maps showing hot spots for flood risk and forest fire prevention to enhance decision making and national preparedness.

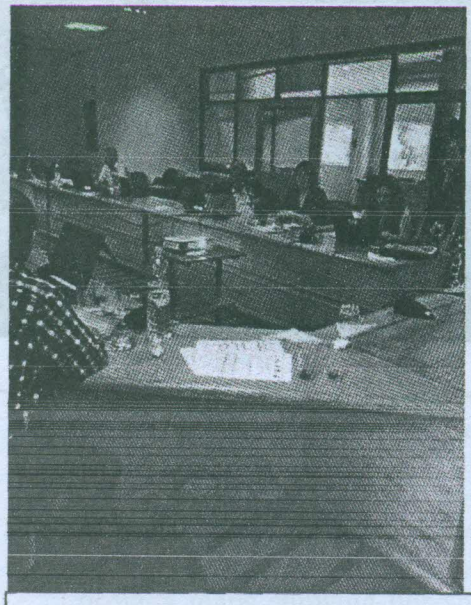
Farmers Workshop

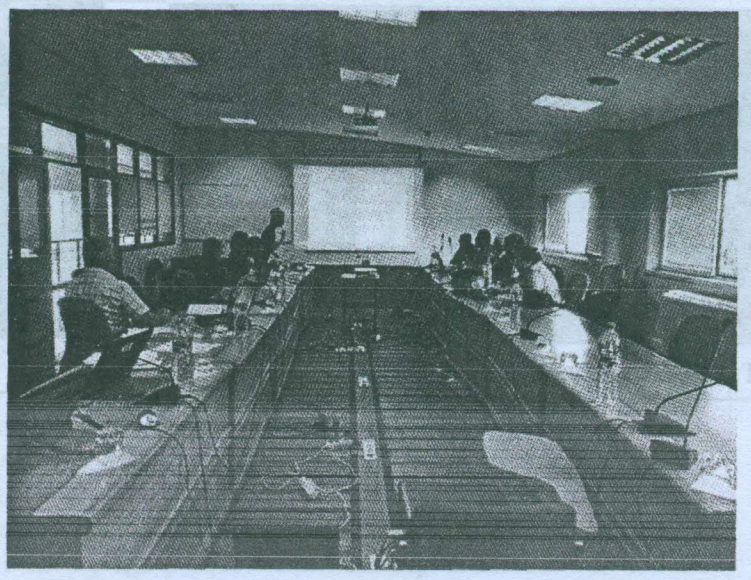


Training on Hyperspectral Equipment

MOROCCO

Training sessions on the WISP tools at CRTS for the End-users





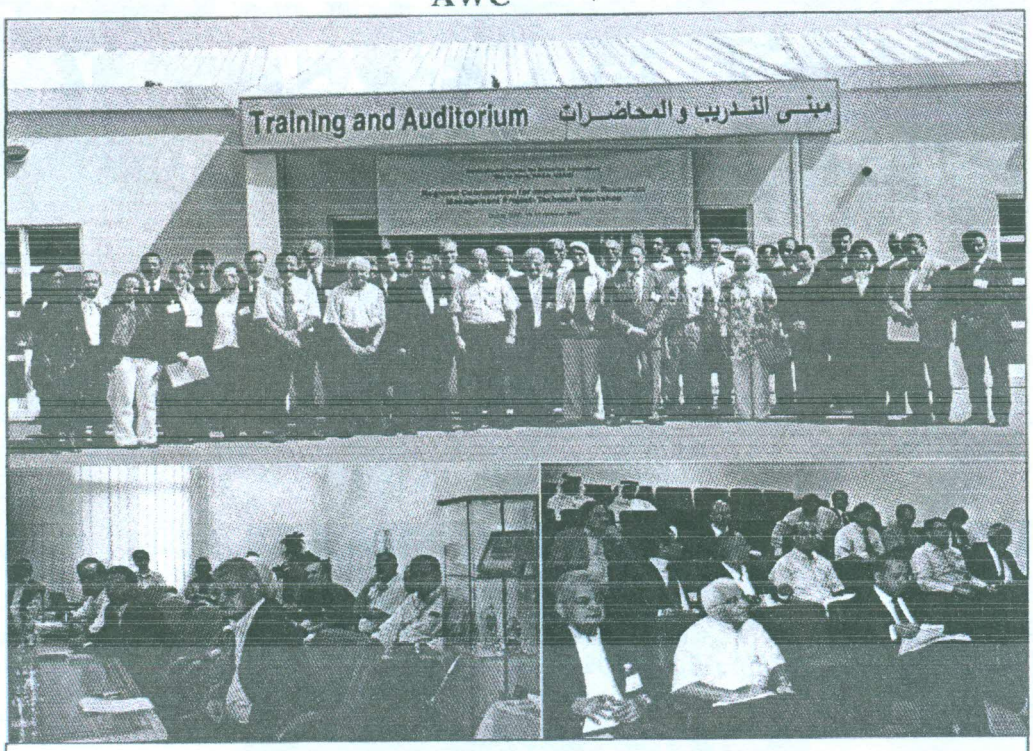
Mid-Term Review – Morocco 2014

Workshop on "Identification and analysis of users' needs"– Tunis - November 2013

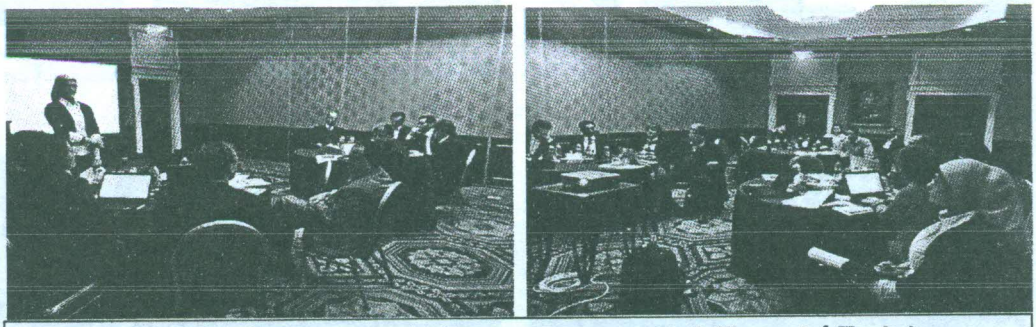
