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ACRONYMS

AEnRI	Agricultural Engineering Research Institute
ANOVA	Analysis of Variance
ARC	Agricultural Research Center of the Egyptian Ministry of Agriculture and Land Reclamation
DAC	Development Assistance Committee
EC	Evaluation Criteria
EQ	Evaluation Question
GAP	Good Agricultural Practices
GHG	Greenhouse Gas
ICARDA	The International Center of Agricultural Research in Dry Areas
JRDP	Joint Rural Development Programme
MALR	Ministry of Agriculture and Land Reclamation
MEL	Monitoring, Evaluation and Learning (ICARDA)
MRB	Mechanized Raised Bed
MWRI	Ministry of Water Resources and Irrigation
OECD	Organization for Economic Co-operation and Development
SDGs	Sustainable Development Goals
SECO	(Swiss) State Secretariat for Economic Affairs
WUA	Water User Association

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1. Introduction

The project evaluation activities started on July 15 and ended by end of October 2020. The evaluation follows the guidelines of the EU-JRDP for evaluation of funded projects.

1.1 Description of the operation

The project is entitled “Enhancing water productivity by improving on-farm irrigation management in Minya and Fayoum, Egypt”. The project was initially planned for a duration of 24 months from 27 November 2017 to 27 November 2019. The project is interrelated with the EU-JRDP Project of improving meskas implemented by the Ministry of Water Resources and Irrigation (MWRI) in the same command area. Whereas a meska serves an area of about 100 to 350 feddan (one feddan = 4200 m² = 0.42 hectare), a marwa typically serves an area of 3 to 5 feddan. As meskas represent a higher level of irrigation channels than marwas, improvement of marwas should follow meska improvement. This resulted in a delay of project start from November 2017 to February 2018 when the meska improvement took place. The project has been extended twice for a total of 7 months: i) 5 months because of technical reasons and ii) 2 months because of COVID 19. The project aimed to sustainably improve the livelihoods of poor-resources rural communities in Minya and Fayoum Governorates by introducing open-source solutions that are scientifically based and environmentally sound. The project objectives were as follows:

- (i) improve the productivity of the small scale-farming system through more effective and efficient use of water and land resources
- (ii) improve on-farm income by scaling out the improved irrigation and agricultural practices, and
- (iii) develop and disseminate innovative and cost-effective integrated package at field level that can increase agricultural water productivity.

The project activities were implemented in three locations, two of them were in Fayoum (Biahmou and Awlad Mohamad) and the third location was in Minya (Hafez El-Sharkia). The project is characterized by being applied rather than research oriented. The project targeted the introduction of a comprehensive package that, in a holistic way, should result in better water management and improved land and water productivity. The following activities have been implemented:

- 1) Marwas rehabilitation,
- 2) Laser land leveling,
- 3) Introduction of mechanized raised bed (MRB) production package,
- 4) Soil improvement through application of gypsum and/or other additives,
- 5) Open field drain rehabilitation
- 6) Training of water users’ associations (WUAs)

This has been supported by the estimation of crop-water requirements of the major crops in the project command areas for proper design of rehabilitated marwas section and the development of a geo-database for the project locations and activities.

Based on the 2nd call for proposals made by the Italian Embassy in Cairo for Scaling up Good Agriculture Practices in the Governorates of Fayoum and Minya to increase crop water productivity by improving on-farm irrigation management, ICARDA submitted a concept note followed by a full application document aiming to implement this action, which was approved by the Italian Cooperation and the EU-JRDP management. In November 2017, ICARDA signed the contract for “Enhancing water productivity by improving on-farm irrigation management in Minya and Fayoum, Egypt”.

1.2 Description of the general context

The project under evaluation addresses highly needed interventions for land and water management in project implementation areas.

1.2.1 The regional and sectoral situation

Egypt is faced by an extreme water shortage. In addition to growing needs due to a rapidly growing population, the supply of Nile water is further threatened to diminish due to upstream developments. This will put the country in a situation where priorities for water allocation will have to be set, and agriculture is expected to be the main loser. Agriculture is by far the largest water demanding sector consuming about 85% of all available water resources. Nevertheless, the agriculture sector provides livelihoods for 55% of the population and directly employs about 30% of the labor force. Thus, initiatives to save irrigation water and increase water productivity are vital for the country. The Egyptian Government has recently started implementation of the “Agricultural Development Strategy towards 2030” with special focus on sustainable management of land and water through improving on-farm irrigation management in the Nile Valley and Delta. In view of the limited water resources and ever-increasing demands, increasing water productivity is a high priority target. This project is aligned with the country’s strategy targeting water use efficiency and irrigation water productivity for small scale farmers in Egypt.

In preparation of this project, consultation meetings and focus group discussions with concerned stakeholders were held in Minya and Fayoum by the EU-JRDP to assess the challenges and constraints facing agriculture productivity and community development. The consultations indicated that the agriculture sector in Minya and Fayoum faces major challenges which can be summarized as:

1. Land fragmentation,
2. Lack of appropriate GAPs at field level,
3. Inequitable water distribution along meskas and marwas
4. Inefficient and outdated extension systems and advisory services.
5. Low adoption of new/good practices
6. Low investment in agriculture sector/education
7. Water quantity and quality decrease
8. Poor water, land, and fertilizers management
9. Poor engagement and involvement of community in introduced new agricultural activities/interventions

1.2.2 The current project situation

The project generally achieved its targets with some delay as explained above. The following table compares project targets to achievements.

Target according to project logical framework matrix	Achieved by 31/7/2020	Comments
Improve conveying efficiency by 15%	Average time required for irrigation has been reduced by 25%	
Improve water productivity by 50%	Water productivity has been improved by 44%	
20% of farmers are using new technologies	80% of beneficiaries committed to using new technologies in the future	
500 demonstration plots and 2 platform operationalized	1141 demonstration plots and 3 consolidated platforms	228% achievement
At least 8 WUAs in both locations	WUAs were existing in project implementation areas, 16 have been trained	
At least 9,000 meter-length of improved marwas serving 350 beneficiary farmers	10,575 m of marwa improved serving 559 beneficiaries	117.5% achievement
Improved soil quality of at least 100 faddan	200 faddan	200% achievement, based on soil sample analysis, gypsum was replaced by three different types of soil modifiers
Maintain open field drains, target 20 km	11 km in Fayoum. Minya project areas has no field drains.	55% achievement. Remaining budget re-allocated to marwa improvement component
300 faddan laser levelled	510 faddan land leveled	170% achievement
Raised bed machines manufactured and 500 faddans cultivated	6 raised bed machines were manufactured and handed over to the Agriculture Directorates upon project completion. 1141 faddan raised bed implemented.	228% achievement
Training sessions, 150 trainees, 2 traveling workshops, at least 4 consultation meetings in both governorates	6 Farmer Field Schools (120 participants) + 14 Field Days (310 participants) + 4 farmer workshops	280% achievement
2 exit workshops conducted	2 exit workshops conducted	100% achievement
2 journal papers	Journal papers are under publication	50% achievement
2 dissemination materials developed	6 dissemination materials have been developed	300% achievement

1.3 Methodology and description of the evaluation

An evaluation is an evidence-based judgment of project performance compared to initial expectations. The main purpose of the evaluation is to guide decision making and provide input to political priority setting. It also assists in improving the quality of future interventions. It can identify areas for improvements, highlight good and bad practices, and identify unintended or unexpected effects of the action. The evaluation needs to identify what has happened on the ground, why, and how much has changed. Generally, an evaluation should be carried out after sufficient time has passed to allow changes to be identifiable and measurable.

