終了時評価調査結果要約表（英文）

<table>
<tr><td colspan="3">I. Outline of the Project</td></tr>
<tr><td colspan="2">Country： Arab Republic of Egypt</td><td>Project title : The Project for Sustainable Systems for Food and Bio-energy Production with Water-saving Irrigation in the Egyptian Nile Basin</td></tr>
<tr><td colspan="2">Issue/Sector：Agricultural and Rural Development</td><td>Cooperation scheme：Technical Cooperation (SATREPS)</td></tr>
<tr><td colspan="2">Division in charge： Rural Development Department,</td><td>Estimated Total Cost：400,301,000Yen</td></tr>
<tr><td rowspan="3">Period of Cooperation</td><td rowspan="3">(R/D): June, 2009 ~ June, 2014
(Amended R/D):
June, 2009 ～March, 2015
(Five years and ten month)</td><td>Implementation Organizations in the Partner Country
Cairo University (CU)
Water Management Research Center (WMRC)
Agriculture Research Center (ARC)</td></tr>
<tr><td>Supporting Organization in Japan
University of Tsukuba
Tottori University</td></tr>
<tr><td>Related Cooperation: Water Management Improvement Project II (WMIP II), Strengthening for Water Management Transfer (SWMT) (Technical Cooperation)</td></tr>
</table>

1. Background of the Project

Due to the rapid population growth, averaging the annual increase as high as two percent per year, the Government of Egypt has set its national development goals focusing on expansion of employment opportunities in agriculture sector and increase in food production. However, Egypt is facing shortage of water resources and farmland. For instance, the agricultural production in the Nile Delta as a major agricultural area seems to have been already reached at the maximum of the productivity, and there is little space to develop new farmland in the area as well. In addition, it is difficult to develop new water resources since the amount of water intake from Nile River which covers most of the water resources is limited to 55.5billion tons by the bilateral agreement with Sudan.

Under this circumstance, Egypt is trying to develop improved water management methods in order to expand irrigated neighboring desert area and to increase food production. This expansion of the farmland is expected to absorb increasing workforce into agricultural sector which includes 30% of the workforce, and incomes of small-scale poor farmers.

While the Socio-Economic Development Five Year Plan (2007/8-2011/12) and National Water Resources Plan (NWRP) emphasize the agricultural and irrigation development for expansion of the farmland as priority more concrete measures are necessary to realize these policies. Therefore comprehensive and concrete measures for effective water use need to be proposed.

Based on the conditions stated above, Government of Egypt has submitted a proposal for the joint research project, Science and Technology Research Partnership for Sustainable Development (SATREPS), to the Government of Japan. This project, “Sustainable Systems for Food and Bio-Energy Production with Water-Saving Irrigation in the Egyptian Nile Basin” started in April 2009, and expected to propose the methods which realize efficient and sustainable agricultural production with efficient water management to respond to the above mentioned condition.

2. Project Overview

The Project has been implemented as a joint research between Egyptian research Institutions (Faculty of Agriculture, Cairo University, National Water Research Center, and Agriculture Research Center), and Japanese Universities (Tuskuba University and Mie University), in order to propose the methods which realize efficient and sustainable agricultural production with efficient water management to response to the above mentioned condition as well as grasping the present situation in the Nile Delta after 50 years from the construction of Aswan high Dam.

(1) Overall Goal

To contribute to increasing agricultural production and to expanding employment opportunities, as stated in the Socio-Economic Development Five-Year Plan, the National Water Resource Plan and Agricultural Production Plan for Egypt 2017.

(2) Project Purpose

To propose the methods which realize efficient and sustainable agricultural production with efficient water management to respond the rapid population growth.

(3) Outputs
(Output1) Evapotranspiration and salt/water balance in the Nile Delta are clarified.
(Output2) An improved plan of irrigation management at the different canal levels in the Nile Delta is developed.
(Output3) Methods for controlling salinity and fertility of soil are developed.
(Output4) Appropriate crop production and irrigation management systems at the farm level are developed.

