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FURTHER ADVANCING THE BLUE REVOLUTION INITIATIVE (FABRI)

QUARTERLY PROGRESS REPORT NO. 10: DECEMBER 15, 2013 – MARCH 14, 2014

14 APRIL 2014

This report was produced for review by the United States Agency for International Development. It was prepared by DAI/Washington.

COLLABORATING ENTITIES

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ACRONYMS

ACWUA	Arab Countries Water Utilities Association
ADB	Asian Development Bank
AFR	Africa
AfDB	African Development Bank
AfWA	African Water Association
AfWOP	Africa Water Operators' Partnerships
AfWW	Africa Water Week
AfYWP	African Young Water Professionals
AGU	Arabian Gulf University
AMCDRR6	Asia Ministerial Conference on Disaster Risk Reduction
AMCOW	African Ministers' Council on Water
APS	Annual Program Statement
BPA	Blanket Purchase Agreement
CO	Contracting Officer
COP	Chief of Party
COR	Contracting Officer's Representative
DAI	Development Alternatives, Inc.
DEC	Development Experience Clearinghouse
DRR	Disaster Risk Reduction
ELI	Environmental Law Institute
FABRI	Further Advancing the Blue Revolution Initiative
FPPO	Fixed Price Purchase Order
GIS	Geographical Information System
GMS	Greater Mekong Sub-region
GMS-BF	Greater Mekong Sub-region Business Forum
GPR	Ground-Penetrating Radar
GWOP	Global Water Operators Partnerships Alliance
GYGA-MENA	Global Yield Gap Atlas for the Middle East and North Africa
IAV	Institute of Agronomy and Veterinary Science Hassan II
ICA	Independent Consultant Agreement
ICARDA	International Centers for Agricultural Research in Dry Areas
ICBA	International Center for Biosaline Agriculture
IMU	Interim Management Unit
INRGREF	National Research Institute for Rural Engineering, Water, and Forestry
IRESA	Institution of Agricultural Research and Higher Education
ILRI	International Livestock Research Institute
IRS	Internal Revenue Service
IWA	International Water Association
IWRM	Integrated Water Resources Management
JAXA	Japan Aerospace Exploration Agency
JPL	Jet Propulsion Lab
JUST	Jordan University of Science and Technology
KISR	Kuwait Institute for Scientific Research
LOE	Level of Effort
LMI	Lower Mekong Initiative
MD	Managing Director
MEDRC	Middle East Desalination Research Center
MENA NWC	Middle East and North Africa Network of Water Centers of Excellence

MPE	Mekong Partnership for the Environment
MRC	Mekong River Commission
NCARE	National Center for Agricultural Research and Extension
NGO	Non-Governmental Organization
NRW	Non-Revenue Water
ONAP	Office National de l'Assainissement et du Drainage
OSU	Oregon State University
PIP	Performance Improvement Plan
PR&D	Policy, Research, and Development
QEERI	Qatar Environment and Energy Research Institute
QNFSP	Qatar National Food Security Program
RDMA	[USAID] Regional Development Mission for Asia
R&D	Research and Development
RFP	Request for Proposals
RSS	Royal Scientific Society
RWS	Reference Weather Stations
SAR	Synthetic Aperture Radar
SEI	Stockholm Environment Institute
SIM	Smart Infrastructure for the Mekong
SODECI	Société de Distribution d'Eau de la Côte d'Ivoire
SQU	Sultan Qaboos University
TAMU	Texas A&M University
TdE	Société Togolaise des Eaux
TEM	Terrestrial Ecosystem Mapping
TFDD	Transboundary Freshwater Dispute Database
TOR	Terms of Reference
UJ	University of Jordan
UNISDR	UN Office for Disaster Risk Reduction
UNL	University of Nebraska-Lincoln
USAID	United States Agency for International Development
USG	United States Government
USU	Utah State University
WASH	Water, Sanitation, and Hygiene
WHOI	Woods Hole Oceanographic Institute
WIF	Water Innovation Fellowships Program
WOP	Water Operators' Partnerships
WU	Wangeningen University, Netherlands
YWP	Young Water Professionals
YWSP	Young Water Scientist Partnerships Small Grants Program

EXECUTIVE SUMMARY

FABRI's tenth Quarterly Progress Report provides an implementation update on the six key activity results which support improved management of water in the Middle East and Africa, project management updates, and any major issues faced and how they were resolved.

TECHNICAL PROGRAM

Result 1: Middle East and North Africa Network of Centers of Excellence Established and Operating.

- Cumulatively, the Policy, Research, and Development (PR&D) Grants Program awarded grants for ten collaborative projects for more than $3 million. Research teams completed grant negotiations, held project start-up meetings, and commenced research activities.

- Two U.S.-Network Research Partnerships held start-up meetings: (1) Combatting the Emerging Impacts of Harmful Algal Blooms on Desalination Plants: Bloom Detection, Forecasting, and Strategies for Impact Reduction, led by the Middle East Desalination Research Center outside Boston MA and (2) Radar Probing of Groundwater in Hyper-Arid Environments: Understanding Aquifer Dynamics in High Discharge Areas, led by the California Institute of Technology in association with the Jet Propulsion Laboratory in Muscat, Oman.

- The Young Water Scientist Partnership (YWSP) Small Grants Program and Water Innovation Fellowships (WIF) Program continued to receive proposals. FABRI extended the proposal deadlines for both programs to July 31, 2014.

- FABRI started planning for a joint Assembly of Governing Members and Thematic Partnerships Conference to be held in Marrakech, Morocco on June 22-25, 2014.

Result 2: Integrated Water Resources Management (IWRM) Programming Strengthened.

- The research team for the IWRM project, Mitigating Environmental Risks of Wastewater Reuse for Agriculture, completed grant negotiations and held a project start-up meeting.

Result 3: Access to Clean Water and Sanitation Improved in Target Countries.

- The African Water Association (AfWA) convened its annual AfWA Congress event February 15-18, 2014, for which FABRI designed and led a panel on non-revenue water and also gave a Small Grants Program workshop targeted to African Young Water Professionals (AfYWP).

- FABRI released a Request for Proposals (RFP) for the design of an AfWA website which will provide technical resources to its members.

- FABRI began preparing for the 5th Africa Water Week (AWW) to be held in Dakar, Senegal in May.

Result 4: Research and Development Capacities in Irrigation, Groundwater Management, and Drought Risk Assessment and Mitigation Strengthened.

- The PR&D Grants Program awarded grants for three projects relating to irrigation, groundwater management, and drought risk assessment and mitigation. Two of the project held start-up meetings and commenced research activities.

Result 5: Transboundary Water Cooperation Strengthened in Key River Basins.

- FABRI's Senior Mekong Affairs Advisor provided input to the midterm review of the Mekong River Commission (MRC) Fisheries Program.

- FABRI coordinated and helped develop plans for a regional fish database that would include key stakeholders. USAID and MRC Fisheries Program will co-host a planning workshop in May 2014 to reach an agreement on the scope and design of the database.

- FABRI supported the USAID Regional Development Mission for Asia Executive Office by following up on a partnership with the Asian Development Bank and the United Nations to finalize a session dedicated to the private sector in disaster risk reduction (DRR) at the Asia Ministerial Conference on Disaster Risk Reduction (AMCDRR6), scheduled for June 2014.

Result 6: Technical and Outreach Capacity of USAID Staff in Water and Sanitation Programming Enhanced.

- FABRI was directed by the Founders Committee to design and convene five thematic partnership workshops and a MENA NWC Congress over the next 18 months. Planning began for the first event, scheduled to be held in Morocco in late June.

Project Management

- FABRI fully executed 16 PR&D grants, and USAID approval for two additional projects is pending.

- During this period, FABRI issued a subcontract to Stockholm Environmental Institute – US Center for $88,382 for its role as a U.S. partner to a PR&D research project.

- FABRI issued a subcontract to University of Florida for $116,351 for its role as a U.S. partner to a PR&D research project.

- In January, FABRI issued Blanket Purchase Agreements (BPAs) to two translation companies: Jan D. Gibboney Technical Translators and JR Language Translation Services, Inc. to assist with English-French translations.

Issues and Remedies

Two issues faced by project management during this quarter include:

The Principal Investigator of MENA NWC did not submit updates for this quarterly progress report although it is a grant requirement and they were repeatedly asked. For this issue, the PR&D Grants Manager wrote these sections. FABRI will send this and all future copies of the QPR to all Center directors and Principal Investigators to inform them of their past noncompliance and, in the future, will regularly send reminders to ensure they fulfill this requirement.

Several MENA Centers have asked FABRI to cover their international travel on a research project rather than through their grants. In a few isolated cases, FABRI covered the travel costs for some scientists to attend the start-up meeting for their research project. But FABRI does not have adequate discretionary funds to make this a regular practice. It will inform the Centers that they must arrange and pay for travel themselves. If they cannot, FABRI will reduce the grants accordingly and researchers will not be able to travel to their partners unless they cover the costs themselves.

1. INTRODUCTION

Water plays a pivotal role in the political, economic and social lives of nations and people. Many countries, including those in the Middle East and Africa, are facing common water challenges- drought, inefficient agricultural water use, groundwater management, inadequate or poor quality water supply, weak or absent mechanisms for sharing transboundary water, etc. Such challenges can lead to conflict within communities and among countries, as well as have negative health, financial and social impacts on populations.

To help respond to these regional water challenges, FABRI is providing technical support to USAID's Middle East and Africa bureaus, fulfilling all requests at the highest technical standards. In this capacity, FABRI has launched and established a new regional water network called the Middle East and North Africa Network of Water Centers of Excellence (MENA NWC), strengthened integrated water resources management programming, improved the long-term viability of water and sanitation service providers, rationalized water allocations and use, encouraged collaboration among riparians in transboundary river basins, and raised USAID visibility in water and sanitation.

Partnerships form the foundation of all aspects of this initiative. FABRI develops partnerships—between and among the scientific community, governments, universities and research institutions, the private sector, and civil society—to achieve the project's goals and to ensure that the water sector in the Middle East and Africa is capable of sustaining, and building on those achievements after FABRI has closed. We are forging intellectual and financial partnerships among the water sector's major players to create an integrated process that spans the identification and design of new approaches and technologies to their production and adoption. Continued investments and advances in the water sector will improve economic output, agricultural returns, and public health and ease economic burdens and alleviate human suffering.

FABRI's core result is the launch of the Middle East and North Africa Network of Water Centers of Excellence (MENA NWC). This initiative is an outcome of President Obama's call to establish Centers of Excellence in the Muslim World during his June 2009 "New Beginnings" speech in Cairo. Secretary Clinton also mentioned the initiative during her World Water Day speeches in 2010 and 2011.

MENA NWC links technical and research institutions across the region, encouraging them to work together and with outside counterpart institutions on critical water challenges. The Network strives to foster partnerships that build and exchange regional science and technology capacity to improve water resources planning and management; and develop and disseminate policy tools and technical and management interventions that expand water supply, manage demand, and dramatically increase its efficient and productive use.

A network of cooperating institutions are facilitating collaborative activities, including competitive grants programs, capacity building, institutional twinnings, exchanges, fellowships, communications, and knowledge management. The Network is the main vehicle for FABRI's goal to strengthen the water sector in the Middle East and North Africa.

Additionally, FABRI is supporting innovative WASH activities in Africa, focusing on providing institutional support to two regional associations to test and share successful approaches in non-revenue water and on setting national policies to enhance sanitation programs throughout Africa.

FABRI's tenth quarterly report outlines the program's achievements and plans to build regional capacity of various actors from the water sector in the Middle East and Africa.

2. PROGRESS DURING THE QUARTER

FABRI has six major objectives:

- **Result 1: Establish an operational Middle East and North Africa Network of Centers of Excellence (MENA NWC).** FABRI is supporting the creation of the MENA NWC by acting as the Interim Management Unit until a Secretariat is established. The initiative will establish MENA NWC organization, leadership, and finances, as well as manage collaborative, technical, and capacity-building activities via Policy, Research, and Development (PR&D) Grants. Through the MENA NWC, FABRI aims to integrate research and development capacity in the member Centers with the development and dissemination of applied technologies and practices for innovative approaches, systems, and technologies to address water issues important to the region. An important piece of this work is the development of a communications and knowledge sharing plan to support the sustainability of the Network.

- **Result 2: Strengthen Integrated Water Resources Management Programming.** FABRI is strengthening the legal and regulatory framework for IWRM and implementing methodologies to improve and promote the efficient use of water resources through the MENA NWC IWRM Thematic Partnership.

- **Result 3: Access to Clean Water and Sanitation Improved in Target African and Middle Eastern Countries.** FABRI is strengthening the performance of water and sanitation service providers by working with regional "platforms" and associations. The goal is to provide them with innovative and tangible support to improve financial, economic, and operating efficiency, including development of association Business Plans, Non-Revenue Water (NRW) initiatives, capacity building, and communications and knowledge sharing programs.

- **Result 4: Strengthen Research and Development Capacities in Irrigation, Groundwater Management, and Drought Risk Assessment and Mitigation.** FABRI is working with one of the MENA NWC Thematic Partnerships to identify the most promising and regionally-relevant technologies and techniques for efficient, productive use of water in agriculture; engaging the leading experts in these technologies to transfer knowledge to MENA NWC institutions; and developing and presenting outreach activities in target countries to encourage government engagement and private sector partnerships around the most successful approaches.

- **Result 5: Strengthen Transboundary Water Cooperation in Key River Basins.** Through Oregon State University, FABRI is conducting an analysis of transboundary cooperation approaches and applying study findings to the Tigris-Euphrates basin. The results will be used to identify, design and implement one or two pilot projects. In addition, FABRI hired a Senior Mekong Affairs Advisor based in Bangkok, Thailand who began work in August 2013.

- **Result 6: Enhance Technical and Outreach Capacity of USAID Staff in Water and Sanitation Programming.** FABRI will strengthen USAID staff capacity in this area by providing materials and insights based on our non-revenue water and sanitation programs in Africa.

The following section describes the progress that FABRI has made on each of these objectives during the quarter.

RESULT 1: MIDDLE EAST AND NORTH AFRICA NETWORK OF CENTERS OF EXCELLENCE ESTABLISHED AND OPERATING

Requirement 1.1: Support Establishment of MENA NWC

This activity is completed.

Requirement 1.2: Design a Trust Fund or Endowment to Help Ensure the Sustainability of the Network

The Founders Committee agreed that the creation of a trust fund or endowment for MENA NWC ought to be considered near the end of the current business planning period in 2017. This activity is currently on hold.

Requirement 1.3: Support Operations of the MENA NWC Secretariat

During the period, the Founders Committee held its final meeting on the Dead Sea in Jordan from February 23-24, 2014 (see Requirement 1.4 for a discussion of the meeting). In preparation for this meeting, the Interim Management Unit (IMU) prepared a briefing book which included:

- Draft bylaws for the Network
- A revised draft of the Network's five-year Strategic Business Plan which covers the operational period of MENA NWC from 2014-2018
- Updates on the Network's research programs
- A concept note for the Network's Thematic Partnerships meetings
- CVs of candidates to the Board of Directors
- Recommendations from Taoti Creative on the MENA NWC website
- A scope of work for a course for member Centers on developing research partnerships with the private sector

Following the meeting, the Interim Board of Directors and several PR&D researchers presented the Network at the University of Jordan's Water in the Arab World conference on February 26, 2014. The event was attended by more 80 people representing academic and research institutions, government and donors.