1.3.1 General analysis methods

First, collected data are entered to excel. Each questionnaire was given an identification number. Data were entered such that each row corresponds to a respondent and each column contains the answer to a single research question. This resulted in a matrix of 92 columns and 142 rows (Fayoum) and 100 rows (Minya). Numbers have been converted into ranges as applicable, and yes/no answers into binary form. After curation, data were checked for accuracy. Some errors were encountered either within the questionnaire, i.e. the respondent providing an answer which is outside an acceptable range, most probably due to misunderstanding the question, responding hastily, or due to spelling errors. Another possible source of error may be due to an error in data entry. In order to detect errors, minimum and maximum values were extracted for each column in order to identify outliers. For each outlier, the questionnaire in question was consulted. If the error was in data entry, the error was corrected. If the error was in the questionnaire response, then this entry was discarded.

The way of analyzing data depended on the type of question. For data such as age, land area owned, number of years cultivating, etc., averages, minimum and maximum values and standard deviations were calculated. For rating scale questions, average response and standard deviation was calculated. In order to calculate changes in water consumption rate, two types of questions were designed. One which asked about the time required for irrigation before and after the project, and another which asked about an estimate of % in water savings due to the project interventions. These data were processed and compared to arrive at the value of water saving due to project interventions. A similar approach was applied to assess change in yield and income due to project interventions. Using water saving and yield increase data, in addition to actual water consumption data before the project, the change in water productivity was calculated. ANOVA and T-tests were applied to determine how scores of different locations differed on water saving and productivity values.

1.3.2 Methods for defining the evaluation questions

The EU-JRDP provided an evaluation matrix containing evaluation criteria and preliminary generic sub-questions. Evaluation criteria include relevance, effectiveness, efficiency, impact, sustainability and cross-cutting issues. During the preparation of the Methodological Approach document, the evaluation matrix was edited and enriched with sub-questions and information sources relevant to the project under evaluation.

1.3.3 Methods for data collection tools

Several data collection tools were designed to accommodate the wide spectrum of project stakeholders. Structured interviews were designed to cover the evaluation questions relevant to project management and government stakeholders. These interviews focused on project management, coordination and sustainability issues. Structured interviews were held with central stakeholders in their offices in Cairo and with decentral stakeholders in their offices in Fayoum and Minya during the field survey period.

For project beneficiaries, questionnaires were carefully designed to obtain data which could be processed to answer evaluation questions under consideration. Questionnaires contained 15 question groups. The first group collected

general information regarding name, age, sex, land area etc.). This was followed by question groups to assess actual participation in project component(s) and the situation before project implementation. Group 4 was dedicated to collect performance data regarding production rates and water utilization. This data was later processed to extract information on actual yield increase, water saving, and change in water productivity due to the project interventions. Groups 5 to 9 collected data of farmers' perception and evaluation of the individual project interventions, and finally groups 10 to 15 collected information regarding overall satisfaction and recommendations. Triangulation was applied for critical questions to test consistency and accuracy.

2. Answers to evaluation questions

In accord with the EU-JRDP guidelines, the project is evaluated against six evaluation criteria (EC): relevance, effectiveness, efficiency, impact, sustainability and cross-cutting issues. For each evaluation criterion, research sub-questions have been designed for assessment. In the following sections, research sub-questions of the evaluation criterion under consideration are summarized in a table together with an evaluation score, which gives an overall assessment of project performance with regard to this sub-question. Evaluation scores of sub-questions are based on a Leickert scale from 1 (highly unsatisfactory) to 5 (highly satisfactory). The table is followed by a substantiation of the rationale behind the evaluation outcome for each sub-question.

2.1 Relevance

The relevance of the project has been evaluated to assess to what extent the project has targeted defined objectives in complementarity with other actions undertaken by EU-JRDP stakeholders and other actors in the Governorate and sector. Evaluation included assessment of relevance of context diagnosis in project documentation, assessment of coherence and credibility of project formulation and intervention logic to the context and needs identified, and determination of the presence and use of complementarities, synergies and coherence between project activities and the levels of intervention (regional / national).

EC sub-question	Source of information	Evaluation score
To what extent was the project designed based on a need assessment and a context analysis?	Project documents, field investigations, structured interviews	4
How does the action serve the priorities of key EU-JRDP stakeholder ministries, such as MALR and MWRI	Analysis of strategy reports and national plans, interviews with stakeholders	5
To what extent does the action encourage or facilitate sufficient coordination, complementarities, and synergy with other on-going interventions, and to what extent have complementarities/partnerships been sought and established and synergies been created in the delivery of assistance?	Interviews with relevant stakeholders and project staff	4
Is the institutional set-up of the action adapted to meet the objectives and expected results? Is the practical implementation of this montage faithful to its theoretical version?	Interviews with relevant stakeholders and project staff	5
To what extent are the strategies and objectives of the project adequate and guarantee the coverage of the needs of the actors?	Analysis of project documents and structured interviews	5

To what extent was the project designed based on a need assessment and a context analysis?

In preparation of this project, consultation meetings and focus group discussions with concerned stakeholders were held in Minya and Fayoum by the EU-JRDP to assess the challenges and constraints facing agriculture productivity and community development. The consultations indicated that the agriculture sector in Minya and Fayoum faces major challenges which have been summarized as:

1. Land fragmentation,
2. Lack of appropriate GAPs at field level,
3. Inequitable water distribution along meskas and marwas
4. Inefficient and outdated extension systems and advisory services.
5. Low adoption of new/good practices
6. Low investment in agriculture sector/education
7. Water quantity and quality decrease
8. Poor water, land, and fertilizers management
9. Poor engagement and involvement of community in introduced new agricultural activities/interventions

Based on the 2nd call for proposals made by the Italian Embassy in Cairo for Scaling up Good Agriculture Practices in the Governorates of Fayoum and Minya to increase crop water productivity by improving on-farm irrigation management, ICARDA submitted a concept note followed by a full application document aiming to implement this action, which was approved by the Italian Cooperation and the EU-JRDP management. In November 2017, ICARDA signed the contract for “Enhancing water productivity by improving on-farm irrigation management in Minya and Fayoum, Egypt”.



Figure 1: Project implementation areas in Fayoum (north) and Minya (south)

The overall objective of the action is to sustainably improve the livelihoods of rural communities in Minya and Fayoum by introducing some improvements to farming activities at the field level.

The specific objectives are:

1. Improve the productivity of small scale-farming systems through more effective and efficient use of water and land resources,
2. Improve on-farm income by scaling out the improved irrigation and agricultural practices,
3. Develop and disseminate innovative and cost-effective integrated packages at field level that increase agricultural water productivity.

The action is characterized by being applied rather than research oriented. The project targeted the introduction of a comprehensive package that, in a holistic way, should result in better water management and improved land and water productivity. The following activities have been implemented:

1. Marwas rehabilitation,
2. Laser land leveling,
3. Introduction of mechanized raised bed (MRB) production package,
4. Soil improvement through application of gypsum and/or other additives,
5. Field drain rehabilitation
6. Training of water users' associations (WUAs)

This has been supported by the estimation of crop-water requirements of the major crops in the project command areas for proper design of rehabilitated marwas section and the development of a geo-database for the project locations and activities.

Nevertheless, specific field details were not sufficiently researched, and resulted in the need to adapt targets during the course of the project. This includes the absence of open drains in the Minya beneficiary farms which resulted in the replacement of the drain rehabilitation component by additional Marwa rehabilitation interventions.

How does the action serve the priorities of key EU-JRDP stakeholder ministries, such as MALR and MWRI?

Egypt is faced by an extreme water shortage. In addition to growing needs due to a rapidly growing population, the supply of Nile water is further threatened to diminish due to upstream developments. This will put the country in a situation where priorities for water allocation will have to be set, and agriculture is expected to be the main loser. Agriculture is by far the largest water demanding sector consuming about 85% of all available water resources. Nevertheless, the agriculture sector provides livelihoods for 55% of the population and directly employs about 30% of the labour force. The sector accounts for about 20 percent of total exports and foreign exchange earnings. However, Egypt imports about 40 percent of its food requirements and incurs a total food import bill of USD2.5 billion per year. Thus, initiatives to save irrigation water and increase water productivity are vital for the country.

