Summary Results of the Evaluation Study

<table>
<tr><td colspan="2">I. Outline of the Project</td></tr>
<tr><td>Country: Republic of Tunisia</td><td>Project Title: Valorization of Bio-resources in Semi-Arid and Arid Land for Regional Development</td></tr>
<tr><td>Issues/Sector: Agriculture</td><td>Cooperation Scheme: Science and Technology Research Partnership for Sustainable Development</td></tr>
<tr><td>Division in Charge:
Rural Development Department</td><td>Estimated Total Cost: 396 million yen (At the time of evaluation)</td></tr>
<tr><td rowspan="2">Period of Cooperation:
May 2010 – May 2015 (60 months)</td><td>Implementation Organizations in the Partner Country:
● Ministry of Higher Education and Scientific Research (hereinafter referred to as “MHESR”)
● National School of Engineers of Sfax (ENIS)
● Center of Biotechnology of Sfax (CBS)
● Institute of Arid Regions (IRA)
● Center of Biotechnology of Borj Cedria (CBBC)
● National Agronomic Institute of Tunisia (INAT)</td></tr>
<tr><td>Supporting Organizations in Japan:
● University of Tsukuba
● Kyoto University
● Tokyo Institute of Technology</td></tr>
<tr><td colspan="2">Related Cooperation: –</td></tr>
<tr><td colspan="2">1. Background of the Project
Tunisia has a unique topography with the distance from the Mediterranean Sea to desert areas being short (100-350 km); most of the desert areas belong to arid or semi-arid zone. There is a significant difference of dryness in these areas with a variety of bio-resources. It is known that microorganisms and plants in these desert areas have adapted to the marginal environment and they contain valuable biologically functional constituents. However, research examples of antioxidant functions are few. Tunisia is expected to be the second largest exporting country of olive oil in the world in 2015 but most of the exported olive oil is in the form of bulk tank; value added bottled products for example are limited. Regarding medicinal plants, several practices and analyses suggest that they may contain several useful components such as melanin synthesis inhibition molecules, etc. However; again, such valuable components are not utilized so far.
Therefore, it is imperative to search for the possible functional usefulness of bio-resources, develop a method to use, and add value to the products thereof. It is also necessary to develop methods for breeding new varieties adaptable to the arid environment and where possible ensure the mass production of those bio-resources whose availability is rather limited in the arid land.
The Government of Tunisia requested this project, “Valorization of Bio-resources in Semi-Arid and Arid Land for Regional Development”, as Tunisian-Japanese joint research activities already exist between the two countries. The Project has been started in June 2010 with a five-year bridge and includes research institutions involving not only the five Tunisian institutions but also three institutions in Japan.</td></tr>
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2. Project Overview

This project is implemented to develop the integrated basis to conduct the prospection of useful compounds in bio-resources in semi-arid and arid land, evaluation of their functionality, their cultivation and the commercialization through the joint research between Japanese and Tunisian research institutions.

(1) Overall Goal

1. Implementing institutions become the center of excellence for valorization of bio-resources in semi-arid and arid land.
2. Commercialization of the products developed based on useful bio-resources stimulates regional development

(2) Project Purpose

Integrated technical basis to conduct the prospection of useful compounds in bio-resources (olives, medicinal plants and halophytes) in semi-arid and arid land, evaluation of their functionality, their cultivation and the commercialization are developed.

(3) Outputs

1. Function of useful compounds in bio-resources (olives, medicinal plants and halophytes) in semi-arid and arid land and their habitats are analyzed.
2. Advanced technology of water use appropriate to the local environment and the method to ensure a stable environment which is sustainable for the production of bio-resources (olives, medicinal plants and halophytes) in semi-arid and arid land are developed.
3. Integrated database of bio-resources (olives, medicinal plants and halophytes) in semi-arid and arid land that links to the library/sample bank is developed.
4. Breeding methods of abiotic stress-tolerant food crop species using molecular marker are developed.
5. Techniques to valorize and commercialize bio-resources (olives, medicinal plants and halophytes) in semi-arid and arid land are developed..