(4) Inputs
Japanese side：Total cost 400,301,000 Yen
Expert 18 Experts
Long Term Expert (Project Coordinator) 3 Experts
Training in Japan 21 CPs
Provision of Equipment 147,123,762 Yen
Operational Cost 66,200,055 Yen

Egyptian side
Counterparts (CPs) 73 C/Ps
Provision of office space and laboratory and development of experimental farms
Operational Cost Transportation fee and utilities (2,051,136 yen (a part of cost share form WMRI)

II. Evaluation Team

Members of Evaluation Team	<Japanese Side>		
	Mr. Takeaki SATO	Leader	Visiting Senior Advisor, JICA
	Mr. Taro AZUMA	Evaluation Planning	Advisor, Team 2, Agricultural and Rural Development G1, Rural Development Dep., JICA
	Mr. Akira OGASAWARA	Evaluation & Analysis	Consultant, VSOC Co., Ltd.
	(Observor>		
	Dr. Kotaro INOUE	Science and Technology (Evaluation)	Principal Fellow/ Programme Officer, Japan Science and Technology Agency (JST)
	Ms. Miho TAKAHASHI	Science and Technology (Evaluation)	Assistant Programme Officer, JST
	<Egyptian Side>		
	Prof. Abd El Alim Metwally	Leader	Professor of Agronomy, Faculty of Agriculture, Cairo University (CU)
	Prof. Mohamed Fahmy Hussein	Member	Professor, Soil Science Department, Faculty of Agriculture Cairo University (CU)
	Prof. Mohamed Lotfy Yousef Nasr	Member	Professor of Water Economics, Water Management Research Institute (WMRI)
	Dr. Mohamed El Kholy	Member	Associate Professor, Environment Deportment, Soil, Water and Environment Research Institute (SWERI)
Period of Evaluation	2015/ 1/10～1/31		Type of Evaluation：Terminal Evaluation

III. Results of Evaluation

3. Outline of the Result of Evaluation

3-1. Achievement of Outputs and Project Purpose

<Output 1> Achieved

The water and salt balance in the pilot drainage site and quantitative values of evapotranspiration (ET) of each irrigation method were clarified, and the strip irrigation, drip irrigation instead of extended irrigation interval method are proposed. In addition, other than the indicators, the Project found out that the ET value was decreased remarkably over the horizontal distance of 10 times the wind break tree height.

Indicator 1-1. Fluctuation of transpiration and evaporation by using the eddy correlation system from the field under the long-interval irrigation treatments is quantified and agreed with the previous studies, Indicator 1-2.The water use efficiency (yield per unit water) in conventional and proposed water saving irrigations is quantitatively compared, Indicator 1-3 The relation between windbreak porosity and reduction of evapotranspiration is quantified for Casualina and Eucalypts trees, Indicator 1-4 The water/salt balance model for canal/drain command area is developed and extended to the delta area, are achieved.

<Output 2> Achieved

The Project found out that there was a clear difference in farmers' behavior between areas where a limited water intake time by rotation irrigation was observed and areas near to canals where farmers could take irrigation water at all time. Along with the findings, two possible methods for the implementation of water saving were considered; 1) to reduce irrigation time with leaving amount of irrigation water as it is, and 2) to reduce amount of irrigation water with leaving irrigation time as it is. Furthermore, it was revealed that water saving would increase the rate and frequency of recycling drainage water in downstream areas, while it would not affect upstream areas and thus effects of water saving was concentrated on downstream areas. Based on this analysis, the Project proposed intensified water recycling in the upstream part of the main irrigation canal as well.

Indicator 2-1 Analysis of monitoring data on fluctuations of water levels, frequency of pumping and pumping volume at the pilot Marwa/Meska is presented, Indicator 2-2 Interaction of observed fluctuations above with the capacity of Marwa, the number of farmer and area of farmland is identified, Indicator 2-3 Fuel efficiency for traditional pumping and improved pumping methods at the pilot Marwa/Meska is quantified, Indicator 2-4 Impacts of water saving options at the branch canal level are assessed under different scenarios by using the results above, are achieved.