More than 90% of agricultural lands of Egypt are located in the narrow fertile strip of land represented by the Nile Valley and Nile Delta (Figure 2). These lands, referred to as the old lands, are irrigated through a system of irrigation canals drawing from the Nile. Flood irrigation is practiced which is generally not very efficient. In new reclamation areas in the desert, modern irrigation systems (drip or sprinkler) are required by law. Introduction of modern irrigation systems in the old lands has been investigated but generally discarded due to high costs of

adapting the infrastructure to these systems and due to the unsuitability of the systems for field crops grown generally in the old lands.



Figure 2: The old lands of Egypt, represented by the narrow green valley and the Nile Delta

The old lands are home to more than 90% of Egypt's population. Land ownership is fragmented, with average land tenure around 1 feddan (0.42 hectare). Subsistence farming is practiced in most areas. The project implementation areas in Fayoum and Minya are representative of such old lands.

The relevance of the project is measured against the objectives and targets of Egypt's Sustainable Development Strategy 2030 (Ministry of Planning, Monitoring and Administrative Reform, 2016). The strategy has 10 pillars, namely 1) Economic Development, 2) Energy, 3) Knowledge, Innovation and Scientific Research, 4) Transparency and Efficient Government Institutions, 5) Social Justice, 6) Health, 7) Education and Training, 8) Culture, 9) Environment, and 10) Urban Development. The project directly contributes to achieving targets of pillars 1, 2, 5 and 9. The following targets of the strategy are impacted by the project in project implementation areas (as shall be shown below through survey results).

Pillar 1: Economic Development

The rationalization of the use of natural resources is emphasized in Pillar 1, in particular for the sectors of agriculture and water and irrigation.

Agriculture Sector:

- Rationalize the use of water resources
- Increase agricultural productivity for land and water
- Develop agricultural technology

- Develop an agricultural guidance system
- Improve the performance of farmers' voluntary institutions

Water and Irrigation Sector:

- Develop and manage water resources and rationalize the use of water in all fields
- Complete and rehabilitate the national infrastructure for water systems
- Rehabilitate canals and drains networks and all irrigation facilities
- Execute studies and scientific research about technical and scientific applications in agriculture

Pillar 2: Energy

- Reducing the intensity of energy consumption
- Reducing energy consumption rate for all sectors
- Limiting the environmental impact of the sector's emissions
- Reducing the levels of sector's emissions and pollutants

Pillar 5: Social justice

- Providing protection for the neediest groups
- Guaranteeing fair distribution and reducing class divisions by providing support to marginalized groups
- Positive discrimination towards marginalized and the most needy social groups, including those below the extreme poverty line, homeless children, people with special needs, the elderly, and residents of the most dangerous slums

Pillar 9: Environment

- Rationalized and sustainable management of the assets of natural resources, including air, water, energy, and lands with the natural and mineral resources they contain, while focusing on water resources and achieving water security given the great impact of this issue on national security, especially after Egypt has entered the water scarcity phase, in addition to the impacts of climate change and the expected increase in population, which will result in increasing demand with fixed available water resources. This will also lead to the failure to meet the needs of the citizens and production activities.
- The second objective addresses the reduction of environmental pollution. In this objective, focus is placed on two main issues: the first issue is to eliminate air pollution by reducing air pollution rates. The second issue is reducing environmental pollution resulting from wastes, which includes polluting water resources through polluted drainage water.

To what extent does the action encourage or facilitate sufficient coordination, complementarities, and synergy with other on-going interventions, and to what extent have complementarities/partnerships been sought and established and synergies been created in the delivery of assistance?

The action has coordinated well with relevant stakeholders in project implementation areas. ICARDA partnered for the project implementation with the Agricultural Research Center (ARC), which has a significant presence throughout Egypt through projects and training. The project has from its start actively involved the local directorates of agriculture in project implementation. For the marwa rehabilitation component the project has coordinated with the MWRI through the mesqua improvement project (also funded by the EU-JRDP). Project implementation areas have been selected a/o to be in areas where mesquas are improved to reap the full benefits of the upgrading of the irrigation infrastructure. The project component of the introduction of Mechanized Raised Beds (MRB) complements several initiatives by the Ministry of Agriculture and Land Reclamation for modernization of agriculture in the old lands such as the Sustainable Agricultural Mechanization in Minya and Fayoum Governorates (SAMSIMIFA) implemented by the ARC and funded by the Italian Development Cooperation. However, the

project under evaluation had an added value of providing a comprehensive improvement package consisting of complementary components.

Is the institutional set-up of the action adapted to meet the objectives and expected results? Is the practical implementation of this montage faithful to its theoretical version?

The institutional setup of the action was generally supportive to meet the project objectives. While ICARDA provided know how and managerial support, the ARC, with its presence in project implementation areas, facilitated the achievement of results on the ground. This is reflected in achieving or surpassing project targets for most components, and in the general satisfaction of stakeholders and project beneficiaries. In addition, focal points, who were available full time in project implementation areas, served as a link between local and central management of the project on one hand, and between management and beneficiaries on the other.

To what extent are the strategies and objectives of the project adequate and guarantee the coverage of the needs of the actors?

The strategies and objectives of the project were based on a need assessment of beneficiaries in the project implementation areas. The main strategy was to target as far as possible beneficiaries and end users which made the action very impactful and fulfilling of beneficiaries' needs.

2.2 Effectiveness

Effectiveness assesses the extent to which the project enabled the implementation of effective activities at the Governorate and local levels. Assessment is carried out as to what extent activities have been implemented according to the plan, whether the planned results have been achieved according to intervention logic, and how the changes (if any) in the planned activities contributed to foster the achievement of the project objectives.

EC sub-question	Source of information	Evaluation score
To what extent have the activities been implemented according to the work plan?	Project documents, field investigations, structured interviews	4
To what extent do the observed effects link to the intervention?	Field interviews, field visits, analysis of survey results	5
To what extent have the planned objectives and outcomes in the project been achieved?	Project documents, field investigations, structured interviews	5
Have the activities achieved results beyond the pre-established targets?	Structured interviews with project beneficiaries and stakeholders	5

To what extent have the activities been implemented according to the work plan?

Project implementation took place in Hafez El-Sharkia in Minya and in Biahmo and Awlad Mohamed in Fayoum. The project is interrelated with the EU-JRDP Project of improving meskas implemented by the Ministry of Water Resources and Irrigation (MWRI) in the same command area. Whereas a meska serves an area of about 100 to 350 feddan (one feddan = 4200 m² = 0.42 hectare), a marwa typically serves an area of 3 to 5 feddan. As meskas represent a higher level of irrigation channels than marwas, improvement of marwas should follow meska improvement. This resulted in a delay of project start from November 2018 to February 2019 when the meska improvement took place. Thus, the project implementation started officially in November 2018 and ended on July 31, 2020. The final project report was released by mid September , 2020. Otherwise, project implementation followed the work plan adequately, but with the above-mentioned shift.

Another hurdle was the emergence of COVID-19 during project implementation. This had some impact on delivery of project training but was managed through introduction of alternative training methods as is discussed below.

To what extent do the observed effects link to the intervention?

Comparison to control fields indicated that observed effects are generally linked to the intervention. This was also verified by structured interviews with government officials and heads of WUAs in project implementation areas and by questionnaire results provided by project beneficiaries as shown below.

To what extent have the planned objectives and outcomes in the project been achieved?

The project has achieved or surpassed planned objectives for most components. The exception is in the drain rehabilitation component, where actual field conditions showed the unsuitability of the proposed intervention in the locations of Awlad Mohamed in Fayoum and in Minya. Unused funds for this activity were directed towards marwa rehabilitation. Another exception is the actual publication of 2 journal papers. These papers are presently under publication. The following table compares planned objectives to actual achievements.

