SUPPORT SUSTAINABLE WATER MANAGEMENT AND IRRIGATION MODERNIZATION FOR NEWLY RECLAIMED AREAS

May 2020

SDGs:

Countries: Egypt
Project Codes: TCP/EGY/3604
FAO Contribution: USD 400 000
Duration: 1 February 2018 – 31 December 2019
Contact Info: FAO Representation in Egypt
FAO-EGY@fao.org
Implementing Partners

Ministry of Water Resources and Irrigation (MWRI), Irrigation Improvement Sector, Groundwater Sector; Ministry of Agriculture and Land Reclamation (MALR), Agriculture Research Center.

Beneficiaries

MWRI (Irrigation Improvement Sector, Groundwater Sector) and MALR (Agriculture Research Centre). Indirect beneficiaries include farmer organizations and water user associations.

Country Programming Framework (CPF) Outputs

CPF 2. Priority Area B: Improving productivity and efficiency in the agricultural sector: 2.2. Irrigation modernization.

BACKGROUND

A key challenge for the agriculture sector in Egypt is to feed its growing population in the context of increasing demand on the finite water resources and a trade deficit. Horizontal expansion into new land in the desert has long been strategic in meeting this challenge. Major land reclamation activities have been initiated under the National Reclamation Project, with the objective of increasing agricultural land area by two percent, making agricultural land nine percent of the total area of Egypt. These activities aim to sustainably use the groundwater resources of the Nubian Sandstone Aquifer and other GW systems in different parts of Egypt to irrigate an area of up to 1.5 million feddan (630 000 ha). To this end, the Government of Egypt requested FAO support to the land reclamation programme. Within the Regional Initiative on Water Scarcity, FAO would pilot a data and information management system, based on monitoring and remote sensing (RS) data to assist MWRI and MALR to monitor water consumption and water productivity in the newly reclaimed areas.

IMPACT

The project not only contributed to increasing water use efficiency but also added value to that water by taking into account water productivity. MWRI and MALR now have a full package of technical information to manage newly reclaimed areas. The lessons learned under the project will benefit all GW-irrigated areas and should be expanded to other areas in the country. In this context, a practical network of future leaders in those institutions involved in the GW sector has been established.

ACHIEVEMENT OF RESULTS

The project successfully achieved its aims. It set up and tested an automated water consumption monitoring and water accounting system at two selected pilot areas (Siwa Oasis and Farafra Oasis) in the newly reclaimed areas, for use by MWRI and MALR, the ministries responsible for monitoring water consumption for agricultural purposes. A drip and subsurface irrigation system was installed in both pilot oases. The project developed a land development monitoring tool based on RS and Geographic Information System (GIS) for use by MALR, as well as standard processes and methodologies for field data collection and analysis. Training was given in the use of these to ministry staff. It provided agricultural extension services through farmer field schools (FFSs) for more than 50 farmers, organized farmer-to-farmer visits and other means of technology transfer, including study tours to Australia and Italy. All the tools developed were successfully applied at pilot level and can be expanded to other areas at national level.
SUSTAINABILITY

1. Capacity development

Egypt is aware of the need to transform agriculture to reduce its water requirements. The project contributed to knowledge in support of government efforts and related policies, and established a collaborative technique in two different remote areas. The impact will be sustained by a follow-up programme in coordination with MWRI and MALR. Both ministries are already involved in the country strategy for reclaiming four million feddan, ensuring that the project is sustainable. Sustainability on the ground will also be ensured by the inclusion in project activities of young professionals.

2. Gender equality

Although gender equality was not highlighted in the Project Document, the project was implemented with a gender balance in all activities, including data collection and travel to remote areas. Women represented one third of trainees and of the MWRI team, and 25 percent of the team from MALR. Activities under the Letter of Agreement (LoA) with Heliopolis University for Sustainable Development (HU) were led by a woman, while the team from the Regional Centre for Training and Water Studies (RTCWS) comprised two women and three men. Of the four project consultants, one (GW) was female.

3. Environmental sustainability

A significant effort was made to address environmental issues, including the future of the finite quantity of GW and salinity mitigation, as well as economic sustainability.

4. Human Rights-based Approach (HRBA) – in particular Right to Food and Decent Work

Although this topic was not specifically addressed in the Project Document, the unfinalized survey conducted on farmer practices with water may reveal some issues related to labour conditions.