Taoti Creative, a Washington, D.C. based website development firm, prepared a Digital Engagement Strategy that was product of photo-interviews and written survey responses with over 20 MENA NWC stakeholders including MENA NWC Center Directors, Technical Leads, researchers, Founders Committee members, and U.S. partners. The report presented Taoti's recommendations for the design of the MENA NWC website. Following feedback from the Founders Committee, the IMU worked with Taoti to design an initial website online for the Network as a place to provide initial information about the Network and post Network documents (www.menanwc.org). The website was submitted to USAID for review in mid-March 2014. The full website will launch in June 2014 in conjunction with Assembly of Governing Members and Thematic Partnership Conference in Marrakech, Morocco in June 2014.

The Network's two small grants programs – the Water Innovation Fellowships and Young Water Scientist Partnerships – closed during the period. The WIF program received 27 proposals and the YWSP program received 7 proposals. Following the deadline, the Annual Program Statement for the WIF

program was amended to extend the deadline for proposals through July 31, 2014 (for a summary of additional changes see Requirement 1.5). A similar modification will be made to the YWSP program in the upcoming quarter.

In December, FABRI released a Request for Proposals (RFP) to solicit proposals to develop innovative approaches to ensure the financial sustainability of MENA NWC. The successful bidder will develop a realistic strategy, an achievable action plan, and content for effective marketing materials to that end. The IMU did not receive any proposals. Firms sited the following reasons for not bidding: the RFP did not reach the interested parties within the firm, there was a lack of interest in working internationally, and the firms were concerned that the RFP had two stages – strategy and action plan design and implementation. The RFP was revised to focus only on strategy and action plan design and released on March 17, 2014. Proposals are due April 11, 2014.

Planned Activities for the Third Quarter of Year Three

- Continue to integrate new MENA NWC Centers into ongoing Network activities;
- Finalize bylaws for MENA NWC;
- Finalize the 2014-2018 Strategic Business Plan;
- Prepare and submit application to the IRS for tax-exempt status;
- Launch the MENA NWC website;
- Identify a timeline for operationalizing the Network, including hiring permanent staff, establishing a bank account, setting up an accounting system, and writing operational manuals;
- Select a firm to work with MENA NWC on a financial sustainability strategy and action plan;
- Technical and logistical arrangements for the Interim Board meeting in Morocco June 2014;
- Technical and logistical arrangements for the Assembly of Governing Members and Thematic Partnership Conference in Morocco in June 2014;
- Prepare concept paper on capacity building using online training platforms; and
- Design a course for member Centers on developing research partnership with the private sector.

Requirement 1.4: MENA NWC Founders Committee Established

The Founders Committee held its final meeting February 23-24, 2014 at the Dead Sea in Jordan. During the two-day meeting, the Founders Committee unanimously approved a motion to recharacterize itself as the Interim Board of Directors with the same membership and internal structure. This was necessary in order for the IMU to apply to the Internal Revenue Service for the Network's tax exempt status as a 501(c)(3). FABRI is actively collecting nominations for candidates to the Board of Directors. The deadline for nominations for the permanent Board is 1 June 2014. The final slate of nominees for the Board will be set at the June 21-22 meeting of the Interim Board and Network Governing Members will have an opportunity to review the candidates for "no objection" at the Assembly of Governing Members meeting the following week in Marrakech, Morocco. The first annual meeting of the Board of Directors will be in September 2014 in Lisbon, Portugal preceding or during the IWA Global Water Congress.

Other agreements and approvals include:

- Welcoming Elisabeth Kvitashvili as a new member, representing the U.S. Agency for International Development.

- Approved the following individuals as officers of the Corporation:
  - President – Muwaffaq Saqqar

  - Vice President – Harvey Perlman

- Approved the following individuals as officers of the Interim Board:
  - Chair – Muwaffaq Saqqar
  - Treasurer – Harvey Perlman
  - Secretary – Peter Reiss (ex officio)
- Reviewed the draft bylaws prepared by Gail Harmon, the Network's attorney, and instructed the IMU to revise based on the Interim Board's comments and the responses from the Network's attorney to specific questions raised by the Interim Board.
- Reviewed the Strategic Business Plan and instructed the IMU to revise the Business Plan based on comments provided during the meeting.
- Agreed to create the Scientific Advisory Council to include renowned scientists and researchers, answerable to the Executive Director in shaping scientific research policy and strategy.
- Agreed to release again the RFP to identify a firm to assist the Network to secure financial sustainability. The RFP will only focus on strategy and action plan design.
- Instructed the IMU to get an initial website online for the Network as soon as possible as a place to post Network documents and leave the more complex parts of the website to the full version.
- Instructed the IMU to modify the Annual Program Statements for the two small grants programs – the Young Water Scientist Partnerships and the Water Innovation Fellowships.
- Agreed that the Network would hold a regional meeting of member Center directors and two or three Thematic Partnerships on June 23-25, 2014 in Marrakech, Morocco.
- Agreed that the first MENA NWC Congress would be held on the campus of Sultan Qaboos University in February 2015 with active donor, private sector, and government participation. Two to three Thematic Partnerships would meet at the same time.
- Agreed to organize and convene a workshop at the International Water Association (IWA) Global Water Congress and Exhibition in Lisbon, Portugal on September 21-26, 2014.
- Agreed on developing criteria for joining the Network and issuing a call through the website but that no new members would join until September 2014 with the seating of the Board of Directors

Planned Activities for the Third Quarter of Year Three

- Prepare briefing book and make logistical and travel arrangements for the June Interim Board Meeting in Essaouria, Morocco; and
- Identify additional candidates for the MENA NWC Board of Directors.

Requirement 1.5: Technical, Demonstration Activities of the Network Launched

MENA NWC Small Grants

The Network's two small grants programs – the Water Innovation Fellowships and Young Water Scientist Partnerships – closed during the period. The WIF program received 27 proposals and the YWSP program received 7 proposals. Following the deadline, the Annual Program Statement for the WIF

program was amended to extend the deadline for proposals through July 31, 2014. Additional modifications included:

- Requiring applicants to be (1) a citizen of a Middle Eastern or North African country, (2) currently resident of a country in the Middle East or North Africa where a MENA NWC Center is present, and (3) employed by an institution or entity based in the Middle East or North Africa. Applicants can email mena-nwc-waterinnovations@dai.com to verify whether or not a MENA NWC Center is present in their country.
- Modifying the list of allowable and not allowable uses for grant funds.
- Adding requirements for grantees to maintain active registrations in U.S. government procurement databases.
- Requiring Technical and Cost Proposals to be written in either French or English

A similar modification will be made to the YWSP program in the upcoming quarter. In addition, at the instruction of the Interim Board of Directors, the YWSP program will be modified to include a second option, whereby young researchers from a non-member entity may receive a grant to work on a research project funded under the Network

Planned Activities for the Third Quarter of Year Three

- FABRI will review research projects submitted under the small grants programs for award, convene the respective Selection Committees, advice applicants of award decisions, negotiate grant terms, and award grants.

POLICY, RESEARCH, AND DEVELOPMENT (PR&D) GRANT PROJECTS RELATING TO WATER-FOOD-ENERGY NEXUS, WATER SUPPLY AND SANITATION, AND NON-CONVENTIONAL WATER

Project	Participating Centers and External Partners	Project Activities in the Last Quarter	Planned Project Activities in the Upcoming Quarter
Water-Food-Energy Nexus			
Developing an Integrated Water, Energy, and Food Resource Management Tool for Policy Analysis and Decision Support	QNFSP INRGREF UJ Purdue	Launched project virtually, instructed team members on basic architecture of the management tool software, and started to identify data requirements.	Hold first project workshop June 10-11, 2014 in Rabat, Morocco.
Non-Conventional Water			
Use of Green Nanoparticles as a Biofouling- Resistant Agent in Reverse Osmosis Desalination	JUST ONEE University of Rhode Island University of Toledo-Ohio Georgia Tech	Held project start-up meeting in Rabat, Morocco, February 17-18. Developed project work plan, and started procurement process for membrane testing equipment.	Conduct PI training on the equipment and membrane preparation. Hold second project team meeting in Amman, Jordan June 18-19, 2014. Procure membrane testing equipment for JUST and ONEE.
Solar Pumping and Desalination	UJ An Najah	Negotiated grant agreement.	Hold project start-up meeting. Frame the technical and economic models and gather data.

Water Supply and Sanitation			
Expanding Access to Sanitation for Unsewered Communities in Middle East and North Africa Countries	ONEE RSS UJ IAV	Held project start-up meeting and inception workshop in Marrakech, Morocco, January 28-30. Developed project work plan. Performed analysis to identify stakeholders to be involved in project. Met with decision makers. Selected pilot project sites.	Hold inception workshop in Jordan. Conduct field appraisal of pilot sites. Design and construct pilot projects. Form local stakeholder committees. Test and characterize raw wastewater.
Developing Diagnosis Techniques and Strategies to Reduce NRW in the Middle East Region[a]	ACWUA AfWA	Negotiated grant agreement.	Hold project start-up meeting. Develop project work plan.

[a] This project was previously planned as a FABRI subcontract for a U.S.-Network Research Partnership, but will now be awarded as a PR&D Grant.

U.S.-Network Research Partnerships. FABRI continued to launch subcontracts for three research projects to apply emerging technologies in the region:

1. Combating the Emerging Impacts of Harmful Algal Blooms on Desalination Plants: Bloom Detection, Forecasting, and Strategies for Impact Reduction.

During the quarter ending March 14, 2014, FABRI and MEDRC held the project kickoff meeting at Woods Hole Oceanographic Institution on January 9-10, 2014. FABRI submitted the subcontract approval request to USAID at the beginning of quarter three and is awaiting a response.

2. The Global Yield Gap and Water Productivity Atlas for Jordan, Morocco, and Tunisia.

The University of Nebraska's Global Yield Gap Atlas for the Middle East and North Africa (GYGA-MENA) project began on September 1, 2013. During this reporting quarter, the team completed the following tasks:

- FABRI finalized agreements with the three project partners: INRGREF (Tunisia), NCARE (Jordan), and R&D Maroc (Morocco).
- Computers and software were setup and installed, and have been shipped out to the three partners.
- Using the gridded weather data, climate zones for the three countries were generated following the methodology of the GYGA project.
- Crop harvest maps for each of the major crops (wheat, barley and potato) have been generated. The teams are at the last stage of verifying the maps and making necessary corrections. This task is expected to be completed during the next quarter.
- Researchers identified reference weather stations. Based on the crop harvest area maps and distribution map of weather stations in each of the countries, researchers identified reference weather stations (RWS). The RWS forms the buffer zone with a radius of 100 km to serve as the points of estimation for yield potentials and yield gaps. As a result, data collection for weather, cropping system, crop management practices, soil, and actual yield, will be conducted in those RWS.
- Project representatives participated at the Third Annual GYGA project Workshop in Addis Ababa, Ethiopia. Seven scientists from the three GYGA-MENA teams participated in the

workshop held at International Livestock Research Institute (ILRI), March 24-27, 2014. In addition to the plenary sessions, the GYGA-MENA project held its own group meeting to review project progress, discuss technical issues, provided further training on data preparation and reporting, decided on unified choice of models for simulation, and made plans for regional meetings in 2015.

UNL expects that major activities in the next quarter will be centered on data collection for simulation of yield potentials and estimation of yield gaps. Data to be collected include:

- Weather data, including daily maximum and minimum temperature, solar radiation, precipitation, humidity and wind speed (A minimum of three years of ground data are required);
- Soil data, including areas of up to three major soil types within a RWS, soil texture and crop rooting depth;
- Cropping system data, including crop rotation, irrigated or rainfed, irrigation management, planting date or window, planting rules, plant population, crop variety; and
- Actual yield at the spatial scale of RWS or smaller.

3. Radar Probing of Groundwater in Hyper-Arid Environments: Understanding Aquifer Dynamics in High Discharge Areas.

As conceived by the California Institute of Technology (Caltech) in association with the Jet Propulsion Laboratory (JPL) in Pasadena, the study will map the ground deformation associated with water table depth variation over segments of the North African and coastal aquifers in Morocco and Oman where high discharge rates are observed. The study will map the depth of the water table and explore radar capability to monitor the water freshness from signal decay measurements in high discharge zones. The study uses technologies first developed for use on Mars. The Network Centers participating in the research project include the Institute of Agronomy and Veterinary Science Hassan II (IAV)/ R&D Maroc in Morocco and Sultan Qaboos University (SQU) in Oman.

During this reporting period, the project team completed the following tasks:

- USAID, IAV, SQU and Caltech held the kick-off meeting in Muscat, Oman, January 26 - 28, 2014, during which the team (1) Completed an overview of the potential research sites in Morocco and Oman and defined Al-Sharkia aquifer as the primary study site, (2) Defined existing GPS, Terrestrial Ecosystem Mapping (TEM)and resistivity ground data sets with the local water management authorities that will support survey data interpretation, and (3) Discussed team member roles, and the project agenda and deliverables.
- Caltech acquired 80 ALOS L-Band polarimetric Synthetic Aperture Radar (SAR) Scenes from the Japan Aerospace Exploration Agency (JAXA), covering the entire area of the Al-Sharkia aquifer from 2006 to 2011.
- Caltech acquired research survey equipment, processing station, and software licenses needed. Team members also integrated images and software to be delivered for each center for each computing station.
- Caltech prepared training courses for both IAV and SQU to be delivered with the two processing stations.
- The team began the SAR site characterization and localized Ground-Penetrating Radar (GPR) profiles in the Al-Sharkia area.
- Requested that QEERI join the project at no cost in order to participate in the joint survey, scheduled for in June.

Planned Activities for the Third Quarter of Year Three

- Visit QEERI in Doha in late April in order to increase available resources for the project team and perform preparatory characterization of Qatar Central Aquifer using QEERI funds. QEERI will fund travel to Qatar. The survey will help to test and calibrate the Low Frequency radar equipment in advance of the September survey. The visit will also involve local travel in Oman to give a lecture at SQU, deliver the first SAR processing station and discuss funding for helicopter integration plans with Omani's air force. Perform the Al-Sharkia site pre-characterization and explore the potential for finding paleo-channels in the SAR scenes and defining the June and September survey setup

- Visit IAV in Morocco in May to deliver the second SAR processing stations and perform L-Band SAR training and data analysis with the two groups. IAV will be responsible for the inSAR deformation analysis and SQU for the polarimetric mapping.

- Administer a test survey with SQU, IAV and QEERI over Qatar Central aquifer in June in preparation for the September primary survey in Sharkia. QEERI will ship equipment to SQU following the June survey.

Planning for Thematic Partnerships Conference. FABRI started planning for a joint Assembly of Governing Members and Thematic Partnerships Conference in Marrakech, Morocco on June 22-25, 2014. The Thematic Partnerships Conference will be an opportunity to share progress on the Network's three grants programs and to broaden the scope of the Network's technical activities and involve other scientists not directly participating on research projects. Participants will complete the following tasks:

- Identify a shortlist of policy and technical priority areas for the Thematic Partnerships;
- Develop a framework for the Network's first annual work plan; and
- Launch Communities of Practice as active knowledge sharing groups around technical topics.

Planned Activities for the Third Quarter of Year Three

- Anticipated project activities for the Projects relating to the Food-Energy-Water Nexus, Non-Conventional Water, and Water Supply and Sanitation Thematic Partnerships are summarized in the table above.
- FABRI will continue planning for the joint Assembly of Governing Members and Thematic Partnerships Conference in Marrakech, Morocco on 22-25 June 2014.
- FABRI will issue subcontracts with MEDRC and ACWUA for U.S.-Network Research Partnerships, and both projects will start research activities.