Target according to project logical framework matrix	Achieved by 31/7/2020	Comments
Improve conveying efficiency by 15%	Average time required for irrigation has been reduced by 25%	
Improve water productivity by 50%	Water productivity has been improved by 44%	
20% of farmers are using new technologies	80% of beneficiaries committed to using new technologies in the future	
500 demonstration plots and 2 platform operationalized	1141 demonstration plots and 3 consolidated platforms	228% achievement
At least 8 WUAs in both locations	WUAs were existing in project implementation areas, 16 have been trained	
At least 9,000 meter-length of improved marwas serving 350 beneficiary farmers	10,575 m of marwa improved serving 559 beneficiaries	117.5% achievement
Improved soil quality of at least 100 faddan	200 faddan	200% achievement, based on soil sample analysis, gypsum was replaced by three different types of soil modifiers
Maintain open field drains, target 20 km	11 km in Fayoum. Minya project areas has no field drains.	55% achievement. Remaining budget re-allocated to marwa improvement component
300 faddan laser levelled	510 faddan land leveled	170% achievement
Raised bed machines manufactured and 500 faddans cultivated	6 raised bed machines were manufactured and handed over to the Agriculture Directorates upon project completion. 1141 faddan raised bed implemented.	228% achievement
Training sessions, 150 trainees, 2 traveling workshops, at least 4 consultation meetings in both governorates	6 Farmer Field Schools (120 participants) + 14 Field Days (310 participants) + 4 farmer workshops	280% achievement
2 exit workshops conducted	2 exit workshops conducted	100% achievement
2 journal papers	Journal papers are under publication	50% achievement
2 dissemination materials developed	6 dissemination materials have been developed	300% achievement

Have the activities achieved results beyond the pre-established targets?

As shown in the above table, most activities have achieved results beyond the pre-established targets. The following additional achievements of the project are notable:

- 3 internships (2 PhD and 1 Masters)
- Manufacturing and handing over of 4 harvesters
- Preparation of online training materials and electronic field manuals to be used on farmers' mobile phones (this was initiated by COVID-19 emergence)

2.3 Efficiency

Project efficiency assesses to what extent the actions implemented and their associated costs, and the results achieved, have been appropriate in the implementation of the project. Evaluation of efficiency includes the analysis of project budget as to whether the financial disbursements allowed the realization of the planned activities in due time and at lowest costs, the assessment of whether the costs associated with the intervention are proportionate to the benefits it has generated, and whether the coordination between project offices (main and field) allowed the timely execution of all activities and procedures.

EC sub-question	Source of information	Evaluation score
To what extent has the intervention been cost-effective?	Project documents, field investigations, structured interviews, analysis of project budget	5
To what extent are the costs of the intervention justified, given the changes/results it has achieved?	Analysis of expenditures and cost items	5
What is the cost estimate of the benefits achieved by the different project interventions?	Analysis of benefits and survey of market values	5
What is the cost of implementation of project interventions beyond the project?	Analysis of benefits and survey of market values	5
To what extent have the administrative procedures supported the timely implementation of the activities (including purchase of material and equipment)?	Structured interview with project staff	4
How and to what extent did the coordination between main and field offices affect the implementation of the activities?	Structured interview with project staff	4

To what extent has the intervention been cost-effective?

The total project budget amounted to 1,483,300 Euros. The following chart shows the breakdown of cost items. Human resources accounted for 18%, which is quite reasonable. The chart shows that 65% of the budget went into realization of activities on the ground. This includes costs for supplying of field equipment, soil additives, improved seeds, marwa rehabilitation and drain maintenance. It also includes costs for training provision and stakeholder workshops. Thus, about two thirds of the project budget went into direct benefits to end users. This may be considered as very cost effective.

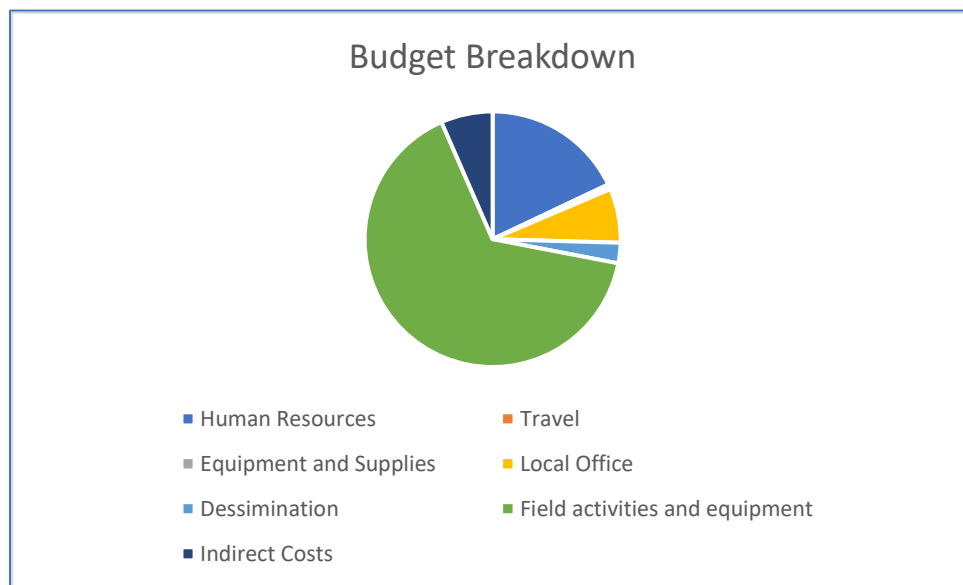


Figure 3: Breakdown of project budget

To what extent are the costs of the intervention justified, given the changes/results it has achieved?

Benefits by project interventions in project implementation areas are numerous and may be summarized in the following points:

Overall benefits

- Raising awareness at all levels about importance and possibility of producing more with less
- Creating a generation of water stewards promoting the new technologies and concepts
- Providing a viable alternative of irrigation water reduction in the old lands (which constitute more than 90% of Egypt's agricultural lands) by 25% without the need for costly modern irrigation equipment which are also not well suited to most types of field crops grown in the old lands

Benefits of improved marwas

- Reduction of irrigation time by 25%
- This in turn results in reduction of fuel consumption by the same percentage
- This results in reducing fuel requirements, pumping costs and GHG emissions by same percentage
- Improved marwas helped in delineation of land ownership and reduction of water seepage to adjacent agricultural lands and helped providing adequate water supply to tail end users
- This in turn resulted in less conflicts between beneficiaries and less complaints to authorities
- Further, it resulted in eliminating the need for weed removal which was needed at least twice per year

Benefits of mechanized raised beds

- Reduction in irrigation water by 25%

- Reduction in fuel consumption by irrigation pumps by 25%
- Yield increase by 20-25%
- Improving strength of plant stem due to optimized plant spacing and optimized ventilation and lighting in between plants
- Improved harvest quality due to optimized growing conditions
- Reduction in need of fungicides (less irrigation water, better ventilation between plants and between raised beds, better drainage)
- Reduction in seed requirements by 15%
- Reduction in fertilizer requirements by 16%
- Reduction in time of field preparation and planting by 80%
- Reduction in cost of planting and agricultural field processes
- Reduction in drainage water as a result of reduction in irrigation water
- Reduction in water pollution due to reduction in fertilizer requirements and amounts of drainage water
- Farmers started after project to experiment with using the MRB machines for other crops such as sugar beet and soy; as the head of the WUA in Minya stated during an interview: this project changed the old way of thinking towards a new way of water saving and working with what we have



Figure 4: Head of Bahr Biahmo WUA inspecting a harvested corn cob

What is the cost estimate of the benefits achieved by the different project interventions?