5. Technological sustainability

Taking into account local capacity, resources and knowledge, the project introduced various technological approaches and tools that are very important, such as drip and subsurface irrigation, as well as free RS and GIS tools.

IMPLEMENTATION OF WORK PLAN

Project implementation was delayed by a long procurement process. Despite this, the project achieved its outputs within the scheduled timeframe and budget. Some support, above all to study tours, was provided by project GCP/RNE/009/SWE.

Envisaged risks included the unavailability of existing GW models, the inadequate sharing of data by governmental institutions, organizational insufficiencies, the delayed installation of measuring and data transfer equipment, difficulties with technical systems and data transmission, and illegal attempts to bypass the regulated water supply. These risks did not materialize or were successfully mitigated by the project. A further risk was the location of the selected site (about 900 km from Cairo), the management of which required considerable effort in terms of planning, preparation and travel.

FOLLOW-UP FOR GOVERNMENT ATTENTION

It is recommended that detailed analyses of the water accounting and monitoring systems developed in the two pilot sites be published. Long-term data collection of water consumption should also be conducted. The progress of the irrigation systems installed in the pilot sites should be followed up and the results of the training activities disseminated as a tool for land expansion programmes at country level.
6. Economic sustainability

The project was complemented by project GCP/RNE/009/SWE funded by the Swedish International Development Cooperation Agency. Technical tools from the FAO Water Productivity Open-access portal (WaPOR) were used for crop mapping in Siwa. All the products and services provided by the project are free and applicable. This was planned from the beginning of the project to ensure sustainability.

DOCUMENTS AND OUTREACH PRODUCTS

- FAO. 2019. Progress and final report. Agriculture in newly reclaimed areas. LoA with Horticultural Research Institute (HRI), MALR.
- FAO. 2019. Progress and final report. Irrigation in newly reclaimed areas. LoA with MWRI.
- FAO. 2019. Progress and final report. Capacity Building for newly reclaimed areas. LoA with HU.
- FAO. 2019. Progress and final report. Design, operation and maintenance of modern irrigation systems. LoA with RTCWS.
## ACHIEVEMENT OF RESULTS - LOGICAL FRAMEWORK

<table>
<thead>
<tr>
<th>Expected Impact</th>
<th>Sustainable and long-term oriented use of available water resources</th>
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</thead>
<tbody>
<tr>
<td>Control of water resources</td>
<td>1. Information management system with databases, spatial analysis tools and web portal established and operational.</td>
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<tr>
<td>2. Training curriculum for FFSs developed, with farmers receiving agricultural extension services through FFS training in pilot areas.</td>
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</table>

### Outcome

**Baseline**

1. 0
2. 0

**End Target**

1. 1
2. 20

**Comments and follow-up action to be taken**

Databases and spatial analysis tools were established, to be used for the following: crop mapping, GW management, sustainable and efficient agriculture. A training curriculum for FFSs was developed. This highlighted water management knowledge and increased knowledge and understanding of participants on integrated water management. A practical network of future leaders in the GW sector across participants’ institutions (formally and informally) to build greater transboundary benefit-sharing and cooperation was established during training and study tours. Participants’ awareness of the benefits of collaboration across institutions was raised. This effort will be continued within target ministries as a result of the technical skills obtained.

### Output 1

**Water accounting and monitoring system for water consumption**

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Target</th>
<th>Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>National assessments of water accounting baseline.</td>
<td>Implementation in selected pilot area (Siwa Oasis as a case study) and in Farafra Oasis.</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Baseline**

0

**Comments**

This output was fully implemented and reported through the LoA with MWRI. Water wells and springs are the only water supply available in Siwa Oasis, with the majority tapping the shallow carbonate aquifer at depths of between less than 10 and 120 m and few deep wells (±1 000 m). These wells pump 236.6 million m$^3$ per year to meet water demand for agriculture and municipal uses. The monitoring system for water consumption depends on weather data to calculate crop water requirements as indicated by Modified Penman-Monteith equation. Crop mapping using WaPOR for the whole of Siwa Oasis was collected with acceptable accuracy (90%). Follow up publication with detailed analysis is recommended.