Requirement 1.6: Network Strengthening Through Private Sector Participation

As part of the program's continuous communication activities, FABRI conducted outreach activities and presentations on the Network's small grants programs in Tunisia, Morocco, and Jordan where participants expressed their interest in submitting proposals for funding and discussed opportunities for cooperation with the centers. Moreover, the partnership agreement between ACWUA and DHI Group on the newly awarded ACWUA research proposal on non-revenue water (NRW) was concluded. FABRI discussions with other businesses continued for participation in other ongoing research projects.

In response to the identified weak capacity of the Centers to implement partnerships with the private sector, FABRI completed an initial design of a training program to strengthen the capacity of MENA NWC Centers in establishing partnerships with the private sector. The activity has been reviewed and discussed with the Founders' Committee members during their last meeting in Feb 2014 and the scope of work will be finalized in the coming quarter.

Planned Activities for the Third Quarter of Year Three

- Launch a training program for MENA NWC Centers on public private partnerships
- Continue facilitation of meetings between the Centers and the private sector on specific research projects and topics
- Initiate business mapping activity in Morocco
- Prepare for the upcoming Thematic Partnership conference in Morocco and design the private sector participation activities.

RESULT 2: INTEGRATED WATER RESOURCES MANAGEMENT PROGRAMMING STRENGTHENED

FABRI is implementing Result 2, Integrated Water Resources Management (IWRM) Strengthening, through MENA NWC research projects. Activities for the IWRM project "Mitigating Environmental Risks of Wastewater Reuse for Agriculture" are summarized in the table below.

POLICY, RESEARCH, AND DEVELOPMENT (PR&D) GRANT PROJECTS RELATING TO INTEGRATED WATER RESOURCES MANAGEMENT

Proposal Topic	Participating Centers and External Partners	Project Activities in the Last Quarter	Planned Project Activities in the Upcoming Quarter
Mitigating Environmental Risks of Wastewater Reuse for Agriculture	SQU INRGREF UJ University of Florida	Held project start-up meeting.	Select experimental crops and start crop experiments. Gather data on pharmaceuticals in each country and identify compounds for testing in wastewater. Characterize treated wastewater. Design surveys to evaluate farmers practices with wastewater. Identify and characterize sites for groundwater vulnerability assessment.

Planned Activities for Third Quarter of Year Three

- Anticipated project activities for the IWRM project "Mitigating Environmental Risks of Wastewater Reuse for Agriculture" are summarized in the table above.

RESULT 3: ACCESS TO CLEAN WATER AND SANITATION IMPROVED IN TARGET COUNTRIES

Requirement 3.1: Water and Sanitation Service Provider Performance Strengthened

Non-Revenue Water Program. The African Water Association (AfWA), along with its partners, Société de Distribution d'Eau de la Côte d'Ivoire (SODECI), the Office National de l'Eau Potable (ONEP), Office National de l'Assainissement et du Drainage (ONAP), convened the 17th AfWA Congress in Abidjan, Côte d'Ivoire on 17-20 February 2014. The Congress began with a session led by the Non-Revenue Water (NRW) Task Force, for Managing Directors (MDs) of water companies participating in the AfWA-USAID NRW Program. Fourteen MDs attended the session and officially received copies of their NRW audits.

During one of the main plenary sessions during the Congress, AfWA and FABRI designed and led a NRW panel attended by about 400 participants. FABRI also offered a workshop to African Young Water Professionals (AfYWP), attended by about 80 participants. The AfYWP workshop focused on "How to Write a Winning Proposal for Small Grants."

The Task Force also held a members update meeting. Below is a list of agreements from their meeting.

- **Audit Phase Completion** - The remaining audits will be finalized during the next quarter. At this point, completion of audits for South Africa, Congo/Brazzaville and Gabon are unlikely. Task Force members mentioned Botswana and Lesotho as other possible options.
- **Audit Report Standardization** - Etienne Tchagole will review all of the French-language audits and assess their completeness and consistency. He will also review the comments by Malcolm Farley about the English-language audits to draw overall conclusions. A two-page summary of his observations will be shared with the Task Force for the remaining audits.
- **Synthesis report Outline Preparation -** Harrison agreed to prepare an initial outline to share with Task Force members prior to the Africa Water Week (AfWW) meeting.
- **Performance Improvement Plan (PIP) Phase Launch** - Participating member utilities will be asked to prepare their PIP plans by 15 April and send them to AfWA. They will be reminded that the sooner they submit their PIPs, the more likely they may receive support.
- **New Task Force Members Selection and Training** - The Task Force reconfirmed agreements from the previous Swaziland meeting to increase its size from 16 to 30 with nine from the utilities being audited with no current members and seven coming from sitting members. With the recent retirement of Etienne, TdE of Togo will need to identify a replacement.
- **AfWW Donors' Meeting -** The Task Force invited Malinne Blomberg of the African Development Bank (AfDB) to a session. She had found the discussion and NRW presentation interesting and useful. Malinne made very positive remarks about the NRW program and the opportunities it provided to attract investment.
- **AfWOP Program Linkages** - Linking to the Africa WOP Program could be beneficial, since they bring resources that can be used with the NRW Program's water companies. The Task

Force invited Simeon Kenpack, the WOP-Africa Coordinator, to attend a session to learn more about how the two programs can collaborate. It learned that they share many participating water companies, and that the WOP-Africa program's emphasis appears to be on capacity building and while the NRW program is more action-oriented, it does strongly support skills building in the water companies.

- **Etienne Tchagole's Role as Senior Advisor** -Task Force members welcomed Etienne's new proposed role as Senior Advisor. He will help manage the effort on behalf of AfWA, join audits, help with PIPs, and spur communication. Mr. Tchagole's STTA position is pending final approval by USAID.
- **Harrison Mutikanga's Role as Senior Advisor** - The Task Force agreed that Harrison's return was a very positive development. He can fill a range of functions, starting with the development of an outline for the Audit Synthesis Report. He will be on the Ghana audit team and will be a general intellectual resource.
- **AfYWP Small Grants Proposal Reviewers** - In order to help young water professionals prepare proposals, the Task Force selected Harrison, Malusi Dlamini, John Ruhiu, Cephas Oguah and Peter Bhembe for English proposals review and Vincent Gnalla, Moumouni Sawadogo, and Etienne for French proposals review. They will provide comments and advice prior to submission.

African Young Water Professionals Small Grants Program (AfYWP). FABRI and AfWA have received 19 small grant proposals, from countries including DRC, Cameroun, Kenya, South Sudan, Tanzania, Uganda, and Zimbabwe. Of these, five have been declined, as the topics did not meet any of the defined program themes. One, from a young water professional from Kenya, has gone through two rounds of Selection Committee review and the remaining will be submitted for Selection Committee review as soon as they provide all the required documentation.

During this quarter, four more national chapters were formed: Burkina Faso, Cote d'Ivoire, DRC, and Ghana. Previously formed national chapters include Chad, Cameroon, Kenya, Mali, Rwanda, Senegal, South Africa Tanzania, Togo, Uganda and Zimbabwe. The next group to be formed includes Benin, Burundi, Malawi, Mozambique, Namibia, and Swaziland.

Communications and Knowledge Exchange. During this period, FABRI released the AfWA website design Request for Proposals (RFP), with proposal receipt deadline of April 4, 2014. As AfWA is a membership-based organization, the main goal of the website will be to provide technical resources to its members. It will also allow members to join and pay their dues online. Simplifying the membership and payment process should help increase AfWA membership.

Fifth Africa Water Week. In 2012, the African Ministers Council on Water (AMCOW) requested that Peter Reiss, FABRI COP, act as Convener of the *Water, Sanitation & Hygiene (WASH)* track at the 4th Africa Water Week (AWW), held in Cairo in May of that year. The eight FABRI-organized technical WASH sessions were considered by both participants and AMCOW to have been highly successful, with positive evaluative feedback. During this quarter, AMCOW requested that FABRI assume a similar role at the 5th AWW to be held in Dakar, Senegal, in May 2014. FABRI will host the technical sub-theme, Water, Sanitation, and Hygiene: Partnerships, Innovations, and Investment Post-2015. Working closely to support USAID's Water Team and under its direction, FABRI functions as the event secretariat, helping to determine the eight technical sessions and coordinate with the lead conveners. This task requires FABRI to interact with the principal global players in the WASH sector, including the Bill &

Melinda Gates Foundation, WaterAid, the World Bank's Water & Sanitation Program - Africa, the International Sanitation Center, UNICEF, and WHO. Jeremy Hagger has been brought in short-term to oversee the activity.

Planned Activities for the Third Quarter of Year Three

- Complete the NRW utility audits in Cote d'Ivoire and Ghana
- Begin the PIP phase of the NRW Program
- Award the first round of AfYWP Small Grants
- Select additional Task Force Members
- Define all 8 WASH technical sessions, speakers, and formats for AWW, and review, translate, and transmit materials to AMCOW for event presentation and publication to the conference website
- Provide final support to prepare AWW sub-theme summaries and wrap up for delivery to plenary and AMCOW

RESULT 4: RESEARCH AND DEVELOPMENT CAPACITIES IN IRRIGATION, GROUNDWATER MANAGEMENT, AND DROUGHT RISK ASSESSMENT AND MITIGATION STRENGTHENED

Requirement 4.1: Conduct Identification and Analysis of U.S., Regional, and International Water Programs Aimed at Promoting Efficient, Productive Use of Water in Agriculture in the MENA Region

FABRI will implement Result 4 through MENA NWC research projects. Projects relating to irrigation, groundwater management, and drought risk assessment and mitigation are summarized in the table below.

POLICY, RESEARCH, AND DEVELOPMENT (PR&D) GRANT PROJECTS RELATING TO IRRIGATION, GROUNDWATER MANAGEMENT, AND DROUGHT RISK ASSESSMENT AND MITIGATION

Proposal Topic	Participating Centers and External Partners	Project Activities in the Last Quarter	Planned Project Activities in the Upcoming Quarter
Efficient Treatment and Provision of High-Quality Reclaimed Effluents Suitable for Irrigation	Technion NCARE Al Quds University	Held project start-up meeting. Developed project work plan.	Establish database for the effluent and influent parameters at the existing Al Quds treatment plant. Experiment with ultrafiltration operations at The Technion to improve permeate recovery rates. Repair NCARE membrane plant. Perform baseline soil and water monitoring at The Technion lysimeters. Develop framework for decision support system.
Application of Near-Real Time Monitoring Systems for Irrigated Agriculture	ICBA INRGREF SQU NCARE	Held project start-up meeting. Developed project work plan.	Plan experimental trials. Procure and install soil, plant, and weather monitoring equipment. Develop sampling protocols and forms for agronomic diagnosis, farm survey, and economic impact and adoption studies.
Developing Partnerships and Innovative Technologies to Improve Water Use Efficiency at River Basin Scale in Jordan, Morocco and Tunisia	INRGREF NCARE IAV SEI	Held project start-up meeting. Developed project work plan.	Identify and engage stakeholders. Gather data. Develop stakeholder engagement plan.
Managed Aquifer Recharge Using Treated Wastewater	SQU UJ RSS UNL	Negotiated grant agreement.	Hold project start-up meeting. Develop project work plan. Identify data for existing managed aquifer recharge projects.

Planned Activities for Third Quarter of Year Three

- Anticipated project activities for the Projects relating to the Food-Energy-Water Nexus, Non-Conventional Water, and Water Supply and Sanitation Thematic Partnerships are summarized in the table above.

RESULT 5: TRANSBOUNDARY WATER COOPERATION STRENGTHENED IN KEY RIVER BASINS

Requirement 5.1: Conduct Analysis of U.S. and Regional Transboundary Water Cooperation Programs, with a Focus on the Euphrates, Tigris, and Nile Basins

Oregon State University's Program in Water Conflict Management and Cooperation led by Prof. Aaron Wolf submitted a third draft of an assessment of regional transboundary water cooperation programs. The Program houses the Transboundary Freshwater Dispute Database (TFDD), the largest collection of information on transboundary conflict and cooperation in the world.

Planned Activities for Third Quarter of Year Three

- Finalize the final report from Oregon State University for submission to USAID and for widespread dissemination.

Requirement 5.5: Launch Pilot Project in Key River Basin

USAID asked FABRI to provide a full-time expert to assist it with Mekong River Commission (MRC) support. Klomjit Chandrapanya was chosen to serve as Senior Mekong Affairs Advisor. The role of the Advisor is to prepare a comprehensive long-term, external engagement strategy for the USAID Regional Development Mission for Asia (RDMA) to promote fair and effective governance of water, food, and energy in the Greater Mekong Sub region (GMS) as it relates to development of hydropower on the Mekong River She is also responsible for strategy execution and coordination, including developing a five-year Plan of Action to implement the RDMA's Mekong External Engagement Strategy that specifies key activities, required tasks, responsible actors, and due dates, and for communications and outreach. Klomjit Chandrapanya began working for FABRI on August 5, 2013.

The Mekong River Commission is the only regional intergovernmental body in the lower Mekong basin that acts as a forum for member countries to discuss transboundary water resources management. The US government has a strong interest in strengthening the MRC. This reporting period coincided with especially heightened interest in the area, when Secretary Kerry visited Vietnam in mid-December and spoke about the importance of the Mekong River, particularly the Mekong Delta, for food security. He underscored why decisions on infrastructure development such as dams need to be "made carefully, deliberately, and transparently" by sharing data and best practices in an open and cooperative dialogue among all riparian countries. Following the Secretary's visit, other high-level State Department officials, including PDAS Scot Marciel, visited the region in early 2014 to meet with key stakeholders.

During this quarter, FABRI's Senior Mekong Affairs Advisor supported USAID/RDMA's Regional Environment Office and the State Department with convening donors and other development partners to discuss hydropower development in the Mekong with PDAS Marciel. In addition, the Senior Advisor also provided input to the midterm review of the MRC's Fisheries Program, to which USAID has provided a grant of USD 2M to supports its 2011-2015 work program. In March, MRC donors (some 13 development partners providing about USD 100 million over 2011-2015) met in advance of a joint MRC members and donors meeting to discuss recommendations from multiple assessments of the MRC. The Senior Advisor reviewed the reports and provided key insights to the meeting. The input will be useful as

MRC focuses its efforts in the last two years of its strategic planning cycle to facilitate regional dialogue on sustainable water utilization. It will also serve to better share data and information, as was recommended by the mid-term reviews.

In addition to the work advising RDMA's Sustainable Mekong team on its Mekong Partnership for the Environment (MPE) and Smart Infrastructure for the Mekong (SIM) projects, the Senior Advisor coordinated and helped develop plans for a regional fish database that would assemble key stakeholders, including fisheries administrators in each lower Mekong country, local and international research institutes, and academia. USAID and MRC's Fisheries Program will co-host a planning workshop in May 2014 to reach an agreement on the scope and design of the database.

FABRI also supported the USAID/RDMA Executive Office by following up on a partnership with the Asian Development Bank's Greater Mekong Sub-region (ADB GMS) Business Forum (or GMS-BF) and the UN Office for Disaster Risk Reduction (UNISDR) Asia Office to finalize an event and logistics for a dedicated session on the private sector in disaster risk reduction (DRR) at the sixth biennial Asia Ministerial Conference on Disaster Risk Reduction (AMCDRR6), to be hosted by the Government of Thailand in June 2014. This session will take the place of a seprate workshop preceding the conference, which was originally envisioned.

Planned Activities for Third Quarter of Year Three

- Continue to support the Senior Mekong Affairs Advisor. This role will be crucial to USAID on Mekong hydropower-related issues as the State Department develops new strategies and plans to engage Mekong countries.
- Revise a comprehensive plan of how the USG as a whole could support and strengthen MRC, based on guidance provided by MRC members' Prime Ministers given at the MRC Summit in early April 2014 and senior-level adoption of various mid-term review recommendations. The MRC will develop plans to reorganize its Secretariat and begin a reform process in late 2014.
- Coordinate with ADB, GMS-BF and the UNISDR on the private sector session at the sixth biennial Asia Ministerial Conference on Disaster Risk Reduction in June 2014.