Considering quantifiable benefits, the most important might be water saving and yield increase which are estimated below. A similar approach could be applied to estimate costs of benefits due to energy needs reduction, GHG emissions reduction, reduction in water pollution, reduction in seed costs, reduction in fertilizers costs, reduction in planting costs, etc

Cost estimate of water saving

The land is cropped twice per year, one winter and one summer crop. Typical crops in the project areas are wheat in winter and maize in summer.

Typical water use for wheat crop is 3000 m³/faddan and for maize crop is 4000 m³/faddan without intervention.

The intervention led to water saving of 20% (conservative estimate) i.e. 600 m³/faddan wheat and 800 m³/faddan maize, i.e. 1,400 m³/faddan per year.

Area served by project = 1140 faddan

Water saving per year = 1400 x 1140 = 1,596,000 m³

Estimating the cost per m³ at 0.5 Euro (cost of providing an alternate unit of water through desalination), then the cost of saved water in project implementation areas is equal to 798,000 Euro.

Cost estimate of yield increase

The average yield per faddan is 2.4 ton for wheat and 2.6 ton for maize without intervention.

The intervention led to yield increase of 25%, i.e. 0.6 ton/faddan wheat and 0.65 ton/faddan maize.

Cost 180 Euro per ton of wheat and 145 Euro per ton of maize. Thus, the additional income due to yield increase is 202 Euro per feddan.

Additional income in project implementation areas due to yield increase is 1140x202 = 230,000 Euro

Comparing to the project costs, the above analysis indicates that the project benefits pay off in less than 2 years.

What is the cost of implementation of project interventions beyond the project?

Rehabilitated marwas require very little, if any, maintenance. There are no mechanical parts and the marwas are well constructed. There might be some need for minor repair to lining material and gates. This could be carried out by the WUAs, who are now in charge of the marwas.

It is expected that raised bed machines will require some routine maintenance and spare part replacement. It could be estimated at 10% of machine cost annually. One machine costs about 100,000 LE, i.e. maintenance could be estimated at 10,000 LE (ca. 500 Euros) per year. However, the machines have been handed over to the Agricultural Directorates who have a dedicated mechanical department. The machines are expected to be rented to farmers at a reasonable cost of 150LE/faddan. The machine can serve about 10 faddan/day. The planting season is about 30 days wheat and 30 days for corn. It could be further used for sugar beet and for soy. Thus, the machine could operate about 100 days per year with a gross income of 100 x 10 x 150 = 150,000 LE per year. This could cover the costs of operation, maintenance and replacement at the end of the lifetime of the machine, and still provide an income for the Agricultural Directorate.

To what extent have the administrative procedures supported the timely implementation of the activities (including purchase of material and equipment)?

Project managers indicated that the administrative procedures were smooth and did not result in any delays for implementation and purchases.

How and to what extent did the coordination between main and field offices affect the implementation of the activities?

Coordination between field offices was very good. This was facilitated by the participation of the ARC which has decentral offices and staff, and also by the employment of full-time project focal points in project implementation areas.

2.4 Prospective Impacts

Evaluation of prospective impacts assesses to what extent the project has contributed to or is likely to contribute to long-term economic, environmental, and social changes for beneficiaries (individual, communities, institutions). This includes assessment of whether the action has achieved the planned results of the project and put solid basis for the achievement of a long-term impact, and how external factors affecting impacts are identified and measured.

EC sub-question	Source of information	Evaluation score
To what extent have the project activities achieved the objectives?	Project documents, field investigations, structured interviews	5
To what extent has the sense of ownership of the activities and their results been fostered and achieved?	Field investigations, structured interviews, meetings with project beneficiaries	5
If any, what are the constraints and difficulties that affected the achievement of the impact? To what extent did these constraints and difficulties affect the achievement of the impact?	Structured interviews with project management, project documents	5
To what extent have the indicators in the logical framework been updated and to what extent can they fully evaluate the achievement of the impacts?	Review of project proposal document and project reports	5
To what extent have the Government and other levels of local governance, communities and other partners fulfilled their obligations and has this contributed to positive outputs in terms of implementation and program impact?	Structured interviews with project stakeholders	4
To what extent did external factors affect or are likely to affect, positively or negatively, the impact of the intervention? What are the external factors affecting, positively or negatively, the impact of the intervention?	Interviews with project management staff and other stakeholders	4

To what extent have the project activities achieved the objectives?

The overall objective of the action was to sustainably improve the livelihoods of poor-resources rural communities in Minya and Fayoum governorates by introducing open-sources solutions that are scientifically based and environmentally sound.

The specific objectives of the project are:

1. Improve the productivity of the small scale-farming systems through more effective and efficient use of water and land resources
2. Improve on-farm income by scaling out the improved irrigation and agricultural practices
3. Develop and disseminate innovative and cost-effective integrated packages at field level that can increase agricultural water productivity

Based on the analyses of project efficiency and effectiveness carried out above, the overall objective and specific objectives 1 and 3 may be regarded as fully achieved.

Specific objective 2 with regards to scaling out the improved agricultural practices may be regarded as partially achieved. Although the MRB machines have been handed over to the Agricultural Directorates to help spreading of the technology, the machines purchased through the project will not be sufficient to cover the needs of all interested farmers in the surroundings of project implementation areas. Further, there are no plans nor funds to scale out improved marwas beyond project implementation areas.

To what extent has the sense of ownership of the activities and their results been fostered and achieved?

Discussions with stakeholders and beneficiaries indicated that there is a high level of ownership of project activities and results. Beneficiaries are considering themselves proponents of a new way of thinking about farming and water utilization. They are eager to carry on the activities and are trying to adapt and invent beyond project results.



Figure 5: Head of Awlad Mohamed WUA explaining the operation of the MRB machine

If any, what are the constraints and difficulties that affected the achievement of the impact? To what extent did these constraints and difficulties affect the achievement of the impact?

The targeted impacts were generally well achieved. Perhaps the scaling out to a whole command area rather than to a limited number of beneficiaries would require a larger project with higher funds.

To what extent have the indicators in the logical framework been updated and to what extent can they fully evaluate the achievement of the impacts?

Comparison of the logical framework matrices in the project proposal with updated matrices in project interim and final reports indicated that the matrices are almost identical, with the exception of the following: increasing the number of beneficiaries of marwa improvement from 350 to 450, increasing the land levelling areas from 50 to 100 feddan and stating that the actual drain improvement length shall be determined based on actual field conditions (compared to 20,000 m length in the initial workplan).

To what extent have the Government and other levels of local governance, communities and other partners fulfilled their obligations and has this contributed to positive outputs in terms of implementation and program impact?

Discussions with the project management team and also with stakeholders in project implementation areas indicated that relevant government entities as well as farmer groups and WUAs were actively involved in project implementation and follow up. This ensured a smooth and efficient project implementation and achieving of project results.

To what extent did external factors affect or are likely to affect, positively or negatively, the impact of the intervention?

External factors which had a notable impact on project implementation and impacts were related to climate and health conditions.

Climate impacts

A severe storm which occurred in March 2020 had a strong impact on the winter crop. High rainfall rates and strong winds resulted in the laying down of wheat crops which were close to harvest. Farmers who had planted early were able to harvest before the calamity, but other farmers were generally impacted. According to survey results, this resulted in a drop of wheat production of 4.2% in Fayoum and 9% in Minya compared to the 2019 production figures. Discussions with officials in the Agriculture Directorate indicated that this was a national calamity and production dropped roughly around 30% nationwide. The lower rates of crop loss in project implementation areas may be attributed to planting on MRB which results in a stronger crop. Further the raised beds enhance drainage from the root zone which was able to improve crop resistance to the climate conditions.