<table>
<thead>
<tr>
<th>Activity 1.1</th>
<th>Conduct situational analysis and gap/opportunity analysis</th>
<th>Achieved</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achieved</td>
<td>Yes</td>
<td>A GW situational analysis and gap/opportunity analysis was conducted and made available by MWRI. An assessment of current/future crop yield in the pilot areas was undertaken to understand impact of changed water application on plant productivity. The assessment is detailed in a report of HRI/MALR.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity 1.2</th>
<th>Develop water consumption monitoring and data transmission system and water accounting system</th>
<th>Achieved</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achieved</td>
<td>Yes</td>
<td>At pilot level, a water consumption monitoring system was installed and data were collected. Monitoring depends on flowmeters and climatological data for calculation of theoretical crop water requirements. Date palm and olive trees are the main crops. Data were collected and analysed for the applied irrigation systems (drip and surface irrigation). Long-term follow-up data collection is recommended.</td>
<td></td>
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</tbody>
</table>
## Output 2

**Water productivity maximization methodologies and database developed, tested and made operational to stakeholders**

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Target</th>
<th>Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment of water productivity in newly reclaimed areas. Siwa Oasis was selected as an example of a newly reclaimed area.</td>
<td>Google Earth Engine selected as a free tool and platform for development. Crop mapping with high accuracy conducted by official staff of MWRI and MALR. Weather station with one-hour time series installed to calculate crop water requirements using recommended software. Field verification implanted at the site.</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### Baseline

| 0 |

### Comments

In line with the achieved results and opportunity analysis, a drip and subsurface irrigation system was installed in Siwa and Farafra Oases. Farmers intended to plant date palm, olive and intensive agriculture olive. Follow-up of their progress and achievements in the modernized pilots, as well as of progress of the wider implementation of a modern irrigation system in the pilot areas, is recommended.

### Activity 2.1

**Develop the methodology and GIS system for RS-based monitoring of land development, ground verification**

<table>
<thead>
<tr>
<th>Achieved</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>A methodology was developed to use cloud computing and big data for vegetation monitoring. Google Earth Engine was selected as a platform to develop tools to access RS images (Sentinel 2), enabling visualization, processing and interpretation of RS data through the GIS consultant. This made it possible to process enormous amounts of satellite data in high spatial resolution and work with satellite data in time series for the first time. The tool includes the following functions: 1. Uploading an area of interest (as a shapefile) for monitoring development. 2. Setting the start/end date of a period of interest 3. Creating a true colour composite for the time period for the area of interest. 4. Creating a Normalized Difference Vegetation Index (NDVI-Max) composite for the time period for the area of interest to map the vegetation extent during this time period. 5. Clicking at a point of Interest to plot the change in NDVI during the period of Interest. 6. Downloading a true colour composite image, generated using satellite images captured during the period of interest, for the area of interest. 7. Downloading a NDVI-max Image, based on (NIR-RED) bands of satellite images captured during the period of interest, for the area of interest. 8. The data are diverted to Google Drive and can then be locally downloaded to the user PC. 9. Upscaling for implementation at a wider scale.</td>
</tr>
</tbody>
</table>

### Activity 2.2

**Develop and test the methodology for agricultural data collection and central database storage**

<table>
<thead>
<tr>
<th>Achieved</th>
<th>Comments</th>
</tr>
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<tbody>
<tr>
<td>Yes</td>
<td>Siwa vegetation monitoring: 1. GIS tools were used to explore change in vegetation in Siwa with a focus on selected area. 2. True colour composites were generated for the first six months of 2016 and 2019. 3. NDVI maps were generated to observe the change in vegetation. True colour composite and NDVI maps for the Siwa Oasis were created for crop mapping activity through a team from MWRI and MALR.</td>
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</table>

### Activity 2.3

**Develop agricultural data and water productivity analysis procedures, agricultural extension services**

<table>
<thead>
<tr>
<th>Achieved</th>
<th>Comments</th>
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<tbody>
<tr>
<td>Partially</td>
<td>The project pioneered a holistic approach for comparing the effect of surface and drip irrigation systems used in Siwa Oasis on date palm and olive tree production through the LoA with HRI. The resulting detailed information should help growers, experts and local authorities to adapt the most appropriate irrigation method to be used for the sake of agricultural and water sustainability. Data were gathered from field missions by HRI researchers from January to December 2019. The effect of surface and drip irrigation system on date palm and olive production was measured. It is recommended that the results be published through MWRI.</td>
</tr>
</tbody>
</table>
### Output 3