RESULT 6: TECHNICAL AND OUTREACH CAPACITY OF USAID STAFF IN WATER AND SANITATION PROGRAMMING ENHANCED

Requirement 6.2: Increase USAID's Visibility and Outreach on Water Issues

The MENA NWC Founders Committee has asked FABRI to design and convene several major meetings over the next 18 months, including the following:

- Assembly of Governing Members and three Thematic Partnership meetings in Morocco in June 2014
- Two workshops at the International Water Association (IWA) World Water Congress and Exhibition in Portugal in September 2014
- MEN NWC First Congress and two Thematic Partnerships meetings in Oman in February/March 2015
- IWA Development Congress in Jordan in October 2016

FABRI has begun planning for a joint Assembly of Governing Members and first Thematic Partnerships Conference in Marrakech, Morocco on June 22-25, 2014. The Conference will be an opportunity to share progress on the Network's three grants programs and to broaden the scope of the Network's technical activities and involve other scientists not directly participating on research projects.

Planned Activities for Third Quarter of Year Three

- Prepare a concept paper concerning the meetings
- Organize the first partnership meeting scheduled for June 2014
- Prepare for the next event in the series of thematic partnership meetings

3. PROJECT MANAGEMENT

The period of performance for the FABRI task order is September 15, 2011 through September 29, 2015. FABRI has received $19,324,837 in obligated funds ($15,004,837 from the Middle East Bureau and $4,320,000 from the Africa Bureau). This constitutes 96.6 percent of the $20,000,000 contract ceiling. FABRI has spent $6,816,106.22 as of February 28, 2014, which represents approximately 35 percent of the current obligation.

During this period, FABRI issued a subcontract to Stockholm Environmental Institute – US Center for $88,382 for its partnership on the MENA NWC Project, "Participatory Planning for Improving Water Use Efficiency in Water Basins," along with the National Research Institute for Rural Engineering, Water and Forestry (INRGREF) in Tunisia, the National Center for Agricultural Research and Extension (NCARE) in Jordan, and R&D Maroc.

FABRI also issued a subcontract to University of Florida for $116,351 for a PR&D research project entitled, "Conjunctive Use of Treated Wastewater and Conventional Water Resources to Sustain Agricultural Production and Mitigate Environmental Risks for Reuse: Diagnosis and optimization." The research will be conducted in collaboration with Sultan Qaboos University (SQU) in Oman, the University of Jordan (UJ), and the National Research Institute for Rural Engineering, Water and Forestry (INRGREF) in Tunisia.

In January, FABRI issued Blanket Purchase Agreements (BPAs) to two translation companies: Jan D. Gibboney Technical Translators and JR Language Translation Services, Inc. to assist with English-French translations for FABRI's Africa and Middle East Programs. This will be especially useful for the AfYWP Small Grants Program proposals, which may be submitted in French.

Subcontract agreements with both Purdue University and the University of Toledo are presently pending signature. These two institutions will each serve as a U.S. partner for a PR&D Grants Program project. FABRI is also awaiting USAID CO approval for a subcontract with the Middle East Desalination Research Center (MEDRC) and negotiating subcontracts with the Arab Countries Water Utilities Association (ACWUA), University of Nebraska-Lincoln (UNL), and Texas A&M University (TAMU) so that these organizations may serve as U.S. partners for additional PR&D Grants Program projects.

FABRI fully executed the first five grants under the PR&D Grants Program in January, after which it received USAID approval to award an additional 16 PR&D grants. As of March 14, the total number of fully executed PR&D grants was 16. FABRI has requested CO approval for additional PR&D project grants, and at least 8 grants are expected to be signed during the next quarter.

4. ISSUES AND PROPOSED REMEDIES

Issue 1: The Principal Investigator of MENA NWC did not submit updates for this quarterly progress report although it is a grant requirement and they were repeatedly asked.

Remedy: For this issue, the PR&D Grants Manager wrote these sections. FABRI will send this and all future copies of the QPR to all Center directors and Principal Investigators to inform them of their past noncompliance and, in the future, will regularly send reminders to ensure they fulfill this requirement.

Issue 2: Several MENA Centers have asked FABRI to cover their international travel on a research project rather than through their grants.

Remedy: In a few isolated cases, FABRI covered the travel costs for some scientists to attend the start-up meeting for their research project. But FABRI does not have adequate discretionary funds to make this a regular practice. It will inform the Centers that they must arrange and pay for travel themselves. If they cannot, FABRI will reduce the grants accordingly and researchers will not be able to travel to their partners unless they cover the costs themselves.

5. STANDARDS AND DELIVERABLES SUBMITTED

Requirement	Standard or Deliverable	Date of Submission to USAID
1.1	• Acceptance letter from Sultan Qaboos University and other Centers	During first period
1.1	• Workshop to launch implementation of MENA NWC	12/5-8/11
1.4	• List of candidates for Founders Committee prepared	2/21/12
1.4	• CVs compiled for each candidate and shared with nominating committee	2/21/12
2.1	• Plan for strengthening legal and regulatory framework for IWRM in target countries	3/14/12
2.2	• Plan for evaluating and testing methodologies to promote efficient use of water resources	3/14/12
3.1	• Draft plan for strengthening capacity and performance of water and sanitation providers in AFR and MENA target countries	8/15/12
3.2	• Draft plan for improving operating environment for water and sanitation providers in AFR and MENA target countries	In process
3.3	• Draft plan for improving financial sustainability of water and sanitation sector in AFR and MENA target countries submitted within nine (9) months after award	In process
4.1	• Plan for conducting the identification and analysis provided within thirty 30 days after the award	10/14/11
5.1	• Plan for conducting the analysis provided within 30 days after award	10/19/11
5.1	• Assessment of transboundary water cooperation programs	Delayed due to political turmoil
5.4	• Pilot project design for transboundary water activity	Delayed due to political turmoil
Section F.2(b) Deliverables	• 90 day work plan completed within 30 days of Task Order award	10/14/11
	• First annual work plan completed and delivered within 60 days of task order award	11/11/11
	• Performance Monitoring Plan	3/15/12
	• FABRI Year One Annual Progress Report	11/1/12
	• FABRI Year Two Work Plan	11/1/12
	• FABRI Year Two Annual Progress Report	10/24/13
	• FABRI Year Three Work Plan	10/24/13
	• Quarterly Progress Report No. One	1/18/12
	• Quarterly Progress Report No. Two	4/10/12
	• Quarterly Progress Report No. Three	7/15/12
	• Quarterly Progress Report No. Four	10/19/12
	• Quarterly Progress Report No. Five	1/10/13
	• Quarterly Progress Report No. Six	4/8/13
	• Quarterly Progress Report No. Seven	7/10/13
	• Quarterly Progress Report No. Eight	10/17/13
	• Quarterly Progress Report No. Nine	01/11/14

ANNEX A
FABRI SUBMISSSIONS TO THE DEVELOPMENT EXPERIENCE CLEARINGHOUSE (DEC)

Deliverable	Date Submitted
Quarterly Progress Report No. One	12/11/12
Quarterly Progress Report No. Two	12/11/12
Quarterly Progress Report No. Three	12/11/12
Quarterly Progress Report No. Four	12/11/12
Quarterly Progress Report No. Five	3/12/13
Final Event Report - Nairobi Non-Revenue Water Conference	12/11/12
Final Event Report – FABRI/PEER Proposal Writing Workshop	12/11/12

ANNEX B
UPDATED PERFORMANCE INDICATORS

Intermediate Result (IR)	Sub IR	Indicator	ME or AFR	Standard Indicator Number	2014 Target	Final Target	Actual (Cumulative) as of March 14, 2014
1. Regional Science and Technology Capacity in Water Management Increased through Establishment of MENA NWC	1.1 MENA NWC Governance Structure Established	1.1.1 MENA NWC legally registered	ME	NA	yes	yes	Yes
		1.1.2 Number of essential governance structures established and operative (Founders Committee, Steering Committee, Board of Directors, Secretariat)	ME	NA	4	4	3: Founders Committee, Interim Board, Interim Management Unit
	1.2 MENA NWC Financially Sustainable	1.2.1 Business plan developed and approved	ME	NA	yes	yes	Business Plan developed and submitted to Founders Committee
		1.2.2 Financial support pledged from donors, private sector, and other sources	ME	NA	$25M	$25M	$72,083 from Government of Oman
		1.2.3 Number of types of pledged donors (bilateral, multilateral, foundations, corporate, government, individual) demonstrates diversity of funding sources	ME	NA	4	4	2: Government, Foundation
	1.3. MENA NWC Technical Program Addressing Critical Regional Water Issues	1.3.1 Number of technologies or management practices under research as a result of USG assistance	ME	4.5.2-39a	10	10	14: As part of 10 PR&D Research Projects and 3 U.S.-Network Research Partnerships

Intermediate Result (IR)	Sub IR	Indicator	ME or AFR	Standard Indicator Number	2014 Target	Final Target	Actual (Cumulative) as of March 14, 2014
		1.3.2 Number of technologies or management practices under field testing as a result of USG assistance	ME	4.5.2-39b	10	10	3
		1.3.3 Number of technologies or management practices made available for transfer as a result of USG assistance	ME	4.5.2-39c	4	4	0
		1.3.4 Number of government agencies, private sector firms, and/or civil society organizations partnering with Network Centers on research and development projects	ME	NA	20	20	37 engaged in submitted proposals
		1.3.5 Number of young and women researchers engaged in MENA NWC supported research activities	ME	NA	40	40	44 on 10 PR&D Research Projects, 3 U.S.-Network Research Partnerships, and 7 Young Water Scientists Partnership proposals
		1.3.6 Number of private enterprises, producers organizations, water users associations, women's groups, trade and business associations and community-based organizations that applied new technologies or management practices as a result of USG assistance	ME	4.5.2-42	12	12	0
		1.3.7 Number of visits to the MENA NWC website	ME	NA	25,000	25,000	Website development initiated. Expected launch in third quarter of year three.
		1.3.8 Number of fans on the MENA NWC Facebook Page	ME	NA	5,000	5,000	0

Intermediate Result (IR)	Sub IR	Indicator	ME or AFR	Standard Indicator Number	2014 Target	Final Target	Actual (Cumulative) as of March 14, 2014
	1.4 MENA NWC Strengthened through Private Sector Participation	1.4.1 Number of private sector partners participating in MENA NWC	ME	NA	15	15	3
2. Integrated Water Resource Management Programming Strengthened	2.1 IWRM Legal and Regulatory Frameworks Strengthened	2.1.1 Number of government agencies, utilities, and service providers involved in IWRM research activities	ME	NA	8	8	3
	2.2 IWRM Methodologies Implemented	2.2.1 Number of private enterprises, producers organizations, water users associations, women's groups, trade and business associations and community-based organizations (CBOs) that applied new technologies or management practices as a result of USG assistance	ME	4.5.2-42	6	6	0
3. Access to Clean Water and Sanitation Expanded in Target Countries	3.1 Water and Sanitation Service Provider Performance Strengthened	3.1.1 Number of water operator partnerships facilitated	AFR	NA	9	9	In process through NRW program
		3.1.2 Number of private sector sanitation service providers that have improved management practices as a result of USG assistance	AFR	4.6.2-9	9	9	NRW program underway with audit as Stage 1
		3.1.3 Number of service providers implementing water loss programs with USG assistance	AFR	3.1.8.1-2	50	50	26

Intermediate Result (IR)	Sub IR	Indicator	ME or AFR	Standard Indicator Number	2014 Target	Final Target	Actual (Cumulative) as of March 14, 2014
		3.1.4 Number of private sector sanitation interventions started with USG assistance	AFR	NA	15	15	0
		3.1.5 Number of visits to African water associations' newly designed websites	AFR	NA	25,000	25,000	Redesign in process
		3.1.6 Number of fans of the Facebook pages of the African water associations	AFR	NA	5,000	5,000	0
	3.2 Water and Sanitation Service Operating Environment Improved	3.2.1 Number of governments developing national sanitation strategies	AFR	4.6.1-17	15	15	0
	3.3 Water and Sanitation Sector Financial Sustainability Improved	3.3.1 Number of governments developing plans to obtain outside financing for utility investments	AFR	NA	9	9	Stage 3 of NRW program
		3.3.2 Number of innovative solutions or mechanisms for mobilizing financing for non-revenue water and sanitation programs	AFR	NA	5	5	0
4. Research and Development Capacities in Irrigation, Groundwater Management, and Drought Risk Assessment and Mitigation Strengthened	4.1 Best Practices for Efficient, Productive Use of Water in Agriculture Identified.	4.1.1 Number of technologies or management practices under research as a result of USG assistance	ME	4.5.2-39a	10	10	14: As part of 10 PR&D Research Projects and 3 U.S.-Network Research Partnerships
		4.1.2 Number of technologies or management practices under field testing as a result of USG assistance	ME	4.5.2-39b	10	10	3

Intermediate Result (IR)	Sub IR	Indicator	ME or AFR	Standard Indicator Number	2014 Target	Final Target	Actual (Cumulative) as of March 14, 2014
		4.1.3 Number of technologies or management practices made available for transfer as a result of USG assistance	ME	4.5.2-39c	4	4	0
5. Transboundary Water Cooperation Strengthened in Key River Basins	5.1 Analysis of Transboundary Cooperation Identifies Model Programs and Interventions	5.1.1 Number of transboundary water resources sustainability assessments undertaken	ME	4.5.2-41e	2	2	1 by OSU
	5.2 Transboundary Pilot Project Launched	5.2.1 Number of exchanges (government-to-government, non-government-to-non-government; non-government-to-government)	ME	NA	4	4	0
6. Technical and Outreach Capacity of USAID Staff in WASH Programming Enhanced	6.1 WASH Technical and Outreach Capacity of USAID Staff Increased	6.1.1 Number of WASH training events for USAID staff	ME/AFR	NA	3	3	0
		6.1.2 Number of USAID staff trained in WASH	ME/AFR	NA	90	90	0
		6.1.3 Number of WASH guidance materials updated or developed	ME/AFR	NA	6	6	0
	6.2 USAID WASH Visibility and Outreach Increased	6.2.1 Number of conferences and outreach events facilitated or supported	ME/AFR	NA	6	6	2: AfWW 2012 WWW2013

ANNEX C
MENA NWC RESEARCH PROJECT START-UP MEETING SUMMARIES

MENA NWC

Middle East and North Africa Network of Water Centers of Excellence

RESEARCH PROJECT START-UP MEETING

COMBATTING THE IMPACTS OF HARMFUL ALGAL BLOOMS (HABS) ON DESALINATION PLANTS: BLOOM DETECTION, FORECASTING, AND STRATEGIES FOR IMPACT REDUCTION

JANUARY 9-10, 2014

WOODS HOLE OCEANOGRAPHIC INSTITUTION
WOODS HOLE, MASSACHUSETTS

Participants

Adnan Al-Azri, Sultan Qaboos University, Muscat, Oman
Don Anderson, Woods Hole Oceanographic Institution, Woods Hole, MA USA
Andrew Aubrey, JPL / NASA, Pasadena, CA, USA
Changshen Chen, University of Massachusetts, Dartmouth, MA, USA
Rubao Ji, Woods Hole Oceanographic Institution, Woods Hole, MA, USA
Judy Kleindinst, Woods Hole Oceanographic Institution, Woods Hole, MA, USA
Raphael Kudela, University of California at Santa Cruz, Santa Cruz, CA, USA
Ken Ludwa, FABRI, Washington DC, USA
Shannon McCarthy, MEDRC, Muscat, Oman
Kamal Ouda, USAID/ME, Washington, DC
Peter Petrov, ROPME, Kuwait
Rick Stumpf, NOAA, Silver Spring, MD, USA
Marouane Temimi, MASDAR, Abu Dhabi, UAE

Meeting participants L to R: Raphael Kudela (UCSC), Judy Kleindinst (WHOI), Rick Stumpf (NOAA), Rubao Ji (WHOI), Don Anderson (WHOI), Shannon McCarthy (MEDRC), Ken Ludwa (FABRI), Adnan Al-Azri (SQU), Kamal Ouda (USAID), Peter Petrov (ROPME).