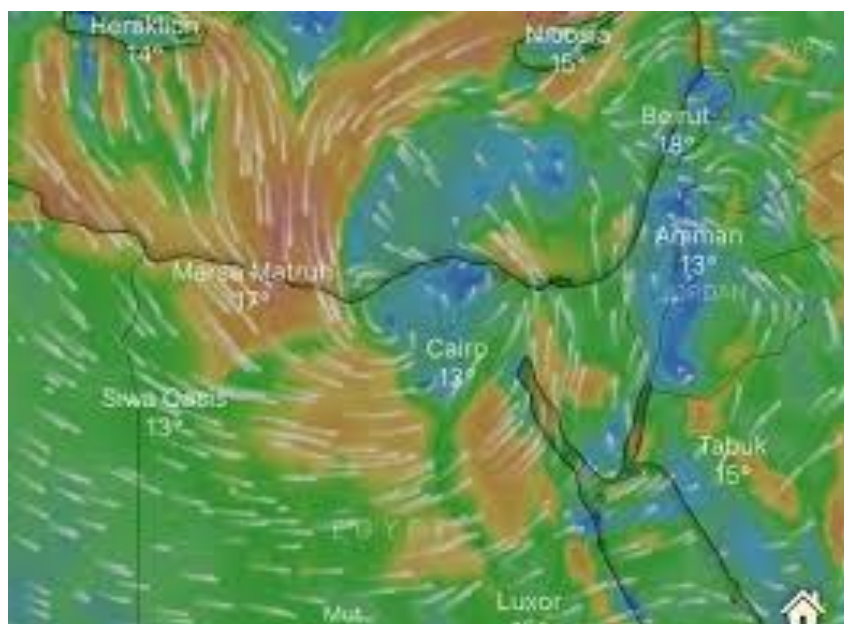


Figure 6: Wind pattern of March 11, 2020 storm

Health impacts

Most project activities had been completed prior to the emergence of COVID19. However, some training and outreach activities were still outstanding. The project management overcome the problem of restrictions on mass gathering with the production of digital training material which farmers could access through their mobile phones. Further, this material was stored also on microchips to enable farmers to consult training sessions of choice while offline. Nevertheless, visibility and awareness activities need to continue to raise awareness about the potential of the provided solutions.

2.5 Sustainability

Sustainability looks at the likelihood of project benefits to continue after the end of the project. This is verified through the commitments and capacities of the beneficiaries to ensure project sustainability, the sufficient consideration of the action of an exit strategy, and the fulfillment of communities and government stakeholders of their obligations.

EC sub-question	Source of information	Evaluation score
What are the commitments and capacities of beneficiaries to ensure program sustainability?	Interviews with beneficiaries and WUAs	4
Have did other farmers try to implement similar interventions on their own?	Interviews with beneficiaries and WUAs	3

What is the maintenance plan for project interventions?	Structured interviews with project stakeholders	4
To what extent have the states, other levels of local governance, communities and other partners fulfilled their obligations, and has this contributed to positive outputs in the implementation and sustainability of the program?	Structured interviews with project stakeholders	4
Does the program sufficiently consider an exit strategy when program interventions end? To what extent is the exit strategy put in place likely to produce the desired results?	Structured interviews with project stakeholders	4
To what extent is stakeholders' engagement likely to continue, be scaled up, replicated, or institutionalized after the end of the project?	Structured interviews with project stakeholders	3

What are the commitments and capacities of beneficiaries to ensure program sustainability?

Beneficiaries have seen actual results. They have seen that they are able to increase their income without spending more. This conviction shall be the driving force to guarantee program sustainability. However, they need some support to be able to carry on. They are now well aware about the use and operation of the MRB machines. They need to have sufficient machines available to support the new technologies. One MRB machine can prepare 20 faddan if lands are adjacent but only 10 faddan otherwise. Thus, one machine can serve about 300 faddan during the growing season which is about one month. The project has provided two machines for each implementation area, which could serve about 600 faddan per growing season. As an example, the command area of Bahr Biahmo in Fayoum is 6000 faddan, i.e. the machines would be able to serve only 10% of the area.

Improved marwas are in place and will continue providing the achieved benefits with little maintenance requirements. However, marwa improvement needs to be expanded to other areas not served by the project.

Beneficiaries have also experienced the positive impacts of soil additives beyond chemical fertilizers which they are used to. They indicated that no mechanism is in place to supply such additives at a reasonable cost when needed.



Figure 7: Farmers in Minya experimenting with growing sugar beet using the raised bed technology after project end (this photo was received from farmers on 18/9/2020 after returning from the field visit)

Did other farmers try to implement similar interventions on their own?

Other farmers, in particular neighboring ones, have seen the benefits of the interventions. However, they need the means to implement such interventions. Providing sufficient MRB machines and soil additives will for sure help in spreading the technology as publicity has already been done. After handing over the machines to the Agricultural Directorates, machine operators who were employed by the project are now considering the purchase of a private machine as a potential business venture. The machine being locally manufactured at relatively low cost makes this a viable option.

Also, marwa lining has proven very efficient and was highly rated by many beneficiaries. WUAs in the project implementation areas have been trained and have actively overseen the design, construction and implementation phases. Again, cost is not prohibitively high, and given the proven gains which surpass costs, other WUAs might be able to collect from beneficiaries and follow suit in the absence of further support through a funded project.

What is the maintenance plan for project interventions?

MRB and harvesting machines have been handed over to the Agricultural Directorates who have a dedicated Mechanical Department for maintenance and repair. The machines are locally manufactured by a reputable

company and spare parts are readily available at reasonable cost. Further, the machine shall be operated in the future against a fee which shall a/o cover any operation and maintenance costs.



Figure 8: Handing over MRB machine to Agricultural Directorate in Fayoum

With regards to the lined marwas, construction has been generally carried out adequately according to engineering norms. Thus, it is expected that maintenance requirements shall be very limited and could be easily carried out by WUAs who have assumed responsibility for the marwas.



Figure 9: Improved marwa in Bahr Biahmo, Fayoum

On the other hand, maintenance of open drains is a recurring process as it constitutes mainly weed removal after regrowth. It is a relatively simple process, so, this could be also a responsibility of the WUAs in the future.

To what extent have the states, other levels of local governance, communities and other partners fulfilled their obligations, and has this contributed to positive outputs in the implementation and sustainability of the program?

All relevant government entities and organizations were involved from the planning stages of the project. According to project management and beneficiaries they were fully cooperative and supportive of the project, which resulted in the satisfactory achievement of project outputs. Meetings with government officials during this evaluation ensured that the government shall continue to support and maintain project achievements.

Does the program sufficiently consider an exit strategy when program interventions end? To what extent is the exit strategy put in place likely to produce the desired results?

Project interventions are numerous but are relatively simple to operate and maintain. MRB machines and harvesters have been handed over to the Agricultural Directorates who will provide the services to farmers at a reasonable fee. Improved marwas have been handed over to WUAs who shall be responsible for operation and maintenance.

On the other hand, there is no clear plan for the provision of soil additives. Farmer surveys indicated that soil additives improved the average soil quality (measured on a scale from 1 to 5) from 3.1 before the project to 4.3 after the project. In order to maintain this, such additives need to be accessible at reasonable cost. When asked whether the project has put in place a mechanism for obtaining additives, 64% replied negatively and 11% were not sure.

To what extent is stakeholders' engagement likely to continue, be scaled up, replicated, or institutionalized after the end of the project?

Stakeholders' engagement in project implementation areas is very likely to continue as has been explained above. However, scaling up, replication and institutionalization require further publicity of the potential of such interventions in helping alleviate Egypt's water and agriculture problems in order to draw attention and create a political will followed by decisions.

2.6 Cross-cutting issues

Cross-cutting issues include environmental, societal and gender considerations. The evaluation assesses to what extent these cross-cutting issues have been considered and whether they have contributed to the achievement of project results. Assessment looks at whether and to what degree the activities benefitted the environment in the implementation areas, whether the local social structure has been strengthened through farmers associations, local action groups, committees, and water users' associations, how the communication and visibility actions implemented contributed to the successful implementation of the Programme, and whether the initiative has a strong gender component.