Capacity building for the technical staff and relevant stakeholders provided

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Target</th>
<th>Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local and international capacity building for different levels of government staff (senior, mid-career, young professional and site staff) from MWRI and MALR, considering gender equity. Training of trainers provided.</td>
<td>More than 200 trainees.</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Baseline**

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**Comments**

Detailed capacity building through the LoAs with HU and RTCWS was provided in the following:

2. Water productivity.
3. Free GIS and RS tools.
4. Design, operation and maintenance of modern irrigation systems.

Training results/programmes should be widely disseminated by MWRI as well as the Project Management Unit of MALR as a tool for land expansion programmes at country level.

### Conduct GIS-based land development tool training

**Activity 3.1**

**Achieved**

Yes

**Comments**

The project trained 25 engineers from MWRI and MALR through an LoA with HU. The training consisted of the following:

- Collection of updated RS datasets (including satellite imagery).
- Database management.
- Incorporation of updated datasets into the GIS system.
- Visualization of land development for easy interpretation by decision makers.
- Updating of LULC maps for easy communication of land development.
- Advanced courses are requested as a follow-up.

### Conduct automated water consumption monitoring system training

**Activity 3.2**

**Achieved**

Yes

**Comments**

The project trained 25 engineers from MWRI and MALR through an LoA with HU. The training consisted of the following:

- Practical exercises as part of the training.
- Database management.
- Water consumption monitoring, related models and telemetric data transmission systems.
- Data quality control and plausibility.

### Conduct field monitoring training

**Activity 3.3**

**Achieved**

Yes

**Comments**

The project trained 25 engineers from MWRI and MALR through an LoA with HU. The training consisted of the following:

- Conduct on-the-ground measurements of water tables (to compare with automated water table measurements) at reference wells, measure water quality directly in the field and in collaboration with identified water laboratories. Training in the operation of the required measuring devices included.
- Train MALR staff how to consult with farmers and collect data on: i) crop types grown and yields achieved; ii) agricultural methods applied; and iii) training of field survey experts in conduct of soil surveys to assess soil quality. Other aspects covered in the training included protocolling and database management.

### Conduct data analysis training

**Activity 3.4**

**Achieved**

Yes

**Comments**

The project trained 25 engineers from MWRI and MALR through an LoA with HU. The training consisted of the following:

- Data analysis training including introduced element on how to assess uncertainties and how to identify errors in the data sets in consultation with FAO.
### Conduct agricultural extension/farmer-to-farmer experience exchange and FFS training, etc

<table>
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<tr>
<th>Activity 3.5</th>
<th>Achieved</th>
<th>Comments</th>
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<tbody>
<tr>
<td><strong>Training</strong></td>
<td>Yes</td>
<td><strong>Achi</strong></td>
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<tr>
<td><strong>Comments</strong></td>
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<td><strong>veved</strong></td>
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<tr>
<td>Training was provided to 75 farmers in Siwa Oasis during August-September 2019 through an LoA with MWRI. The training included the following:</td>
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<td>– Definition of water resources management in Siwa and description of main challenges facing efficient water management.</td>
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<td>– Concept of water user associations including forming and operation concepts.</td>
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<td>– Modern irrigation design, operation and maintenance in the new lands. The course included the advantages of modern irrigation versus flood irrigation, the components of a modern irrigation network (sprinklers or drip), and the operation and maintenance procedures needed to effectively operate a modern irrigation network.</td>
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<tr>
<td>– Trainees also made a site visit to a farm in Siwa operating under modern irrigation systems. Training and workshop programmes were held for a large number of growers, agriculture counterpart staff and participation of private sector entrepreneurs. More than 50 stakeholders participated in the training and workshops. About 90 growers of date palm and olive in Siwa and +10 agricultural extension staff participated in the programmes.</td>
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<td>– A field visit to the village of El-Shahaim, training activities to introduce technology of good agricultural practices, irrigation methods in newly reclaimed lands, symptoms of nutrient deficiency and integrated pest management programme on olive trees and date palm.</td>
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<tr>
<td>– Good practices introduced for date palms and olive trees especially in newly reclaimed lands, and all stakeholders’ questions answered. The training and workshops contributed to developing knowledge and raising awareness of Siwa growers concerning good agriculture practices for date palms and olive trees, which is expected to lead to increased income.</td>
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### Conduct study tour for limited technical staff