Agenda

Thursday, January 9, 2014

8:45 Workshop Logistics / Introductions (Don Anderson and Shannon McCarthy)

9:00 Introduction to the FABRI program (Ken Ludwa)

9:15 General Project Overview and Workshop Objectives (Don Anderson)

9:30 Remote Sensing Capabilities and Plans
- Issues with detection of algal blooms from satellites; UCSC capabilities (R. Kudela)
- Status of HAB forecasting efforts at NOAA (R. Stumpf)
- Projects and capabilities of the Masdar Ocean Color Center (H. Ghedira / M. Temimi)
- Capabilities and mission of ROPME (P. Petrov)
- Capabilities and planned activities in the Gulf region by JPL (A. Aubrey)

12:00 Lunch provided

1:00 Ground-Truthing Programs
- Oman biweekly field sampling (A. Al Azri)
- Masdar field program (H. Ghedira / M. Temimi)

2:00 Numerical Modeling
- FVCOM model and its application for Arabian Gulf region (C. Chen / R. Ji)
- Bloom digitization and transport forecasting (R. Stumpf)

4:00 Planning Session – Numerical Modeling (R. Ji / C. Chen)
- Identify specific project activities and deliverables

5:00 Adjourn – transport back to hotel

Friday, January 10, 2014

8:45 HAB and Desalination Manual
- Suggested chapter titles and potential authors (D. Anderson)

9:45 Planning Session – Remote Sensing Element (R. Kudela / R. Stumpf)
- Identify specific project activities and deliverables

11:00 Ground-Truthing Program Plans and Activities (A. Al Azri / H. Ghedira / M. Temimi)
- Identify specific project activities and deliverables

12:00 Lunch provided

1:00 Format for deliverables and time schedule (K. Ludwa)

1:30 Breakout groups to develop schedules and deliverables:
- Remote sensing

- Numerical modeling
- Ground-truthing program
- Manual

3:00 Plenary discussion and merging of deliverables and time schedules

5:00 Adjourn – transport to hotel / bus station

Background

Many arid countries are increasingly reliant on seawater desalination for drinking water and industrial purposes. An emerging threat to this critical societal need is from harmful algal blooms (HABs). Some HABs produce potent neurotoxins that can persist in treated water, threatening human health. Other HABs restrict operations by clogging intake filters, fouling surfaces, and compromising membranes. The overall goal of this project is to develop capabilities for remote sensing, modeling, and forecasting to provide critical information to desalination plants about the presence and predicted transport pathways of algal blooms that occur in nearby coastal waters, and will provide operators with guidance on how to deal with these events as they occur. Specific objectives include:

- *Using historical data (satellite images and desalination plant operations), optimize algorithms for algal bloom detection and forecasting in the study region.*
- *Refine an existing numerical model of ocean hydrography for the Gulf, Gulf of Oman, and Arabian Sea to include higher near-shore resolution, add a regional meteorological element, and use this model to forecast HAB transport.*
- *Begin real-time acquisition and analysis of satellite images, water column monitoring data, and desalination plant operations for the study sites, and provide forecasts of bloom transport to demonstrate project capabilities.*
- *Prepare a Manual of Practice for HABs and Desalination.*

Opening the Meeting

Co-PI Don Anderson opened the meeting and provided workshop logistics. Individuals introduced themselves and described their research interests and participation in the project. PI Shannon McCarthy provided an overview on MEDRC, which was established in 1997 to promote research and development for desalination in the mid-East and North Africa region. She noted that this kickoff meeting launches the two-year USAID-funded project and that the deliverables of this meeting are a detailed work plan and schedule of milestones and deliverables. Ken Ludwa explained the role of FABRI (Further Advancing the Blue Revolution Initiative) which is funded by USAID. USAID funding is provided to FABRI (USAID project, implemented by DAI); FABRI in turn is funding MEDRC via a sole source subcontract.

Co-PI Don Anderson gave a general project overview and discussed the workshop objectives. He provided a brief background of HABs and their impacts around the world, and then focused on HABs in the UAE and their impacts on desalination plants. There are four program elements – remote sensing of HABs, numerical modeling, combined forecasting effort, and manual preparation.

Remote Sensing Capabilities and Plans

Co-PI Raphe Kudela gave a presentation on detection of algal blooms from satellites and the UCSC capabilities in that regard. One issue not yet clear is which HAB species are the ones that cause problems for desalination plants.

Co-PI Rick Stumpf presented information on the status of HAB forecasting efforts at the National Oceanographic and Atmospheric Administration (NOAA, USA). Lake Erie forecasting efforts and products are likely most comparable with what will be needed in the UAE.

Co-PI Peter Petrov gave a presentation about ROPME's efforts and capabilities in real-time environmental monitoring as part of an early warning monitoring system.

Andrew Aubrey, JPL/NASA, discussed a collaborative project JPL has with KAUST (Burt Jones) on airborne remote sensing. He also provided information on JPL capabilities.

Ground-Truthing Programs

Co-PI Adnan Al Azri gave a presentation on Sultan Qaboos University's HAB monitoring efforts in Oman. His group has been observing both red and green *Noctiluca* blooms and they are not sure if it is one species that changes color, or two separate species.

Marouane Temimi, Masdar Institute, Abu Dhabi provided information on the field program they have for monitoring along the UAE coast.

Numerical Modeling

Co-PI Rubao Ji and colleague Changshen Chen, University of Massachusetts, Dartmouth, described the FVCOM model, its uses, and its application for the Arabian Gulf region and this project.

Co-PI Rick Stumpf gave a presentation on bloom digitization and transport forecasting, using the NOAA project in Lake Erie system for cyanobacteria.

Planning Session – Numerical Modeling

Co-PI Rubao Ji presented information on specific project activities for the numerical modeling component. There was discussion about extending the boundary of the model south of the old boundary to cover much of the coast of Oman. This would include the active upwelling area so is a reasonable plan. It was suggested that MODIS SRTM land mask would help this project component by providing the right resolution.

HABs and Desalination Manual:

Co-PI Don Anderson presented suggested chapter titles and potential authors for the HABs and desalination manual that will be produced through this project. It was suggested that impacts could be included under the background chapter to help people who may not know whether or not they should be concerned. Links to various websites could be provided – these would include sites that have pictures of HAB species, descriptions, etc. Specific information should be included on HABs that have caused problems (e.g., *Cochlodinium*) as well as the top biomass blooms (e.g., *Noctiluca*). An explanation of the difference between high biomass blooms and toxic blooms should be included.

Links to Other Regional Projects

The Masdar Institute will participate in the project on its own funding, extending the geographic reach of the project and providing more comprehensive marine and atmospheric data. Masdar's monitoring

program has 75 stations in the Arabian Gulf. In addition to strengthening the MEDRC project, this also presents an opportunity for knowledge exchange and capacity building between SQU and Masdar (e.g., Masdar's monitoring network has 75 stations compared to SQU's 2).

The JPL/NASA-KAUST airborne remote sensing project will not immediately be tied to the MEDRC project, but Andrew Aubrey and the MEDRC team agreed that there are good possibilities for future collaboration. This could extend the geographic reach of the project to the Red Sea and add new remote sensing elements to the project.

MEDRC Technician

There was discussion about the role and skills needed for a technical specialist to be hired by MEDRC for this project. The person would need to be motivated, have basic computer skills and will be responsible for troubleshooting and working with the remote sensing group on the SOP. A Bachelor's degree in Ecology or Environmental Science is a minimum requirement.

Deliverables

The second day of the meeting was devoted to the Work Plan. Participants broke into small groups to define the work steps and deliverables. These groups included: 1) Modeling; 2) Remote Sensing; 3) Field Surveys; 4) HABs and Desalination Manual. After the small groups, everyone reconvened to complete the Schedule of Milestones and Deliverables (attached) and draft the Work Plan. Co-PIs Don Anderson and Shannon McCarthy will complete the Work Plan and send it as the first deliverable of the Red Tide subcontract.

The team also completed the required Environmental Review. In the first step, using the Environmental Review Form and instructions provided by FABRI, the team determined whether project activities are "high risk," "moderate or unknown risk," or "low risk." If any activities are identified as "high risk" or "moderate or unknown risk," a full Environmental Review Report would be required. However, all activities were classified as "low risk."

Decisions and Next Steps

- Ken Ludwa will incorporate Don Anderson and Shannon McCarthy's changes into the FABRI budget worksheet and send it back to Don and Shannon for final agreement by January 17. Shannon McCarthy will obtain budget approval from the MEDRC Director.

- Don Anderson and Shannon McCarthy will complete the Work Plan and send it as the first deliverable of the subcontract.

- Don Anderson will begin contacting potential authors for the *Manual of Practice*.

- Rubao Ji will commence data collection needed to refine the model and work with Chen to start running the model.

- Judy Kleindinst will send a list of deliverables to all partners and set up reminders for progress reports.

- Raphe Kudela and Peter Petrov will coordinate and commence to download and process remote sensing data. They will also obtain digitized charts of the region.

- Adnan Al-Azri will obtain a bathymetric map of the Barka desalination plant and propose sampling locations on a map and distribute to group for comment.

- Shannon McCarthy will contact the desalination plants in Oman and UAE regarding their participation in the project, draft a press release, issue the MEDRC Technical Specialist job announcement, and begin evaluating candidates.

- The team will schedule a mid-project team meeting in December 2014.

Outstanding Issues and Resolution

1. *Finalizing the Subcontract.* We need to finalize the budget and sign the subcontract. Ken Ludwa will incorporate the changes requested by Don Anderson and Shannon McCarthy in FABRI's latest budget worksheet and send the budget back for final agreement.

2. *Schedule.* The time frame was the only significant project implementation concern raised at the meeting. The team has a realistic schedule for completing the project by July 31, 2015, but the schedule does not have much margin for delays. The team understands that FABRI cannot extend the project unless USAID extends FABRI. FABRI will monitor progress against the schedule and if there is any slippage, proactively work with the PIs to ensure that the project is completed on time.

Ken Ludwa
11 February 2014

MENA NWC

Middle East and North Africa Network of Water Centers of Excellence

RESEARCH PROJECT START-UP MEETING

RADAR PROBING OF GROUNDWATER IN HYPER-ARID ENVIRONMENTS: UNDERSTANDING AQUIFER DYNAMICS IN HIGH DISCHARGE AREAS

JANUARY 28-30, 2014

SULTAN QABOOS UNIVERSITY
MUSCAT, OMAN

Participants

Dr. Ali Al-Maktoumi, Water Resources Center, Sultan Qaboos University, Oman
Eng. Ahmed Salim Al Saidi, Ministry of Regional Municipalities and Water Resources, Oman
Dr. Essam Heggy, California Institute of Technology and Jet Propulsion Laboratory
Eng. Ali Mohsen Jawad, Ministry of Regional Municipalities and Water Resources, Oman
Dean Dr. Anvar Kacimov, College of Agriculture and Marine Sciences, Sultan Qaboos University, Oman
Dr. Kamal Ouda, USAID/Bureau for the Middle East, USA
Dr. Peter Reiss, Further Advancing the Blue Revolution Initiative, USA
Dr. Mohamed Rouchdi, Institute of Agronomy and Veterinary Science Hassan II, Morocco

Agenda

DATE	SESSION	LEADER
January 28	• Welcome and introductions	Ali
	• FABRI Network and USAID updates	Peter / Kamal
	• Project objectives and summary	Essam
	• Criteria for site selection	Essam
	• Logistical needs for surveys	Essam
January 29	• Visit to Royal Oman Police facility	Ali
	• Visit to MRMWR-Oman	Ali
	• Site selection in Morocco	Mohamed
	• Discussion of the data available for site in Oman	Ali
	• Discussion of the data available for site in Morocco	Mohamed
January 30	• Defining dates for fieldwork	
	• Defining capacity building	
	• Work plan: deliverables and timelines	
	• Update on the project team members, e.g. students, and	Essam

	collaborators • Future publication and conferences participation associated with the project	

Background

The research project will use radar-probing technology originally developed by the Jet Propulsion Laboratory (JPL), a division of the California Institute of Technology, to map primordial aquifers on Mars as part of their interplanetary explorations. In 2004 and 2006, JPL contributed to two sounding radars to explore for the first time large-scale aquifers on a planetary surface of Mars. The equipment on Mars Express and Mars Reconnaissance Orbiter are currently probing the Martian subsurface with different penetration capabilities. Both instruments are unique technology demonstrations and do not have any counterparts in the commercial domain. This research project will use that same technology to explore characterize and monitor aquifer dynamics in the deserts of Oman and Morocco. We expect that this research in Oman and Morocco will lead to its expansion across the region in several MENA countries in hyper-arid zones with high ground resistivity.

Major Observations and Decisions

1. Involvement of the Governments of Oman and Morocco

The research teams in Oman and Morocco have already made great strides in incorporating government entities into the project. In Oman, two senior officers of the Ministry of Regional Municipalities and Water Resources (MRMWR) attended every day of the start-up meeting and joined in other meetings with the Royal Oman Police and the Deputy Vice Chancellor of Sultan Qaboos University. They had already worked closely with Ali Al-Maktoumi on the identification of potential sites. In Morocco, Dr. Mahmoud Rouchdi of IAV has been working closely with the staff of the Souss-Mass Basin Management Agency in Agadir on potential sites. These initiatives bring the government into the research activities in meaningful, substantive ways. We discussed the advantages of and need for government officers to be part of visiting teams and emphasized the priority in training them in the technologies over the course of the project.

2. Site Selection Criteria and Review

As Essam stressed, the aquifer should be 20 to 100 meters deep, with a resistive overlaying sediments with minimal clay content and soil moisture, such as alluvial or basaltic materials, in order to get the best possible penetration. In addition to the high ground resistivity, the site ideally should have a low electro-magnetic interference at the 10 to 200 MHz bands. Finally, the probed aquifer should also be a high priority of the government and be free of external or international unrest. Well logs kept by the government should also exist.

- *Oman.* Of the three locations introduced by Ali, Essam repeatedly remarked that Al-Sharqia perfectly matched the research requirements. It has sandy soil to a desirable depth, was situated in a bowl of mountains, and had detailed well logs. The aquifer was a high priority for MRMWR because it has already been identified as one of the Sultanate's strategic groundwater reservoirs and because of the large populations it supplied.

- *Morocco.* Mohamed visited the Souss-Massa basin agency prior to the start-up meeting and introduced six sites, but Essam judged them all to be inappropriate due to very shallow water and

high moisture in the soil. Essam suggests a new site further in the south of Morocco. For this new site, Mohamed said that there might be a lack of data and there might be a need for authorization to explore the site. He agreed to visit the Souss-Massa basin agency in order to find more suitable candidates including in a neighboring basin. Essam agreed to join him at the end of February on the visit.