International Workshop on "Geomatics for Ecosystem based Adaptation in the Dry Areas of North Africa" - Djerba Island, Tunisia, June 2014

Training workshop on Flood mapping with remote sensing and impact of climate change – Tunis, January 2015

Project Dissemination and Closing Seminar – Tunis, May 2015)

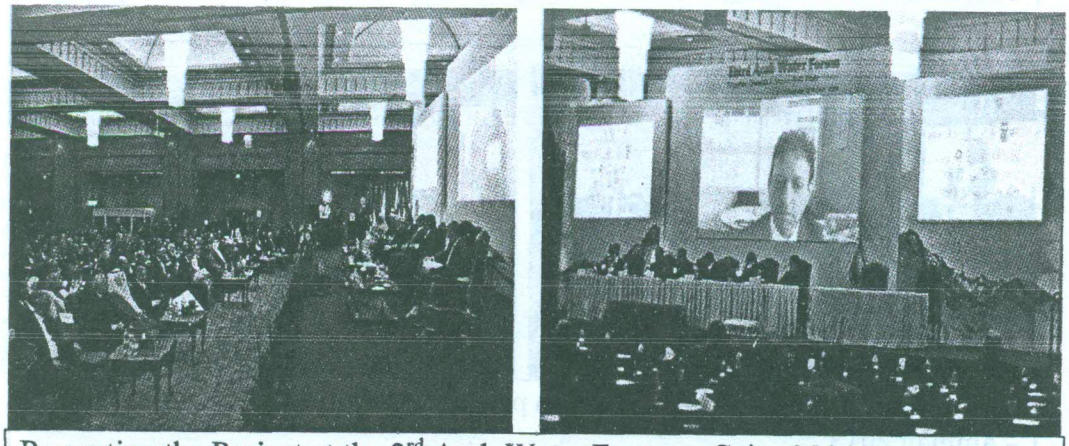


Project Kickoff Meeting



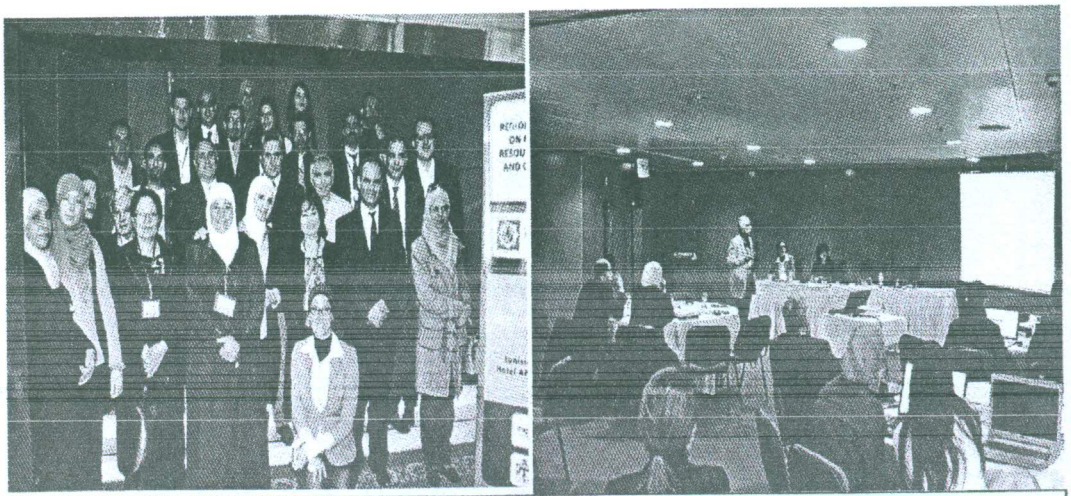
1st Supervision Mission preceded by a procurement & Financial Training – Amman 2013