<Output 3> Achieved

The Project obtained the relevant document on the current situation of salt accumulation in soil and found out that (1) salt accumulation in downstream area is more intensified than in upstream area in the delta, (2) salt accumulation was also observed in some areas scattered in upstream of the delta. The Project has presented the understanding that all such salt accumulation is related to water intake management situation of farmers and drainage water reuse. So as to leach the salt, rice cultivation is clarified as an effective method in the delta. The Project also proposes that selecting cultivars with salt-tolerant properties is also one of the keys to overcome this issue.

Indicator 3-1 Monitoring data on distribution and intensity of salt accumulation at paddy and non-paddy fields in the mid-delta are analyzed and compared with previous studies, Indicator 3-2 Monitoring data on spatial distribution and temporal fluctuation of ground water level, flow and EC value of the tile drainage of the pilot fields are analyzed, Indicator 3-3 Methods of improving tile drainage to control salinity are investigated, Indicator 3-4 Parameters for water, salt, heavy metals and other contaminants movement in soils at the experimental field are identified, Indicator 3-5 Decrease of salinity level after using farmland as paddy field is quantified, Indicator 3-6 Water permeability and physical parameters of soils with the application of calcium sulfate (Gypsum) and organic matter in crop fields is quantified, Indicator 3-7 A simulation model of water, salt, heavy metals and other contaminants movement in soils at the experimental field is developed and extended to delta areas of similar soils, are achieved.

<Output 4> Mostly Achieved

Strip irrigation was proposed as an easily applicable and promising water saving method for the future. It shows a good aspect of higher yield as well as water saving. However, it has some non-applicable crops for strip irrigation, such as Egyptian clover. For non-applicable crops, further technical developments based on the principle of avoiding water logging and water saving are recommended.

Indicator 4-1 Salt tolerance of cultivated varieties of major crops is quantified by using both pot (and lysimeter) experiment(s), Indicator 4-2 Appropriate cropping pattern corresponding to the future water availability is proposed based on survey data on cropping pattern at the target area, Indicator 4-3 Crop yield and quality under different irrigation treatments are identified, Indicator 4-4 Feed value of straws (rice, wheat, maize) grown under different irrigation treatments is measured and an appropriate feeding design is developed, are achieved except

measuring yield of different bio-fuel crops under different conditions, which will be finalized by the end of the Project.

<Project Purpose> Achieved (at the end of the Project)

Indicator 1 Difference of evapotranspiration and crop yield under conventional and different water saving irrigation treatments is quantified, Indicator 2 An optimal water saving irrigation treatment is identified at the Marwa/Meska level by clarifying water management approaches, including water management scheduling, under different irrigation treatments, Indicator 3 An optimal method for the reuse of drainage water is identified in the middle delta, and indicator 4 Optimal cropping patterns are identified according to available water resources, are achieved.

The Project has already developed a policy and research recommendation based on the achievement of the Project, and will submit to Egyptian side as well as having presentation at the occasion of the final symposiums which will be held in March 2015 both in Egypt and Japan to introduce the recommendations and to disseminate the achievement of the Project.

3.2. Summary of Review Results

(1) Relevance

The relevance of the Project is high since the Project is highly consistent with the Egyptian development plan and sector strategy, and Japanese aid policy. The Sixth Five-year Socio-economic Development Plan (2007-2012) is the primary development plan formulated by the government of Egypt. In the Plan, Long-term Agricultural Development Strategy (2007) aims at "increasing agricultural production by 3.9 % annually through achieving economic efficiency in allocation and use of resources to sustain development and protect the environment" as the first objective. The National Water Resources Plan (NWRP) (2006-2017) was also formulated in October 2006, with the coherent strategy consisting of the following three basic pillars; developing additional new water resources, making better use of existing water resources, and protecting health and environment.

Country Assistance Program for Egypt of the government of Japan formulated in June 2008, it states that Japan will provide strategic assistance to Egypt with " Poverty Reduction and Improvement of Living Standard" emphasizing on development of agriculture and rural communities.