3. Expand Survey in Morocco or Airborne Survey in Oman?

This difficulty in identifying an appropriate site in Morocco led the team to consider two options: (1) expand the ground surveying to include Morocco or carry out an airborne survey in Oman in the second year of the project. The decision will be based on the reconnaissance visit to Morocco and an assessment of the project's status in February-March 2015. In any case, IAV and the basin management agency will be actively involved in all research efforts, including all training and data analysis as well as flights planning.

4. Airborne Surveying of the Aquifer

The research budget includes only ground surveying using a geoscanner which is pulled behind a slowly moving vehicles or by hand back and forth across the terrain. Airborne surveying, fixing the radar unit to helicopter extensions, would provide far more interesting results with a more substantial coverage, if arrangements can be made. If FABRI had to cover the costs, it would add a considerable cost to the project of roughly $50,000. The team decided to meet with staff of the Royal Oman Police to discuss options and costs. It set aside the morning of the second day to visit the Muscat installation adjacent to the international airport. The Army is another source of helicopters, and Ali Al-Maktoumi said he would approach them to learn more.

5. Visits / Interviews

The meeting participants visited a several key parties during the meeting:

- *Ministry of Regional Municipalities.* Team members visited MRMWR to meet with senior officials and review ground data and publications for the candidate aquifers. The team met with the Deputy Director of the Water Resources Unit and his staff. They offered full support and provided documentation which the team deemed very valuable.

- *Royal Oman Police.* We met with Colonel Ibrahim Al-Mawali in the Directorate of Police Aviation (ab139heli@hotmail.com and telephone office 968-245-10370). He discussed the availability and rental cost of small helicopters. It is possible to use their helicopters which are primarily used to emergency operations at sea and in isolated mountainous areas. In order for us to use the helicopters, the police need to contact the Italian manufacturer to get their approval about installation and radio frequency. Essam noted that the radar operated at the low level 20-50 MHz, which should not pose problems for helicopter operation. The Police have 11 large six-seaters and three smaller helicopters, which are most suitable for the research project. The standard charge is OMR 1,000 per hour for flight time and OMR 250 an hour for waiting time. The aquifer under discussion is roughly one hour's flying time from Muscat. The surveying requires roughly one hour each for four days. The total time is minimally four hours per day for four days, equal to OMR 10,000 or roughly $28,000. MRMWR has agreed to join SQU in requesting that the fee be waived for a research project. If not, FABRI would have to cover the cost.

- *Office of the Prof. Dr. Amer Ali Al Rawas, Deputy Vice Chancellor for Research, Sultan Qaboos University.* The DCV was his typically gracious self in welcoming the research team and expressing his commitment to the Network and the research project. He was delighted with SQU's partnership with Caltech. He also said that he would support the request for a waived fee for helicopter use. He also confirmed SQU's interest in hosting a MENA NWC Thematic Partnership Conference on groundwater, but the university requires a minimum of a year to make arrangements.

6. Additional Participation of QEERI

Essam Heggy has been in regular touch with the Qatar Energy and Environment Research Institute (QEERI). Earlier, he had provided training in the technology and analysis to two QEERI staff, but they have not used it yet in the field. Essam suggested that QEERI be added to the research project at its own cost. They will participate in surveying and analysis and conduct a ground survey. The team welcomed QEERI's participation in the research project. Essam will make the final arrangements with QEERI management to join the research project.

Revised Schedule of Meetings and Events

MONTH	ACTION	LOCATION	PARTICIPANTS	SPECIAL REQUIREMENTS
2014				
February	• Work plan submission		Essam Heggy Ali Al-Maktoumi Osman Abdullah Mohamed Rouchdi	
March (four days)	• Site reconnaissance • Lecture at IAV by E. Heggy	Morocco	Essam Heggy Mohamed Rouchdi Imane Sebari MA Basin Agency	
April (5 days)	• Training in SARSCAPE at SQU • Lecture by E. Heggy at SQU • Site reconnaissance • Meet with The Research Council	Oman	Essam Heggy Ali Al-Maktoumi Osman Abdullah Ali Mohsin Jawad Ahmed Al-Saidi Imane Sebari MA Basin Agency QEERI (2)	Equipment and software in-county
June (2 weeks)	• Ground survey in Qatar • Lecture by E. Heggy at QEERI	Qatar	Essam Heggy QEERI	Ground penetrating radar
August (2 weeks)	• SAR analysis	Caltech	Essam Heggy Imane Sebari	
September (3 weeks)	• Ground survey in Oman • Education and public outreach (EPO) lecture following ground survey	Oman	Essam Heggy Ali Al-Maktoumi Osman Abdullah Ali Mohsin Jawad Ahmed Al-Saidi Mohamed Rouchdi Imane Sebari QEERI (2) Kamal Ouda Peter Reiss	
October	• Abstracts submitted for the AGU annual conference		SQU IAV	250 word abstract for acceptance due

			QEERI Essam Heggy	on time
December (1 month)	• Publication writing and AGU conference attendance	Caltech	Essam Heggy IAV SQU QEERI	Analysis completed and draft manuscripts
• 2015				
February 2015	• Decision to continue more intensively in Oman (airborne survey) or expand surveying in Morocco		Research Team	

Roles and Responsibilities by Research Project Members

RESEARCH INSTITUTE	TASK (T)	END DATE	DELIVERABLE (D)
Sultan Qaboos University	1. Provide existing ground validation data 2. Support site selection 3. Support communication with local authorities in Oman to provide a helicopter 4. Arrange site logistic and authorizations with the ministries 5. Participate in field survey 6. Contribute to data analysis 7. Contribute to publications 8. Convene team meetings and workshops. 9. Contribute to progress reports	T1, T2, T3: April 2014 T4: March 2015 T5: September 2014 T6, T7, T8, T9: July 2015	D1 (T1, T2): Resistivity and hydrological Data of the Al-Sharkia site D2 (T3 & T4): Field access authorizations. D3 (T5 & T6): Sites description text for publication D4 (T6): Text on data hydrogeological interpretation of the inSAR and Sounding radar data
Institute of Agronomy and Veterinary Science Hassan II	1. Process ALOS-PalSAR data for Al-Sharqia site in Oman. 2. Provide geo-referenced SAR and Pol-SAR images of the study area in Oman. 3. Perform inSAR analysis to generate displacement maps from 2007 to 2011 4. Give a lecture at SQU / MRMWR 5. Participate in fieldwork in Oman 6. Host students from QEERI 7. Contribute to progress reports		In addition to the contractual reporting agreement, IAV has to deliver: D1: Georeferenced ALOS SAR data in HH, HV, VH and VV of the Sharkia site D2: inSAR Displacement maps of the aquifer discharge from 2007 to 2011. D3: Text contribution on inSAR data analysis for publications

California Institute of Technology	1. Perform site selection 2. Collect SAR data 3. Collect Sounding radar data 4. Integrate Radar Sounder on the Helicopter 5. Host IAV and SQU Scientists 6. Write scientific publications 7. Perform lectures on the survey results and the methodology 8. Write EPO material 9. Prepare and deliver progress reports		D1: Science Publications D2: Conference Abstracts, papers and presentations. D3: EPO materials D4: Progress reports D5: SAR images D6: Sounding radar data D7: Software and processing servers
Qatar Energy and Environment Research Institute	1. Organize a validation survey in June in Qatar central Aquifer. 2. Host team meeting at the end of the project to explore follow up options. 3. Participate in the airborne survey in Oman.		D1: Scientific contribution to assess radar performance

Outstanding Issues and Resolution

1. *Site selection in Morocco.* Essam and Mohamed will visit the Moroccan South in February/March to review potential locations with the basin management agencies in the areas.

2. *Research program in Morocco.* The team will explore over the coming the costs and benefits of doing a ground survey in Morocco or carrying out an airborne survey in Oman.

3. *Cost of the airborne survey in Oman.* SQU and MRMWR will prepare letters for the Royal Oman Police to waive the fee, and they will pursue using Army helicopters as well.

4. *QEERI participation at no additional cost to the research project budget.* Essam will finalize the arrangements with QEERI as soon as possible.

5. *Increasing the role of MRMWR and basin management agency staff in the research project.* The team would like to have as much active participation as possible, including possible travel them to each other's countries and to the U.S. Caltech will review its budget. Essam believes that it will not be necessary to increase the ceiling to accommodate any changes.

Peter Reiss
10 February 2014

MENA NWC

Middle East and North Africa Network of Water Centers of Excellence

RESEARCH PROJECT START-UP MEETING

EXPANDING ACCESS TO SANITATION FOR UNSEWERED COMMUNITIES IN MOROCCO AND JORDAN

JANUARY 28-30, 2014

MARRAKECH, MOROCCO

Participants

Partner	Name
Royal Scientific Society, Jordan	Muhammad Saidam, Principal Investigator Wael Suleiman, Head of Water Studies Tharwa Quotish, Senior Studies & Consultation Specialist Hamad Bani Hamad, Researcher
University of Jordan, Jordan	Lina Abu Ghunmi, Principal Investigator Nivin Al Alami, Research Assistant
International Institute for Water and Sanitation, National Office for Electricity and Potable Water (ONEE-IEA), Morocco	Samir Bensaid, CEO Mustapha Mahi, Lead Principal Investigation Mustapha Hajji, Researcher Mohammed Assafi, Researcher Souad Ouzzine, Researcher Abdelghani El Hidaoui, Researcher Kkaoula Lamzouri, Researcher EL Houssine Chahid, Researcher
University of Cadi Ayad Marrakech, Morocco	Laila Mandi, Professor Naaila Nouazzani, Professor Abdessamad Hejjaj, PhD Student Lahbib Latrach, PhD Student Jamila Khalifa, Professor
Institute of Agronomy and Veterinary Science Hassan II (IAV), Morocco	Said Ouattar, Director General El Houssine Bartali, Researcher Ouiam Lahlou, Researcher
R&D Maroc, Morocco	Mohamed Smani, Director Aziza Mokhtari, Administration
Government of Morocco	Benbouziane Abdrifa, Department of Environment
USAID	Kyriacos Koupparis, USAID/Bureau for the Middle East, USA
DAI/FABRI	Christel Milazzo, DAI/FABRI, USA Razan Quossous, ECO Consult, Jordan

Agenda

DATE	SESSION	LEADER
January 28	• Visit to Governor of El Haouz province • Visit to pilot site • Welcome and introductions • Project objectives and summary	Mustpha Mahi Mustpha Mahi Samir/Said/Muhammad Mustpha Mahi
January 29	• FABRI Network and USAID updates • Presentations of Participating Partners - IAV - ONEE-IEA - RSS - University of Jordan - University of Cadi Ayad Marrakech - R&D Maroc • Workplan in Jordan • Workplan in Morocco	Kyriacos /Christel /Razan Ouiam Mustapha Hajji Muhammad / Wael Lina Laila Mohamed Tharwa Mustapha Mahi
January 30	• Tour of the Marrakech Wastewater Treatment Plant	Mustapha Hajji

Background

This research project will develop, test and promote affordable, sustainable technologies for decentralized wastewater treatment in pilot sites in Jordan and Morocco. In Morocco, field work will be carried out in the village of Trat Menghane where they will pilot a multi-soil-layering (MSL) wastewater treatment system. University of Cadi Ayad Marrakech has developed a lab-scale version of the treatment system using local Moroccan materials that is now ready for testing at a village level. The pilot site in Morocco will serve five households. In Jordan, RSS will identify a site and select an appropriate rural wastewater treatment system for testing.

From Top Left to Bottom Right: Samir Bensaid (ONEE-IEA) and Muhammed Saidam (RSS) speak to residents of Trat Menghane; residents of Trat Menghane welcome the delegation; site of wastewater treatment pilot; agricultural land of Trat Menghane.

Major Observations and Decisions

1. Involvement of the Government and Community Counterparts

The research team in Morocco has made great strides in incorporated both government entities and community stakeholders into the design of the research project. The Governor Younes Bathaoui of El Haouz province understands the research project and expressed his strong support. When the research team arrived to Tlat Maghran, the men of the village lined up holding Moroccan flags to welcome the delegation. Mohamed Lgharnati of the Association Tlat Maghran gave a tour of the village and then hosted a reception in a community area outside the mosque. A government officer from the Ministry of Environment attended the site visit and participated in the start-up meetings the following day. The Jordanian participants were impressed by the strong stakeholder buy-in to the research project in Morocco and indicated that it was something they intend to build in Jordan once the site is selected.

2. Role of the University of Jordan

As originally conceived, the University of Jordan's role is limited to contributing to an initial desk study of the technical, political, social and environmental factors influencing sanitation management in peri-urban and rural communities. However, while discussing the work plan, it was clear that the University of Jordan has the expertise and personnel to substantively contribute to the water quality testing and analysis at the field site(s).

3. Selecting and Testing Appropriate and Affordable Technologies

The research team agreed that their objective is to select "appropriate" technologies and that a focus on "low-cost" insinuates that it might not fully meet the needs of the selected communities. The research team discussed what they consider an affordable technology. In Jordan, RSS reported that peri-urban and rural households will pay 1,000 JD for cesspools or septic tanks. Ultimately, to be marketable, a rural wastewater treatment plant would need to compete both on price and quality.

4. Water Quality Testing

As originally conceived, the research team proposed testing raw wastewater samples over two months to assess the quality of wastewater. In Morocco since the pilot site is already selected, the research partners intend to extend the time for water quality testing. The Jordanian partners had a lengthy discussion regarding the implementation timetable in Jordan and how the time dedicated to water quality testing could be lengthened.

Outstanding Issues and Resolution

1. *Site selection in Jordan.* RSS and UJ will collaborate on a desk study of the opportunities and challenges facing sanitation management in peri-urban and rural communities. With this as a basis, the RSS will select a site to test their selected technologies.

2. *Construction Management.* The research teams understand that the Fixed Obligation Grant (FOG) funding cannot be used to construct the pilot sites. DAI/FABRI will identify an engineer that will work closely with each country research team to tender and oversee the necessary construction. Christel Milazzo will work with both research teams to finalize the Terms of Reference and select the engineer.

3. *Increasing the role of the University of Jordan.* RSS will review its budget and University of Jordan will submit a summary of how much their grant ceiling would need to be increased to accommodate any changes.

Christel Milazzo
12 February 2014

MENA NWC

Middle East and North Africa Network of Water Centers of Excellence

RESEARCH PROJECT START-UP MEETING

UPGRADING TREATMENT PROCESSES TO IMPROVE EFFLUENT QUALITY FOR IRRIGATION

FEBRUARY 06-07, 2014

THE TECHNION
HAIFA, ISRAEL

Participants

Luna Al-Hadidi, NCARE, Jordan
Mohammed Ali Khasrof Mudabber, NCARE, Jordan
Rafik Karaman, Al Quds University, Palestine
Josef Hagin, Technion, Israel
Uri Shamir, Technion, Israel
Raphael Semiat, Technion, Israel
Carlos Dosoretz, Technion, Israel
Alex Furman, Technion, Israel
Sofy Lerman, Technion, Israel
Tal Fabian, Technion, Israel
Sara Azard, Technion, Israel
Gregory Zalmanov, Technion, Israel
Anat Lowengart, Agricultural Extension Service of Israel, Israel
Ken Ludwa, FABRI, USA
John Wilson, USAID, USA
Mark Peters, USAID, USA

Meeting participants L to R: Josef Hagin (Technion), Mohammed Ali Khasrof Mudabber (NCARE), Alex Furman (Technion), John Wilson (USAID), Uri Shamir (Technion), Ken Ludwa (FABRI), Rafik Karaman (Al Quds University), Anat Lowengart (Agricultural Extension Service of Israel), Raphael Semiat (Technion), Luna Al-Hadidi (NCARE).