EC sub-question	Source of information	Evaluation score
To what extent did the activities reduce the (soil, air, water) pollution?	Analysis of questionnaire results, structured interviews	5
To what extent has the social environment been strengthened by creating new social structure or by reinforcing the existing ones?	Analysis of questionnaire results, interviews with beneficiaries and WUAs	4
What is the composition of project beneficiaries with regards to age and gender? To what extent have the activities helped to enhance the value and empowerment of disadvantaged or poor populations such as young people, people with special needs, the elderly, and women? To what extent were women directly involved in the project activities?	Analysis of questionnaire results, structured interviews	4
To what extent have the communication and visibility activities been implemented? To what extent did these C&V activities create awareness and pose the basis for the sustainability of the project?	Structured interviews, review of project C&V products and activities	3

To what extent did the activities reduce the (soil, air, water) pollution?

Environmental impacts of the interventions are rated as very positive. The activities resulted in water saving of about 25%. This results in safeguarding the natural water resources for other desperately needed uses. Further, less irrigation water means less drainage water. The activities resulted in saving in fertilizer use by 16%. This will in turn result in a reduction in nutrients reaching the drainage water. The MRB technology results in a better microclimate around crops with better ventilation and less crop diseases and fungal infection. This has resulted in a reduction in the need for fungicides and pesticides, which has a positive impact on soil, water, air and on the produced crops. Reduction in irrigation water needs will result in a proportionate reduction in pumping requirements. Irrigation pumps are diesel operated. Thus a 25% reduction in fuel requirements and a 25% reduction in GHG emissions is expected due to the interventions. However, these effects are mainly realized within project implementation areas and require a wide scale adoption of project interventions to achieve regional impacts.

Social structure and social harmony have been enhanced in several ways. The capacity of WUAs was enhanced through training and interaction in project implementation. A main reason for disagreement and social disputes is the uneven distribution of water. This was resolved to a large extent due to marwa improvement. Irrigation time was reduced and water was able to reach tail end users easily. Further, the water savings due to this and other project interventions facilitated the supply of adequate water to all users. Based on survey results 85% of beneficiaries indicated that water shortage occurred before the project, while 38% reported incidences of water shortage after project implementation. The frequency of shortages was also reduced after the project. Further, the increase in yield and income resulted in enhancing general well-being of participating families. Marwa improvement helped also delineate land boundaries and resulted in less disputes about land ownership.

What is the composition of project beneficiaries with regards to age and gender? To what extent have the activities helped to enhance the value and empowerment of disadvantaged or poor populations such as young people, people with special needs, the elderly, and women? To what extent were women directly involved in the project activities?

The age of respondents was relatively high. In Fayoum age of respondents ranged between 25 and 82 years, with an average age of 52. 60% of respondents were of age 50 and above. In Minia, age of respondents ranged between 22 and 29 years, with an average age of 51. 56% of respondents were of age 50 and above.

Most of the respondents did not have another job besides farming. In Fayoum 14% of respondents had a second job, while the percentage was only 9 in Minya. Second jobs included trading, government positions, teaching and guarding.

Average land area was 2.5 faddan in Fayoum and 0.72 faddan in Minya. This is a relatively low value, and these people may be generally regarded as poor. Respondents have been cultivating the land on average for 21 years in Fayoum and for 31 years in Minya.

With regards to gender, participants in the survey were predominantly men. Only 2 out of 142 respondents were females in Fayoum and only 2 out of 100 respondents were females in Minya. This may be due to the traditional farming being a labor-intensive occupation. Nevertheless, project interventions have contributed positively to family income which will have a positive impact on all family members. It was recommended by several beneficiaries to include in future project activities packages targeting women such as animal husbandry and home processing of agricultural products to diversify and expand possibilities for family income and improve gender balance.

To what extent have the communication and visibility activities been implemented? To what extent did these C&V activities create awareness and pose the basis for the sustainability of the project?

Communication and visibility activities have been hampered to some extent by COVID-19, which prevented the holding of extensive stakeholder workshops or gatherings. Nevertheless, other avenues were adopted by the project management such as preparation of videos and brochures to raise awareness about the project.

In general, C&V activities need to be further carried out and expanded in order to raise awareness about project results and potential for providing low-cost high-impact solutions to Egypt's water and food security problems.

3. Conclusion

The overall assessment of the project is very positive. During interviews, the quote ‘best project we have encountered’ was repeatedly mentioned by government officials, project staff, heads of NGOs and beneficiary farmers. The average overall rating of the project by beneficiaries was 4.7/5. Several factors have contributed to success, the main being:

- The project was based on a need assessment and targets issues of high priority at local and regional level
- The project provided well-researched and well-designed solutions which had been previously tested and proved successful
- The project provided a comprehensive and complementary package of interventions targeting soil quality and water productivity
- The project management had high management and leadership skills and the management structure was homogeneous and pro-active
- The project networked and actively involved from the beginning all relevant stakeholders and beneficiaries
- The project gave priority to target end users with 2/3 of the budget allocated to products, activities and services realized on the ground.

The following table summarizes the overall rating for each evaluation criterion based on the assessments carried out in Chapter 2. This is followed by conclusions targeting each of the evaluation criteria.

Evaluation Criterion	Evaluation score
Relevance	4.6/5
Effectiveness	4.8/5
Efficiency	4.7/5
Prospective Impacts	4.7/5
Sustainability	3.7/5
Cross-cutting Issues	4.0/5

3.1 Relevance

The project proved very relevant to local and regional priorities and needs. The project was designed based on a careful needs assessment and context analysis. The project directly contributes to 4 of the 10 pillars of Egypt’s 2030 SDGs. The action complements ongoing local and national governmental and donor projects and programmes, with some added benefits as providing a comprehensive and complementary package and targeting directly needy end users. The institutional setup of the action was conducive to achieve the required results.

3.2 Effectiveness

The project has been overall rated as very effective. Project targets have generally been all achieved or over-achieved, with the exception of the rehabilitation of open drains component, which was not possible in two locations

due to the absence of open drains. Funds for this item were redirected to other project interventions. Targeted results were achieved and verified through interviews, questionnaire responses and field visits.

3.3 Efficiency

Project efficiency was highly satisfactory. Analysis of the budget breakdown showed that the intervention was cost effective in several ways. About two thirds of the project budget went into direct benefits to end users. Targeted benefits were satisfactorily achieved, perhaps the major benefits being the provision of a viable alternative of irrigation water reduction in the old lands (which constitute more than 90% of Egypt's agricultural lands) by 25% without the need for costly modern irrigation equipment which are also not well suited to most types of field crops grown in the old lands; raising awareness at all levels about importance and possibility of producing more with less; and creating a generation of water stewards adopting and promoting the new technologies and concepts. An estimate of the costs of benefits achieved by the project interventions indicated that the project pays off in less than two years, which is quite remarkable. A cost analysis indicated that project interventions could be sustained at reasonable costs to end users beyond the end of the project, but a mechanism for provision needs to be ensured for some items such as soil amendments.

3.4 Prospective Impacts

Discussions with the project management team and also with stakeholders in project implementation areas indicated that relevant government entities as well as farmer groups and WUAs were actively involved in project implementation and follow up. This ensured a smooth and efficient project implementation and achieving of project results.

The overall objective of the action was to sustainably improve the livelihoods of poor-resources rural communities in Minya and Fayoum governorates by introducing open-source solutions that are scientifically based and environmentally sound. The specific objectives of the project are: 1) Improve the productivity of the small scale-farming systems through more effective and efficient use of water and land resources; 2) Improve on-farm income by scaling out the improved irrigation and agricultural practices; and 3) Develop and disseminate innovative and cost-effective integrated packages at field level that can increase agricultural water productivity.