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<tr>
<th>Activity 3.6</th>
<th>Achieved</th>
<th>Comments</th>
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</thead>
<tbody>
<tr>
<td><strong>Training</strong></td>
<td>Yes</td>
<td><strong>Achi</strong></td>
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<tr>
<td><strong>Comments</strong></td>
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<td><strong>veved</strong></td>
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<tr>
<td>Within the framework of this project and project GCP/RNE/009/SWE, the following study tours were organized:</td>
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<tr>
<td>1. ICE WaRM, Australia, organized a High-level study tour through an LoA on modern irrigation in Australia in November 2019. The study tour aimed at supporting water monitoring systems and increased water productivity. The four participants were from Minister’s office, site engineers and related research institutes. Trainees summarized the possible applications of knowledge gained as:</td>
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<td>– Use of water treatment technology to produce irrigation water.</td>
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<td>– Separate title of water and land in the newly reclaimed areas as a first initiative.</td>
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<td>– Introduce water trade in the new areas as a way to share water.</td>
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<td>– Use pipes instead of channels.</td>
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<td>– Reform water law to accommodate use of recycled (treated) water for vegetable crops.</td>
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<td>– Review water governance arrangements.</td>
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<td>– Adopt new technologies to produce high-quality waste water.</td>
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<td>– Cooperate in the future on water efficiency in the newly reclaimed areas.</td>
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<td>– Create awareness in the community of alternative water sources and water efficiency.</td>
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<td>– “Think out of the box” - a lesson of drought – e.g. changing cropping patterns.</td>
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<td>– Give more attention to socio-economic aspects.</td>
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<tr>
<td>2. CIHEAM, Bari, Italy, through an LoA organized the second study tour. Four participants were from the Project Management Unit, Minister’s office, site engineers and related research institutes. The following were achieved as a result of the study tour:</td>
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<tr>
<td>– Enhanced understanding of on-demand and rotational irrigation systems.</td>
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<td>– Implementation, design and arrangement, including performance evaluation, of pressurized irrigation systems.</td>
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<td>– Detailed work plan for implementing project activities, including farmers’ feedback. Participants gained considerable knowledge about leading edge technology in the irrigation field in Italy that can then be implemented in Egypt.</td>
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<tr>
<td>Output 4</td>
<td>Pilot application of developed processes and tools in selected areas of interest (piloting)</td>
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<tr>
<td>Indicators</td>
<td>Target</td>
<td>Achieved</td>
</tr>
<tr>
<td>Pilot selection and tools identified.</td>
<td>Processes designed and developed.</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Baseline**

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**Comments**

This output achieved the following:
- Modern irrigation systems installed for 52 feddan.
- Weather station installed in Siwa to compute effluent treatment plant.
- Platform developed to access RS images through Google Earth Engine.
- Crop mapping measuring for Siwa using free tools (WaPOR) with 92% accuracy.

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**Activity 4.1**

Define pilot areas

**Achieved**

Yes

**Comments**

At an earlier stage, different pilots were proposed. It was necessary to find a suitable pilot as an example of newly reclaimed area. The MWRI and MALR project teams recommended Siwa as the first site. The west side of Siwa Oasis, known as Old Siwa, is where farmers first began cultivation under old irrigation techniques, specifically flood irrigation. The east side of the oasis is mostly newly reclaimed areas with large ownership. This side depends in many areas on modern irrigation techniques (sprinkler and drip irrigation). Drainage water flows to the lakes though either free discharge from drains or pump stations at the end of low-level drains. Based on borehole samples data in Siwa, Siwa GW aquifers may be classified into two main aquifers, cracked limestone aquifer and Nubian sandstone aquifer. The second site was Farafra Oasis. Based on an official letter from MWRI, subsurface irrigation system was also installed as a method for more efficient water management.