Agenda

Date	Times	Content	Presenter	Comments
6-Feb	12:00-13:00	Lunch served at the Rabin Cafeteria		
	13:00-13:30	Registration at the GWRI	GWRI Secretariat	Pick up the work plans submitted for each Task
	13:30-14:00	Opening Statements	Shamir and DAI	Administrative matters will be covered in the opening statements
	14:00-15:00	Task I: Treatment of Secondary Effluents by Membrane Technologies	Karaman, Semiat, Dosoretz	Co-workers may make part of the presentation, as determined by the PIs
	15:00-16:00	Task II: Use of Treated Effluents for Crop Production	Al Hadidi, Shaviv, Furman, Lowengart	Co-workers may make part of the presentation, as determined by the PIs
	16:00-16:30	Task III: Management of the Wastewater Treatment and Reuse System	Shamir	Co-workers may make part of the presentations, as determined by the PI
	16:30-17:00	Coffee break		
	17:00-18:00	General discussion of the work plan	All	In plenary and/or in break-out groups of each task
	20:00	Dinner at the Nof Hotel		
7-Feb	09:00-12:00	General discussion of scientific and practical aspects of the project and the plan after the first 6 months	All	In plenary and/or in break-out groups of each task. We may arrange visits to labs and facilities during this time
	12:00-13:00	Lunch served on site at the GWRI		
	13:00-14:00	Summary and instructions for the coming months and beyond	Shamir	
	15:00	Departure of the Jordanian and Palestinian colleagues		

Background

The scarcity of fresh water in the Middle East and North Africa makes irrigation with treated wastewater effluents an imperative. Earlier Palestinian-Jordanian-Israeli collaborative projects supported by the USAID MERC program showed that irrigation with secondary treated effluent, as practiced presently, has negative long-term effects on soils, crops and the environment. Subsequent research proved that membrane technology treatment of secondary effluents generates water that has the required quality and can be done effectively and efficiently. The objective of the proposed project is to upgrade membrane technology treatment processes and improve irrigation water quality and plant nutrient application, while maintaining cost feasibility.

To achieve the stated objectives the work program combines three inter-related components: (1) testing new membranes and systems for treatment of secondary effluents leading to near zero liquid discharge (nZLD) that increases efficiency and alleviates the problem of brine disposal, then mixing ultrafiltration (UF) and reverse osmosis (RO) permeates in ratios suitable for specified soil, climate, crop and environmental conditions; (2) determining plant nutrient requirements and fertigation when irrigating with effluents of these qualities; and (3) developing a management platform that combines information from the first two components into a decision support framework to inform practitioners and decision makers of the technical and management consequences.

Major Observations and Decisions

In terms of technical activities, the team decided to focus on the first six months of the project. Also significantly, the principal investigators discussed leadership of the project.

1. Lead PI

Uri Shamir announced to the team that he is resigning as Lead PI. Dr. Shamir recommended Luna Al-Hadidi as Lead PI. If Dr. Luna does not accept, Dr. Shamir suggested that another participating researcher at The Technion assume the Lead PI position. Dr. Luna, Dr. Rafik, and the other team members from the Technion lobbied Dr. Shamir to remain as Lead PI. Dr. Shamir will discuss the issue with Technion leadership and the co-PIs and advise FABRI of the decision.

Although the issue of Lead PI was not resolved, all members of the team indicated they are still committed to the project. Dr. Shamir said he would remain technically involved in the project, particularly Task 3 (modeling/decision support system). John Wilson (USAID) and Ken Ludwa (FABRI) voiced support for continuation of the project. The team continued with the planning meeting, with Dr. Shamir leading it.

2. Testing Clay Micelles as Pre-Treatment for Membrane Systems (Al Quds)

Al Quds University (AQU) will test the use of clay micelles as pre-treatment for membrane treatment systems. Membrane technologies are effective in removing phosphorus, but this causes membranes to become fouled more quickly. Use of a pre-treatment step could reduce membrane fouling and allow the system to run longer between cleaning, reducing overall operating costs.

In the first six months, AQU will prepare specifications for micelle-clay filters, pumps, and collection tanks; issue a tender; and install and integrate the clay filters within the existing treatment system. AQU

will modify the water quality monitoring database to include the improved effluent values after installing the micelle-clay filters and breakthrough curves for different quality parameters.

Related to the pre-treatment study, AQU will also evaluate removal of pharmaceuticals at various stages in the treatment train (pre-treatment, UF, RO). In the first six months, AQU will select the pharmaceuticals to be monitored, and determine analytical detection methods.

3. Optimizing Membrane Treatment System Operation (Technion)

Using its existing ultrafiltration (UF) and two-stage reverse osmosis (RO) treatment system established under the previous USAID MERC project, The Technion will test and optimize operating procedures to yield effluent of suitable quality for unrestricted irrigation while reducing operating costs. The operation, maintenance, and yield of the UF-pretreatment are subjected to fluctuating quality of different feedwater characteristics, imparting high sensitivity to the system. Changes in quality of the secondary effluent (organic matter and suspended solids) results decreased UF performance. The quality of the UF-permeate in turn affects the performance and yield ratio of RO.

In the first six months, The Technion will evaluate tuning adjustments to the filtration-backwash cycle depending on the quality of the feed, in order to maintain overall system performance. In parallel to AQU's work with clay micelles, The Technion will also evaluate processes to remove phosphate in the water, using activated carbon adsorption or by designing and implementing a biodegradation system based on a fixed-bed bioreactor coupled to photo-catalytic oxidation.

4. Treatment Plant Operation and Effluent Testing on Crops (NCARE and Technion)

NCARE

Using its existing ultrafiltration (UF) and two-stage reverse osmosis (RO) treatment system established under the previous USAID MERC project, NCARE will conduct field experiments on crops not intended to be eaten raw. Different treated wastewater blends will be used using UF & RO membranes. The suggested effluents will be UF/RO ratios of 50/50, 25/75, as well as 100% RO. Drip irrigation will be used to irrigate the crop and fertilizer will be added with the irrigation water. Monitoring of the treated wastewater, soil and plants will be carried out through the growing season.

Technion

The Technion will use its existing lysimeter system to examine the response of a soil-plant system that was previously irrigated with (secondary) treated wastewater to improvement of the water quality to tertiary (membrane treatment) level, with fresh water as a control. The work plan for the next 6 months is relatively modest and includes continuous measurement of relevant parameters (irrigation, drainage, water content and matric potential, nitrogen and other species, root development, and plant indices). The Technion will also begin development of a model that will synthesize data from the lysimeter experiments to describe the biochemical processes in the soil-plant system.

5. Simulation and Optimization Model (Technion)

The Technion will start on two parallel modeling exercises. The first will be an EXCEL-based model that will depict the technological and economic functions of wastewater treatment and reuse for irrigation. The model will serve as the "systems analysis" platform for further discussions and developments by the research team. The second model will utilize the Water Evaluation and Planning (WEAP) platform, and

will use the same information and data as the EXCEL model to simulate the whole system of a secondary wastewater source, a treatment module that generates effluents at various quality levels including the possibility of blending, an irrigation system that uses the effluents for irrigation, and finally discharge of the concentrate.

Within the first six months, the WEAP model is not designed to produce concrete results, but rather to develop the capacity of using WEAP effectively. Past the first six months, the model will be populated with data from the two main elements of this project (treatment, irrigation). Actual model application to the treatment-irrigation system will take place after the other two tasks have results, in order to calibrate the model. The Extension Services in Jordan and Israel will also be engaged in these consultations. Later in the project, the team will examine the possibility of using the model to optimize the configuration and design of the system.

6. Stakeholder Involvement

There was an extended discussion about stakeholder involvement. What the project is doing now is not currently economically feasible for farmers, so it would not make sense to involve farmers in demonstration at this stage. Current policy allows for treated wastewater irrigation on (1) restricted crops that would not be economically feasible or (2) unrestricted crops (e.g., olives) that need a much longer research timeframe to show results. The results of this project could help to support the loosening of restrictions by demonstrating that membrane systems produce water that can be used safely on all crops.

Outstanding Issues and Resolution

1. *Lead PI.* Uri Shamir will meet with Avi Shaviv (GWRI Director) the week after the start-up meeting to discuss project leadership, consult with co-PIs Luna Al-Hadidi and Rafik Karaman and then advise FABRI of the team's decision on Lead PI. FABRI will work with the team to support the transition.

2. *Schedule.* The team has a realistic schedule for completing the project by July 31, 2015, and understands that all work must be complete by this date. However, the project would benefit from additional time for field experiments. The PIs requested that FABRI inform them if USAID extends FABRI, in turn allowing extension of the project.

3. *NCARE Treatment Plant.* NCARE's existing membrane treatment plant is not operational. Before NCARE can start with its experiments, the Center must repair its plant. The plant requires maintenance of the membrane, installation of a data logger, and repair of broken pipes and parts outside the membrane. NCARE will contact the vendor and make arrangements to repair the system. NCARE indicated that it may reallocate some of its budget to repair the plant. The Technion agreed to provide guidance and support. This is currently not a critical issue, but if not rectified within the first quarter, it could cause a delay. FABRI will ask NCARE to provide progress updates on the repairs and discuss alternatives with NCARE and the Lead PI if it appears that repairs will affect the schedule.

4. *WEAP Model Accessibility and Training.* As originally proposed, only The Technion will acquire the WEAP model and work with it. However, NCARE and AQU also would like to obtain the WEAP model, receive training, and work with the model. The cost of the model is not included in the budgets of NCARE or AQU. FABRI is subcontracting with Stockholm Environmental Institute-US (SEI-US), developer and distributor of WEAP, on another MENA NWC project. FABRI will discuss with SEI-US the possibility of discounted WEAP software and a combined training event.

5. *Environmental Review.* The research team did not complete the required Environmental Review during the kickoff meeting. FABRI will follow up with each PI to identify environmental risks and mitigation procedures associated with each Center's work. The Environmental Review Report must be complete before field activities commence.

Ken Ludwa
11 February 2014

MENA NWC

Middle East and North Africa Network of Water Centers of Excellence

RESEARCH PROJECT START-UP MEETING

THE USE OF GREEN NANOPARTICLES AS A BIOFOULING RESISTANT AGENT IN REVERSE OSMOSIS DESALINATION

FEBRUARY 17-18, 2014

RABAT, MOROCCO

Participants

International Institute for Water and Sanitation, National Office for Electricity and Potable Water (ONEE-IEA), Morocco
Samir Bensaid, General Director of International Institute For Water and sanitation (IEA)
Mohamed EL Mghari Tabib, Director, Water Quality Control Directorate
Abdellah Aouzai, Director, Industrial Pole
Khalid Tahri, Director, Engineering Techniques Directorate
Mustapha Ennouhi, Director, Patrimony Directorate
Mahmoud Hafsi, Head of Technology Watch & Documentary center Division, International Institute for Water and sanitation (IEA)- Co-Principal Investigator
Abderrahim Khadir, Engineer, Specific Treatment Service, Water Quality Control Directorate- Co-Principal Investigator
Mohamed Assafi, Head of Technology Watch Service, International Institute For Water and sanitation (IEA)
Mokhtar Jaait, Head of R&D Division, International Institute for Water and sanitation (IEA) Mustapha Mahi, Head of R&D Sanitation Service, International Institute For Water and sanitation (IEA)
Jihane Belmejdoub, Engineering Techniques Directorate
Belaid Maachi, Engineering Techniques Directorate
M. Amine Lazrak, Engineering Techniques Directorate
Lahcen Hasnaoui, Head of Specific treatment Service, Water Quality Control Directorate

R&D Maroc, Morocco
Mohamed Smani, Director

Ibn Tofail University, Morocco
Pr. Azzedine El Midaoui, Ibn Tofail University Kenitra, President
Pr. Mohamed Taky, Professor, Faculty of Sciences

Jordan University of Science and Technology, Jordan
Muna Abu Dalo, Lead Principal Investigator, Director, Queen Rania Al Abdallah Center for Environmental Sciences & Technology
Hani Abu Qdais, Co-Principal Investigator, Professor of Water & Environmental Engineering

University of Toledo, US
Isabel Escobar, Professor and Interim Assistant Dean of Research Development and Outreach, External Collaborator

Georgia Tech University, US
Tequila Harris, Assistant Professor, External Collaborator

University of Rhode Island, US
Vinka Craver, Assistant Professor, External Collaborator (on skype)

Other
Razan Quossous, ECO Consult / Further Advancing the Blue Revolution Initiative, Jordan

Agenda

DATE	SESSION	LEADER
February 17	• Welcome and introductions • Presentation of each institution • Overview of FABRI Network • Overview of project objectives and summary • Discussion of the project work-plan, milestones, timing and roles • Project management and communications • Discuss future meetings	Samir BENSAID Mahmoud Hafsi Muna Abu Dalo Razan Quossous Isabel Escobar Tequila Harris Vinka Oyanedel (via skype) Hani Abu Qdais
February 18	• Presentation of Participating Partners - The University of Toledo - Georgia Tech - JUST and Queen Rania Al Abdallah Center for Environmental Sciences and Technology - ONEE • Field Visit to ONEEP Treatment plant, the Central Laboratory and IEA	 Isabel Escobar Tequila Harris Hani Abu Qdais Mahmoud Hafsi Lahcen Hasnaoui Abderrahim Khadir

Background

This project will develop biofouling resistant nanoparticle (BRN) membranes that will lead to improved water desalination efficiency and reliability under various physicochemical and biological characteristics of brackish and sea water. This will be achieved through the development and characterization, fabrication, and evaluation of biofouling resistant membranes that could be used for desalination applications. The membranes will be tested on brackish water at JUST in Jordan, and on sea water at ONEE in Morocco. The project comprises of the following:

- The characterization of the water quality parameters and biofilm formation potential to be performed at JUST, ONEE, and URI.
- Development and characterization of the nanoparticles and membranes, that will be performed at URI and JUST, and UT and JUST, respectively
- Scalable fabrication of BRN membranes and analysis to be performed at Georgia Tech.
- Membrane implementation, testing and evaluation to be performed at JUST and ONEE (University of Kenitra).

Major Observations and Decisions

1. Environmental Review

It was agreed that the initial environmental screen of the project determined that the project may pose a "moderate or unknown" risk due to the possible release of/exposure to toxic laboratory reagents or silver nanoparticles. Since the researchers will use such small quantities of these chemicals, there isn't a big risk to the environment. Rather, the concern is about human exposure. Because of this, the research team will need to collaborate on both the Environmental Review Form and the Environmental Review Report which have to be submitted with the second deliverable for the project- the work plan.

2. Shipping and Handling of Nanoparticles

Some concerns were raised with regard to the shipping of nanoparticles to Jordan and Morocco. The research team mentioned that the material is non hazardous and that it can be shipped to both countries as lab research material. Forms will have to be filled saying that it is not hazardous material. A debate on whether the nanoparticles can be manufactured in Jordan was also raised through the student that will be coming to JUST from University of Rhode Island and it was questioned whether JUST have the necessary equipment to do that. A list with the needed equipment will be sent to JUST and ONEE.

3. Budget

A question on modifying the budget came up to allow for shipping the water to UT for the purpose of testing the prepared membranes on specific water quality from Morocco because this was not allowed for in the budget.