The evaluation indicated that overall objective and specific objectives 1 and 3 may be regarded as fully achieved. Specific objective 2 with regards to scaling out the improved agricultural practices may be regarded as partially achieved. Although the MRB machines have been handed over to the Agricultural Directorates to help spreading of the technology, the machines purchased through the project will not be sufficient to cover the needs of all interested farmers in the surroundings of project implementation areas. Further, there are no plans nor funds to scale out improved marwas beyond project implementation areas. This might require a larger project with higher funds.

Discussions with stakeholders and beneficiaries indicated that there is a high level of ownership of project activities and results. Beneficiaries are considering themselves proponents of a new way of thinking about farming and water utilization. They are eager to carry on the activities and are trying to adapt and invent beyond project results.

3.5 Sustainability

Project interventions are sustainable to a large degree. MRB and harvesting machines have been handed over to the Agricultural Directorates who have a dedicated Mechanical Department for maintenance and repair. The machines are locally manufactured by a reputable company and spare parts are readily available at reasonable cost. Further, the machines shall be operated in the future against a fee which shall a/o cover any operation and

maintenance costs. With regards to the lined marwas, construction has been generally carried out adequately according to engineering norms. Thus, it is expected that maintenance requirements shall be very limited and could be easily carried out by WUAs who have assumed responsibility for the marwas. On the other hand, maintenance of open drains is a recurring process as it constitutes mainly weed removal after regrowth. It is a relatively simple process, so, this could be also a responsibility of the WUAs in the future.

The sustainability of the project shall be reinforced by the fact that beneficiaries have seen actual results. They have seen that they are able to increase their income without spending more. This conviction shall be the driving force to guarantee program sustainability. However, they need some support to be able to carry on. They are now well aware about the use and operation of the MRB machines. They need to have sufficient machines available to support the new technologies. Improved marwas are in place and will continue to provide the achieved benefits with little maintenance requirements. However, marwa improvement needs to be expanded to other areas not served by the project. WUAs in the project implementation areas have been trained and have actively overseen the design, construction and implementation phases. Beneficiaries have also experienced the positive impacts of soil additives beyond chemical fertilizers which they are used to. They indicated that no mechanism is in place to supply such additives at a reasonable cost when needed. Meetings with government officials during this evaluation ensured that the government shall continue to support and maintain project achievements.

Thus, stakeholders' engagement in project implementation areas is very likely to continue. However, scaling up, replication and institutionalization require further publicity of the potential of such interventions in helping alleviate Egypt's water and agriculture problems in order to draw attention and create a political will followed by decisions.

3.6 Cross-cutting issues

Environmental impacts of the interventions are rated as very positive. The activities resulted in water saving of about 25%. This results in safeguarding the natural water resources for other desperately needed uses. Further, less irrigation water means less drainage water, which is a source of pollution of fresh water bodies. The activities resulted in saving in fertilizer use by 16%. This will in turn result in a reduction in nutrients reaching the drainage water. The MRB technology results in a better microclimate around crops with better ventilation and less crop diseases and fungal infection. This has resulted in a reduction in the need for fungicides and pesticides, which has a positive impact on soil, water, air and on the produced crops. Reduction in irrigation water needs will result in a proportionate reduction in pumping requirements. Irrigation pumps are diesel operated. Thus a 25% reduction in fuel requirements and a 25% reduction in GHG emissions is expected due to the interventions. However, these effects are mainly realized within project implementation areas and require a wide scale adoption of project interventions to achieve regional impacts. However, these effects are mainly restricted to project implementation areas and need wider application to have a considerable national impact.

Social structure and social harmony have been enhanced in several ways. The capacity of WUAs was enhanced through training and interaction in project implementation. Disputes over water shortage have decreased considerably in project implementation areas. Further, the increase in yield and income resulted in enhancing general well-being of participating families. Marwa improvement helped also delineate land boundaries and resulted in less disputes about land ownership.

Most project beneficiaries are of the elderly group (more than 50% above the age of 50). Most beneficiaries are smallholders and may be regarded as poor.

With regards to gender, participants in the survey were predominantly men. This may be due to the traditional farming being a labor-intensive occupation. It was recommended by several beneficiaries to include in future

project activities packages targeting women such as animal husbandry and home processing of agricultural products to diversify and expand possibilities for family income.

Communication and visibility activities have been hampered to some extent by COVID-19, which prevented the holding of extensive stakeholder workshops or gatherings. Nevertheless, other avenues were adopted by the project management such as preparation of videos and brochures to raise awareness about the project.

4. Lessons learned

Lessons learned from the intervention are numerous:

- Probably the most important lesson is that there is still much room to improve water use efficiency and water productivity in the old lands of Egypt without the need for large-scale infrastructure or prohibitively costly interventions.
- Improving water use efficiency is not necessarily at the cost of quality or quantity of the product. The project has proven that more product of higher quality can be produced with less inputs of money, manpower, time, water, energy, seeds and fertilizers.
- A well designed and carried out needs-assessment study and stakeholder consultations prior to the intervention pay off.
- Application of well researched and well tested interventions provides a higher chance of success of a project.
- Relying on relatively low-cost locally sourced supplies and equipment for the project contributes to project efficiency and is more likely to guarantee success and sustainability.
- Coordination and cooperation between government entities, donors, academia and NGOs is vital for success and for the benefit of end users.
- Better natural resources management results in benefits to the environment and to society.
- The project has shown that calamities can generate creativity. This is demonstrated by the creation of WhatsApp groups for communication with extensionists and preparation of electronic training material and field manuals that are easy to follow even by illiterate beneficiaries, which were developed to overcome restrictions imposed due to COVID-19

5. Recommendations

Recommendations to improve the impact of this and future interventions include:

- Communication and visibility activities need to be further carried out and expanded in order to raise awareness about project results and potential for providing low-cost high-impact solutions to Egypt's water and food security problems.
- Better bookkeeping of beneficiaries' data and project results is recommended. At the beginning of the evaluation, it was a little hard to get a hold of beneficiaries' data. There was no standardized data collection and storage format, but it was left to the discretion of the focal point in each governorate. Beneficiaries' names were extracted from scanned field sheets. No coding was provided for beneficiaries, and often different ways to record names (or nicknames) were used for the same beneficiary. This made it difficult at the start to determine who was who. Therefore, standardized book-keeping and recording in digital format of all beneficiaries and activities will make evaluations much easier and time effective.
- Improved marwas narrowed the original marwa by 2/3. Although this resulted in leaving more land for agriculture, it resulted in eliminating the means of reaching internal fields in some settings. Therefore, it is recommended to assess the means of transportation and guarantee accessibility of internal fields along with the design of the intervention.
- Adequate draining is vital for a healthy crop. The project targeted only maintenance of open drains. Covered drains (i.e. perforated underground pipes) were not covered in the maintenance plan, and thus no drain maintenance was carried out in Minia and in Awlad Mohamed in Fayoum. Maintenance of covered drains is possible and effective but requires some machinery which is relatively low-cost. It is recommended to provide such machinery in future interventions.
- If funds are sufficient, it might be also recommended to introduce other machinery with the project such as laser land levelers and deep ploughers.
- It is recommended to provide means of access to soil amendments provided by the project in the future, as most beneficiaries indicated that no mechanism is in place for that. This stands also for improved seeds varieties which were provided by the project.
- Some beneficiaries showed concern about the handing over of MRB machines and harvesters to the Agriculture Department. Their opinion was that such machines would be more readily available and better maintained if it were handed over to WUAs or farmers' associations. A higher number of machines has also been recommended to satisfy the high demand for the machines.
- Many beneficiaries recommended the expansion of project interventions to areas not served by the project.
- During interviews, farmers who had actively participated in the project and realized the possibility of producing more with less recommended providing (small) incentives for those who adopt water saving technologies such as participation in a training session, provision of soil additives, arrangement of visits to other farms, etc.