Regional ET Workshop – Cairo 2014



Presenting the Project at the 3rd Arab Water Forum – Cairo 2014

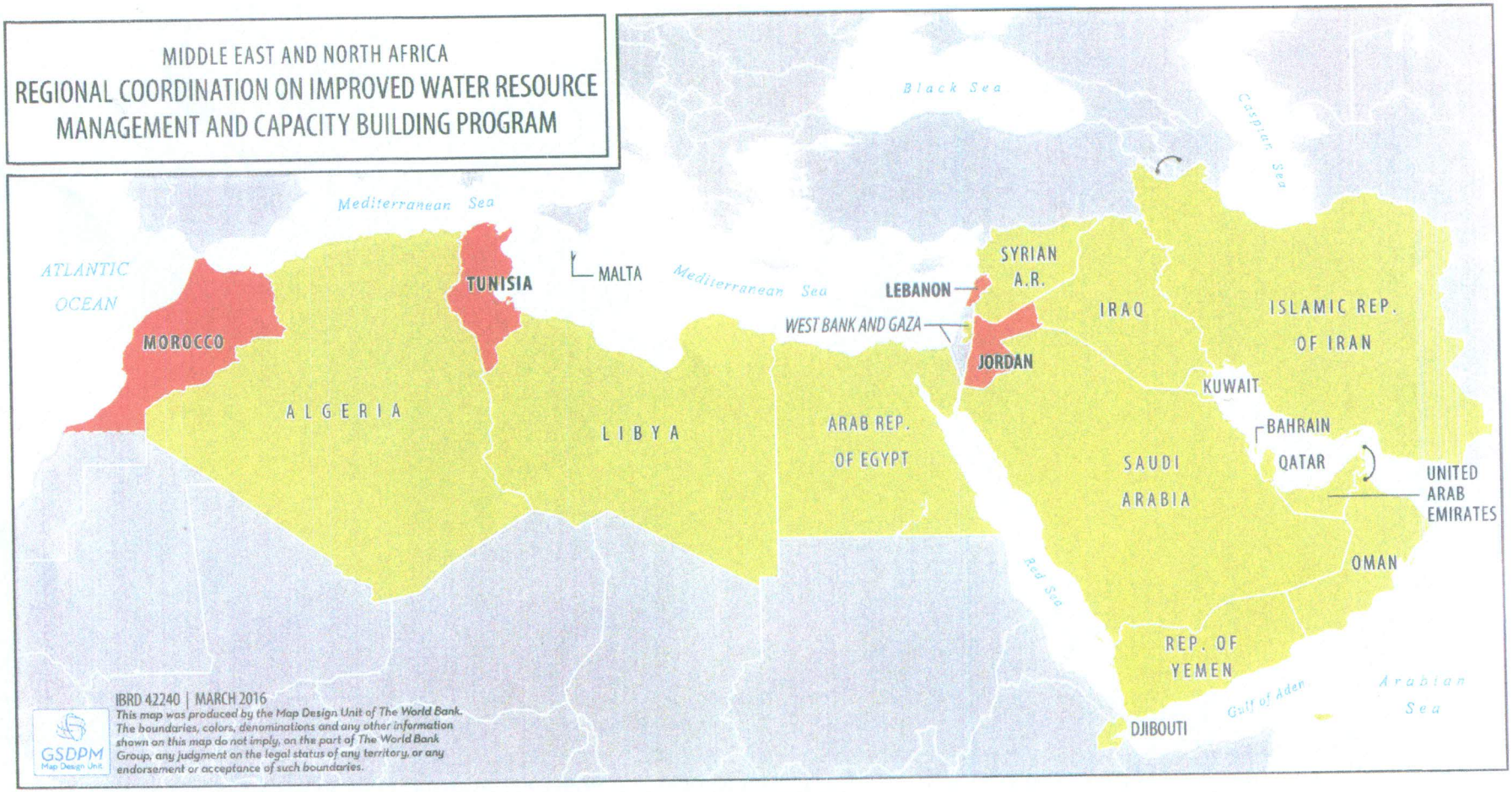
Project Completion Regional Workshop – Cairo 2015



Regional Groundwater Workshop – Cairo 2015

MIDDLE EAST AND NORTH AFRICA

REGIONAL COORDINATION ON IMPROVED WATER RESOURCE MANAGEMENT AND CAPACITY BUILDING PROGRAM



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