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**Activity 4.2**

Supervise procurement and set-up of automated water consumption monitoring system and equipment

**Achieved**

Partially

**Comments**

A methodology was developed to use cloud computing and big data for vegetation monitoring. Google Earth Engine was selected as a platform to develop tools to access RS images.

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**Activity 4.3**

Supervise procurement of necessary equipment for manual monitoring-on-the-ground

**Achieved**

Yes

**Comments**

1. Design and install drip irrigation system for 30 feddan in Siwa.
2. Design and install subsurface irrigation system for 20 feddan in Farafra.
3. Design and install subsurface irrigation system for two feddan in Wadi El Natroun.
4. Supply and install a weather station to monitor crops water requirements in Siwa.
5. Provide monitoring equipment for water level, soil moisture, soil salinity and flowmeters (delayed by procurement process).

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**Activity 4.4**

Set-up water accounting system

**Achieved**

Yes

**Comments**

As GW is the only source of water, GW model results from the GW consultant showed the following:
- GW numerical modelling is an essential tool in GW management. A numerical model for Siwa Oasis was built and used to test operation scenarios for the pilot area. The model was set up to simulate, along an area 117 km east-west by 70 km north-south of variable thickness, approximately 1 800 m of Nubian aquifer, divided into 19 layers for better simulation, 200 m of first limestone aquifer and 350 m of second limestone aquifer. In addition, two leaky sub-aquifers, the first between first and second limestone layers with average thickness of 10 m and the other leaky sub-aquifer between second limestone and the Nubian aquifer with an average thickness of 225 m.
- Boundary conditions were assigned to the numerical model and Nubian aquifer boundary conditions extended far enough to avoid the effect of artificial boundaries on the solution.
- Crop water consumption is the main output; therefore, it was essential to calculate water accounting in the area.

The processing of obtained data should be advanced, using Water Accounting Plus. This could be done in coordination with project GCP/RNE/009/SWE.

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**Activity 4.5**

Assist with remote monitoring of land development activities

**Achieved**

Partially

**Comments**

Free RS and GIS tools (e.g. Q-GIS, Google Earth Engine, WaPOR) were provided for crop mapping using free satellite images (10 m resolution), Open Data Kit and Canopeo applications. MWRI and MALR now have a full package of technical information to manage newly reclaimed areas.
### Activity 4.6
**Conduct ground verification missions**

<table>
<thead>
<tr>
<th>Achieved</th>
<th>Yes</th>
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<tbody>
<tr>
<td><strong>Comments</strong></td>
<td>All field verification missions conducted with project team of MWRI and MALR included findings of ground truthing mission in the GIS tool in order to calibrate remotely sensed data and add complementary field data to the system to find the location, up to the last stage at which modern irrigation systems were installed.</td>
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</tbody>
</table>

### Activity 4.7
**Support agricultural data collection, storage and processing and integration into central database**

<table>
<thead>
<tr>
<th>Achieved</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Comments</strong></td>
<td>The project presented a detailed procedure to compare the effect of the two irrigation systems (surface and drip irrigation) used in Siwa Oasis in date palm and olive tree production. The information obtained from this activity is intended to help growers, experts and local authorities to identify the irrigation method that gives the highest efficiency in irrigation water use and water sustainability in the newly reclaimed areas. The database includes information on: i) crop types grown; ii) yields achieved; iii) soil quality; iv) agricultural methods applied; and v) irrigation method applied.</td>
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### Activity 4.8
**Analyse data and develop recommendations**

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<tr>
<th>Achieved</th>
<th>Yes</th>
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<tr>
<td><strong>Comments</strong></td>
<td>Agricultural data were collected and statically analysed. Recommendations for agricultural extension services were then introduced to local farmers.</td>
</tr>
</tbody>
</table>

### Activity 4.9
**Establish FFSs in pilot areas**

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<tr>
<th>Achieved</th>
<th>Partially</th>
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<tbody>
<tr>
<td><strong>Comments</strong></td>
<td>The project organized FFSs to provide training in olive and date palm cultivation and production in newly reclaimed lands in Siwa Oasis. The FFS training was conducted by HRI, Agricultural Research Centre staff in collaboration with FAO. Over 50 stakeholders involved in date palm and olive cultivation in Siwa were trained. Tests of modern irrigation systems were included in farmers’ fields.</td>
</tr>
</tbody>
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