(2) Effectiveness

Effectiveness of the Project is high. The outputs are expected to be achieved by the end of the Project, then the project purpose also is expected to be achieved accordingly. Achievement level of each output is satisfactory as described in "3.1 Output." Logical sequence of the relationship between output 1, 2, 3 and 4 and the project purpose is strong enough since (i) clarification of evapotranspiration and salt/water balance, (ii) development of an improved plan of irrigation management, (iii) development of methods for controlling salinity and fertility of soil and (iv) development of appropriate crop production and irrigation management systems are indispensable to making proposal of the methods to realize efficient and sustainable agricultural production with efficient water management.

(3) Efficiency

The efficiency of the Project is moderate. With regards to quality and quantity of input from the Japanese side such as dispatch of experts, provision of equipment, operational cost and trainings in Japan are relatively appropriate. Modality of Japanese expert dispatch, long-term researchers could not be dispatched. After the political change in June 2013, the Project attempted to promote smooth coordination of the Project by expanding the dispatch periods of the Project Manager. With regards to quality and quantity of input from the Egyptian side, Egyptian researchers who specialize in various research fields are appropriately assigned. Frequent changes in assignment of Egyptian researchers negatively affected to the efficiency of the Project activities.

[Promoting factors]

- The Project selected study sites of Abshan and Bahr El Nour to evaluate the effects of irrigation water quality on several soil properties. Bahr El Nour was a site developed by a Japanese technical cooperation project, which contributed to the efficiency of the Project.

[Inhibiting factors]

- Interruption and delay of some project activities caused by temporal unstable situation
- Frequent changes in assignment of researcher from Egyptian side.

(4) Impact

- The impact of the Project is relatively high. The overall goal of the Project is set with a considerable longer-term perspective than assumed. In addition to that, it is still uncertain that the overall goal will be achieved three to five years after the termination of the Project since it is considered to be achieved by broader factors/conditions including the contribution of the Project. From this perspective, it is not appropriate the overall goal is targeted to be evaluated on the ex post evaluation. Besides that, the following impacts were observed by the implementation of the Project.

  - The Project is drafting policy and research recommendations to the Egyptian Government based on the research results. The recommendations are expected to be important inputs for the incoming water resource development plan.
  - ET System for Eddy Correlation Method is already introduced to the curriculum of the Faculty of Agriculture of the Cairo University. Due to ET System for Eddy Correlation Method which is introduced by the Project, two master degree students from the Faculty of Agriculture at Cairo University started their theses, working with the Project Manager from the Egyptian side, Dr. Rushdi El-Kilani.
  - The Project is in the process of publishing a book "Irrigated Agriculture in Egypt- past, present and future (tentative title, as of 1 January 2015)," based on the outcomes of the project research activities, which is expected to promote awareness of people working in the field of agriculture and other related sectors.
  - The Project attempts to disseminate the research results in the form of journal article. A total of ten papers were already published. Six presentations in academic conferences, 49 oral presentations and 12 poster presentations were also made in academic opportunities during the project period.
  - Scientific clarification from the Project was highly useful for SWMT implementation on water management according to the Chief Advisor.
  - Improving Small Scale Farmers' Market-Oriented Agriculture Project (ISMAP), JICA technical cooperation project in Egypt, is keen to demonstrate the intercropping and strip irrigation techniques and to practices experiments by the Project to target farmers. It is expected that the experiment results will be disseminated and practiced by farmers in the future.
  - The Project introduced the system for science-based decision-making in Egypt.

- There is no concrete negative impact at the time of the terminal evaluation.

(5) Sustainability

The overall sustainability of the Project is moderate.

(i) Political sustainability

Political sustainability is high since the acceptance of social application is highly consistent with the strategies of the Egyptian government as mentioned in "Relevance" above.

(ii) Organizational sustainability

Organizational sustainability is moderate. Structure of implementation organizations (CU, NWRC and ARC) was established. However, it is not certain that this collaboration between three research institutions continues without supports from the Project.

(iii) Financial sustainability

Financial sustainability is moderate. There were some concerns particularly about cost sharing from the Egyptian side at the beginning of the Project. The Egyptian side shared some transportation cost for field surveys and data collection. In this regard, it is expected for them to bear the cost for research activities in the future. However, it is also necessary to secure the budget for O&M of the equipment that the Project provided.