4. Training on Immobilization of the Nanoparticles on Polybenzimidazole (PBI) Polymer to Cast Membranes at University of Toledo

The team raised a concern about the tight timeline for the project and that the characterization of the membranes takes time because the membranes resistance has to be tested for different water quality parameters at UT. However, it was mentioned that the time will be manageable because UT is already working on the R&D of the membranes, testing of the membranes, and the nanoparticles to be used. The research team agreed that it could be doable within the allowed time frame. The other suggestion was to include the testing part in June. It was suggested to split the training between Universities of Toledo and Rhode Island. It was proposed that Dr. Muna does her training visit to University of Toledo in May for 10-14 days to see the equipment and membranes preparation before the team from University of Rhode Island arrives to JUST so that Dr. Muna is present in Jordan and can meet the team at JUST. The possibility of testing the membrane in Jordan was discussed for easier access to the water and to avoid shipping the water from Jordan to the US. The team will need to agree on the best way to test the membrane on the water from Morocco.

5. Work Plan, Management and Communication

It was agreed that the work plan will be broken down into sub-activities to reflect the exact dates for activities, milestones, and deliverables. Future team management and communications were discussed along with the purpose, audience, branding, vehicles and frequency in addition to best ways for managing information and documents. It was agreed among the team that the drop box will be used. The final dates of deliverables and milestones for the project will be set in the final work plan that will be submitted as a second deliverable for the project including the dates for the Final Workshop and Final report.

6. Second Team Meeting in Amman

It was agreed that the second meeting for the team in Amman is scheduled between 18 and 19 June 2014 before the three US *Universities (Rhode Island, Toledo and Georgia Tech)* visit JUST which will take place between 16th-26th of June 2014 for three days. The final date will be set in the work plan. Students from University of Rhode Island will be at JUST from 15 June to 21 July 2014.

7. Manufacturing of the Membranes

It was agreed that the meeting for membrane preparation will take place on June 18 at JUST. Also, the meeting at Georgia Tech to learn about fabrication will be decided upon in March 2015. Fabrication at Georgia Tech will start end of Sep and will be ready in October. ONEE may also visit Georgia Tech to see the labs. Between Oct first and Dec, the membrane fabrication will be taking place at Georgia Tech labs. After the testing at JUST and ONEE, Georgia Tech will do the fabrication and will need to know the size and the type. The size and the thickness of the membranes to be evaluated will be known by the pilot system testing specifications. Georgia Tech will send the team complete information on what they need for testing as early as possible. Georgia Tech can provide info on the manufacturing side before Jan 2015 so that ONEE and JUST get more time to accelerate the testing.

8. Testing Equipment

FABRI will purchase on behalf of JUST the testing equipment through an in-kind grant to accelerate the process and avoid any delays related to local assembly of the apparatus since JUST do not have the capacity to cover this requirement. Equipment has to arrive to JUST before June 2014. As for ONEE, the research team proposed that they assemble the system in Morocco and they are considering to go through the same procedure as JUST.

9. Testing Conditions

It was agreed that the operating conditions at JUST and ONEE cannot be the same because of the differences in water quality that will be tested, where JUST will test brackish water and ONEE will test sea water. However, it was agreed that the team will need to establish and follow standard operating procedures related to the type of testing and parameters that will be analyzed as well as the biofouling potential and make sure that quality control is maintained in both systems. Flux, TDS, and conductivity measurements could be used for the evaluation of the membranes performances. In terms of paper work and consolidating information, the testing standards and data will be the same. JUST will send information to the team on the testing requirements to standardize the process as much as possible. The team also discussed that agreement needs to be reached on what will be the benchmark for the testing of the membrane and chose a membrane that is commonly used to be able to compare the

performance of the new one with the regular membrane. Membrane testing has to be completed by May 2015. ONEE can host students from UT and Georgia University to see the testing at ONEE and Kenitra University, it will be when ONEE starts testing in December 2014-Jan 2015.

10. Engagement of External Stakeholders and Dissemination

ONEE will work with the Moroccan Membrane and Desalination Society for dissemination of results at the end of the project. Private sector companies will be also engaged and invited to attend the meetings and workshops for the project. ONEE team will present the project in April this year during a conference in Morocco to receive feedback from businesses and governments focusing on Africa region. In Jordan, JUST will be engaging Miyahuna company in all project activities in Jordan.

Razan Quossous
25 February 2014

MENA NWC

Middle East and North Africa Network of Water Centers of Excellence

RESEARCH PROJECT START-UP MEETING

APPLICATION OF NEAR-REAL TIME MONITORING SYSTEMS FOR IRRIGATED AGRICULTURE IN MENA

MARCH 3-5, 2014

NATIONAL CENTER FOR AGRICULTURAL RESEARCH AND EXTENSION AMMAN, JORDAN

Participants

Luna Al-Hadidi, NCARE, Jordan
Samia Akroush, NCARE, Jordan
Mohamed Modabber, NCARE, Jordan
Nabeel BaniHani, NCARE, Jordan
Yaseen Al-Mulla, SQU, Oman
Ian McCann, ICBA, UAE
Makram Belhaj Fraj, ICBA, UAE
Samir Yacoubi, INRGREF, Tunisia
Fethi Bouksila, INRGREF, Tunisia
Ahmed Al Wadaey, Sana'a University, Yemen
Ken Ludwa, FABRI, USA
Kyriacos Koupparis, USAID, USA
Ghazi Abu Rumman, ICT International, Jordan
Peter Cull, ICT International, Australia

Meeting participants in the "Near-Real Time Monitoring Systems" start-up meeting at the National Center for Agricultural Research and Extension (NCARE), Amman, Jordan, March 3-5, 2014. The meeting included representatives of NCARE, ICBA, SQU, Sana'a University, INRGREF, ICT, FABRI, and USAID.

Agenda

Monday March 3, 2014

08:30	Registration of participants
09:00-09:10	Welcome address by DG NCARE
09:10-09:20	Welcome address by Peter Reiss/Ken Ludwa USAID-MENA NWC
09:20-09:30	Welcome address, objectives of the meeting and project work plan by Ian McCann and Makram Belhaj Fraj, Coordinators, ICBA
09:30-10:00	Group Photo and Coffee break
10:00-10:30	Milestones and deliverables and grant procedures by Ken Ludwa
10:30-11:00	Private sector role in the project by Ghazi Abu Rumman & Peter Cull (ICT International)
11:00-11:30	Presentation of the partners centers (5 min team presentation for each center) - JORDAN (NCARE) - OMAN (SQU) - TUNISIA (INRGREF) - YEMEN (WEC) - UAE (ICBA)
11:30-11:45	Research approach and design of work packages by Makram Belhaj Fraj
11:45-12:00	Description/allocation of equipment, discussion of its use in the project by Ian McCann and Ghazi Abu Rumman
12:00-12:15	Website establishment (design, functions) by Ian McCann
12:15-12:30	Coffee break
12:30-13:45	Session I Individual Country Presentations on Project's Work Plan (Along with the contents of the guidelines provided earlier: sites, crops, reporting responsibilities, allocation of people to various tasks, stakeholders, budget) Chairman: Ken Ludwa? Rapporteurs: Ian McCann and Makram Belhaj Fraj 75 minutes for presentation (15 min presentation and discussion for each center) - JORDAN (NCARE) - OMAN (SQU) - TUNISIA (INRGREF) - YEMEN (WEC) - UAE (ICBA)
13:45-14:30	Lunch
14:30-14:45	Welcome address by Director of Water Allocation in Jordan Valley and presentation of the Policy maker's role in the project
14:45-15:00	General discussion and Formation of Technical Committee
15:00-15:30	Feedback and recommendations for the preparations of the work plans
15:30-16:00	Grants finance/administration presentation by Ken Ludwa
16:00-17:00	Review and update of country's work plans and recommendations for the project implementation

Tuesday March 4, 2014

08:30-13:30	Demonstration of instruments

13:30-14:30	Lunch
14:30-15:45	Session II Individual Country Presentations on Project's Work Plan Modified (according to recommendations) Chairman: Ken Ludwa Rapporteurs: Ian McCann and Makram Belhaj Fraj 75 minutes for presentation (15 min presentation and discussion for each center) - JORDAN (NCARE) - OMAN (SQU) - TUNISIA (INRGREF) - YEMEN (WEC) - UAE (ICBA)
15:45-16:00	Synthesis by Ian McCann, Makram Belhaj Fraj and Ken Ludwa and approval of work plans
16:00-16:15	Coffee break
16:15-17:00	Recommendation on project implementation, plan for data sharing and dissemination, and capacity building

Wednesday March 5, 2014

08:30-10:00	Presentation of the knowledge management plan and the plan of data sharing
10:00-10:15	Group photo and Coffee break
10:45-11:15	Management plan presentation
11:15-11:45	The plan of the next meeting
11:45-12:15	Reporting and milestones
12:15-12:30	Feedback from the private sector
12:30-13:30	Closing remarks and recommendations
13:30-14:30	Lunch
14:30-15:45	Meeting officials of Jordan Valley Water Authority (USAID, ICBA and Jordanian partner center)
15:45-16:30	Synthesis of ICBA and USAID: Ian McCann, Makram Belhaj Fraj and Ken Ludwa (reporting, follow up and backstopping, financial work and documents)

Background

Monitoring crops and their environments is a powerful tool to improve on-farm irrigation management. Electronic sensors that measure soil water content, salinity, leaf water potential and sap flow (transpiration) can assess water status and flow through the entire continuum of soil, plant and atmosphere. When combined with data loggers and remote communication via cellular networks, they add a new dimension to irrigation management by enabling near-continuous and near-real-time remote monitoring that can substantially improve irrigation water use.

The technology will be implemented and evaluated in five countries in a variety of environments, production systems and scales, in cooperation with the private sector and national research and outreach systems. Besides direct use, it will support other technologies, including computer modeling and weather based irrigation scheduling.

The targets are better irrigation management, quantitative data supporting enabling policies, and capacity building. Importantly, an innovative knowledge and data sharing platform will allow collaboration and the sharing of science, technology and experience among investigators and stakeholders. Scientists, technical staff, students, and innovative farmers, with the active involvement of young people, women, and the private sector, will constitute an enduring community of practice that enhances competitiveness and fosters entrepreneurship.

Major Observations and Decisions

1. Workplans

This team started with a very well-developed statement of work in their proposal, which will be the foundation of the project workplan. Each Center presented its own workplan and received feedback from the other project partners. Most of the Centers indicated a need to adjust their field experiments from the schedule presented in the proposal, to account for a later than expected start date. The Centers did not finalize their workplans at the meeting. They will return home, make changes, and send the final versions to ICBA for compilation.

2. Coordination of Center Activities

As indicated in the proposal, ICBA, NCARE, Sana'a University, and SQU are scoped to establish and validate the technology platform in their own research facilities (WP 1 and WP 2) and also to perform participatory research and technology transfer with pilot farmers (WP 3). These four partners are working with the soil sensors, weather monitoring, and plant sensors. Plant moisture sensors are the major advancement to be tested in this project.

INRGREF is scoped only for WP3, and only to work with soil sensors and weather monitoring. It is worth noting that INRGREF has a similar budget to the other Centers,

The difference in scoped activities is illustrated in the graphic below.

Participatory Research + Tech Transfer to Pilot Farmers (WP 3) →	**ICBA NCARE Sana'a Univ. SQU**	**ICBA NCARE Sana'a Univ. SQU**
Testing + Validation at Research Facilities (WP 1 +2) →	**ICBA NCARE Sana'a Univ. SQU INRGREF**	**ICBA NCARE Sana'a Univ. SQU**
	↑ Soil + Weather Monitoring	**↑ Plant Monitoring**

The other partners, particularly the Lead PIs, asked the INRGREF PIs if they could include on-farm testing. The INRGREF PIs responded that they could not do on farm trials without first testing and validating the equipment, and there would not be enough time to validate the equipment at their own

research facilities and then do on-farm trials. INRGREF did add that it would invite farmers to observe their field research.

This was a repeated point of discussion over the three days of the meeting. The other PIs are concerned that INRGREF is not meaningfully contributing to the project.

3. Equipment and Data Demonstration

Ghazi Abu Rumman and Peter Cull, with ICT International attended the entire meeting. On Day 2, Dr. Ghazi presented an installment demonstration for the stem psychrometer and sap flow meter, the two instruments that will be used to monitor plant moisture.

Dr. Ghazi Abu Rumman demonstrating the installment of a stem psychrometer, which measures stem water potential, an index of the energy expended by the plant to access water. This indicates the stress the plant is under.

A sap flow meter, installed on an olive tree. With three small probes inserted into the tree, the meter measures moisture flow in both directions, a direct measurement of water use.

4. Procurement

It is critical that all Centers obtain the same equipment. For data comparability, the same technology platform must be used in each location. A website will post real-time results from each Center. During the proposal process, ICBA issued a solicitation for the necessary soil and plant sensors and weather stations. ICT International was the low bidder. However, this bid was supplied to ICBA for the package as a whole. Now each Center must procure its portion of the equipment separately, following its own procurement rules. Although there was initially some concern that some Centers' procurement policies could lead to purchase of different equipment, each PI eventually concluded that they could develop specifications that would allow them to purchase the same equipment packages.

5. Student Involvement

The proposal states that each Center will involve students, and the milestone schedule includes student dissertations/theses as a deliverable. NCARE's budget includes labor budget for four students for six months each. However, Luna Al-Hadidi, NCARE's PI, stated that NCARE may not be able to hire students. NCARE does not have the hiring mechanism for part-time, temporary student employees, and the director would prefer to assign the work to regular employees. Dr. Luna asked if FABRI would require student involvement, or if the work could be done with regular employees. Based on the proposal, FABRI representative Ken Ludwa advised Dr. Luna that students should be involved. Ken and Luna discussed possible alternatives, such as removing the student labor from NCARE's budget and making a small separate grant to the University of Jordan. FABRI will need to follow up with Dr. Luna regarding this issue.

6. Cooperation with Jordan Valley Authority

On the final day of the meeting, Luna Al-Hadidi (NCARE), Ian McCann (ICBA), Makram Belhaj Fraj (ICBA), Ghazi Abu Rumman (ICT), and Ken Ludwa (FABRI) met with Saad Abu Hammour, Secretary General of the Jordan Valley Authority (JVA). Dr. Luna briefed the Secretary General on the research project, and requested support for working with Water User Associations (WUAs) to test and demonstrate the soil, weather, and plant moisture monitoring systems. The Secretary General agreed to support and promote the project with WUAs. However, the Secretary General said that activities in the Jordan Valley should be arranged by the JVA, not NCARE.

Outstanding Issues and Resolution

1. *INRGREF Participation*. INRGREF indicates that they will adhere to the letter of the proposal, and not perform participatory research with farmers. FABRI will still encourage INRGREF to cooperate in accord with the overall spirit of the project, but it would do more damage than good to force INRGREF to do anything. INRGREF will be credited only to the extent that it contributes – for example in publications or websites. FABRI will not censure the rest of the team if INRGREF does not contribute to a particular milestone.

2. *Equipment Procurement at NCARE.* NCARE has a cumbersome and slow procurement process that could delay its participation on the project. FABRI will consult with ACWUA to see if ACWUA can procure the equipment. If so, FABRI would transfer NCARE's equipment funds to provide the equipment as an in-kind grant, with ACWUA as a purchasing agent.

3. *Student Involvement at NCARE.* FABRI will consult with NCARE and University of Jordan to determine the best way to facilitate and pay for student involvement.

4. *Sana'a University Grant Agreement.* FABRI will complete the grant agreement with Hydro Yemen on behalf of Sana'a University.

5. *Environmental Review.* The Research Team did not complete the Environmental Screening form. However, they indicated that they may use fertilizers, pesticides, and herbicides in their field experiments, which makes the project a "moderate risk" classification, and requires a full Environmental Review Report. FABRI will follow up with the team to collect the necessary information to complete the Environmental Review Report. This will include a description of field research facilities and an estimate of types and quantities of agrochemicals used.

Ken Ludwa
11 March 2014