(iv) Technical sustainability

Technical sustainability is moderate. It is expected that the research results on water and salt balance, water management, soil fertility and food and oil crop production will be shared through policy and research recommendation. However, within the counterpart organizations, they did not sufficiently share with research skills, techniques of data analysis, and management of provided research equipment to the other researchers who have not been involved with the Project.

3.3. Factors that promoted or inhibited the achievement of the Project Purpose

(1) Factors concerning to Planning

- Nil.

(2) Factors concerning to the Implementation Process

- Use of a project site developed by a Japanese technical cooperation project for comparison survey on irrigation water quality

3.4. Factors that impeded realization of effects

(1) Factors concerning to Planning

- Nil.

(2) Factors concerning to the Implementation Process
- Interruption and delay of some project activities caused by temporal unstable situation
- Frequent changes in assignment of researchers from Egyptian side
- The Project is recognized as a pioneer project in cooperation among three research institutions, CU, NWRC, and ARC. As for the coordination of these institutions, it took more time and efforts among them and the Japanese experts than expected.

3.5. Conclusion
- The Project has been implemented relatively smoothly at the moment of the terminal evaluation with high relevance, effectiveness and impact, and moderate efficiency and sustainability. It is evaluated that the project purpose will be achieved at the end of the Project with satisfactory achievement level of outputs. Accordingly, the Evaluation Team concluded that it is appropriate to terminate the Project in March 2015 as scheduled.

3.6. Recommendations
(Recommendations for the Remaining Period of Project Implementation)
(1) Completion of uncompleted analysis of research activities
- (For the Project) In collaboration with counterpart organizations, the Project needs to complete some unfinished research analysis on bio-fuel crops for more accurate analysis based on the data during 2013-2014.

(2) Finalizing policy and research recommendations
- (For the Project) The Project is drafting policy and research recommendations and elaborating and revising it based on the discussions with Egyptian side. The Project needs to be sure of completing the recommendations and presenting them to the relevant ministries and research institutions.

(3) Ownership transfer of provided equipment
- (For the Project) The Project needs to complete necessary procedures so as to properly allocate equipment provided by the Project to each institution.

(Recommendations after Termination of the Project)
(1) Reflection of policy and research recommendations into relevant national plan and strategy
- (For MWRI) The Ministry is recommended to attempt to reflect the policy recommendation into new development strategies and incoming sector strategies.
- (For CU, NWRC, and ARC) They are recommended to attempt to reflect the research recommendation into future research plans/ strategies.

(2) Continuation of research activities
- (For CU, NWRC, and ARC) For more accurate statistical implications and more accurate analysis, they are recommended to consider conducting more experiments at the fields.

(3) Strengthening implementation structure for equipment management
- (For CU, NWRC, and ARC) They are recommended to appoint staff in charge of equipment management and to secure an enough budget for its operation and maintenance.

(4) Dissemination of research results
- (For CU, NWRC, and ARC) They are recommended to present research results of the Project as much as possible in the form of published papers, presentations in academic conferences, oral presentation and poster presentation. Furthermore, they are recommended to disseminate the research results to the field by collaboration between three research institutions.

(5) Maintaining academic relationship between Japanese and Egyptian sides
- (For Relevant universities and research institutions of Japanese side) Relevant universities and research institutions and/or researchers in Japan are recommended to continue their supports to the relevant Egyptian research institutions and/or researchers in order for them to continue their research activities.

3.7. Lessons Learned
-Since this Project has three research institutions in Egyptian side as counterparts, it required a lot of efforts for coordination between these institutions. For smooth management of the Project, long-term expert(s) (researcher(s)) should have been dispatched throughout the Project and coordination body among three counterpart organizations from the Egyptian side should have been organized.

- The Project formulated a basic structure for joint research in collaboration with CU, NWRC and ARC. Consequently, the Project is a good example of joint research-work between multi-disciplines in several institutions.

3.8. Follow-up Situation

-Nil.

(end)