(4) Inputs

Japanese Side: estimated total cost: 396 million yen (at the time of the evaluation)

Researchers: 89 members (10 professors, 11 associate professors, 12 assistant professors, 13 researchers, 1 technical assistant, 15 PhD students, 27 master students, 4 others)

Dispatch of researchers to Tunisia: 28 members, 114 trips, 1,200 days in total

Dispatch of project coordinator to Tunisia: 51.9 person-months (including leave period)

Equipment and consumables: JPY 186,795 thousand plus TND 269 thousand

Local cost: TND 739 thousand

Invitation programs to Japan: 4 times 25 people

Training program in Japan: 6 people for long-term and 29 people 33 times for short-term

Tunisian Side:

Researchers: 97 members (11 professors, 14 associate professors, 7 assistant professors, 4 researchers, 16 technicians, 2 engineers, 2 postdoctoral, 33 PhD students, 8 master students)

Major equipment: TND 247 thousand plus EUR 144 thousand

Local cost: TND 199 thousand

Evaluation Team			
Members	Japanese members		
	Mr. Tomochika MOTOMURA	Leader	Senior Advisor to the Director General, Rural Development Department, JICA
	Ms. Naho AIZU	Cooperation Planning	Assistant Director, Field Crop Based Farming Area Division, Rural Development Department, JICA
	Dr. Jun TSURUI	Evaluation Analysis	Consultant, Sustainable Inc.
	(Observers)		
	Dr. Makie KOKUBUN	Science and Technology Planning Leader	JST Program Officer/ Professor, Graduate School of Agricultural Science, Tohoku University
	Mr. Masayuki SATO	Science and Technology Planning Evaluation	Principal Researcher, Department of International Affairs, JST
	Dr. Hiroko ISODA	Project Leader	Director, Alliance for Research on North Africa (ARENA)/ Professor, Faculty of Life and Environmental Sciences, University of Tsukuba
	Tunisian member		
	Pr. Helmi MARDASSI	Leader	The Institut Pasteur de Tunis
	Pr. Moktar HAMDI	Member	General Director of the National Center for Nuclear Science and Technologies
	Pr. Mohamed EN NABLI	Member	Ex-President of the National Committee of Evaluation of Research Activities
Period of Evaluation: 24 Jan - 13 Feb 2015			Type of Evaluation: Terminal Evaluation

III. Results of Evaluation

1. Achievements

1-1. Outputs

(1) Output 1: Achieved

The research group for Output 1 has identified 13 promising functionalities and numbers of original articles were published.

All of Indicator 1-1 (Number of publications, international conference presentations, and application of patents in the related field is at least 15, 50 and 5 respectively, and achievements are 30, 63 and 5 respectively), Indicator 1-2 (Number of researchers, students and technical staffs who have adequate knowledge to analyze functionality is at least 7, 6 and 5 respectively at CBBC, CBS and IRA, and achievements are 11, 7 and 6 respectively), and Indicator 1-3 (Number of promising functionalities of bio-resources identified needs to be at least 8, and 13 have identified as achievement) have been achieved.

(2) Output2: Fairly achieved

The research group for Output 2 has developed four advanced technology of water use and numbers of original articles were published.

Indicator 2-1 (Number of publications and international conference presentations in the related field is at least 12 and 28 respectively, and achievement are 25 and 31 respectively) has been achieved.

Indicator 2-2 (Number of researchers, students and technical staffs who have adequate knowledge to further develop the related technologies is at least 2, 10, 3 and 1 respectively at CBS, ENIS, INAT and IRA, and achievements are 5,8,8 and 0 respectively) has been moderately achieved.

(3) Output 3: Moderately achieved

Data sets of plant species have been prepared for some extent but the database has not been established.

Regarding library/sample bank establishment, Indicator 3-4 (Number of samples preserved in the library/sample bank is more than 360, and achievement is 430) has been achieved. Indicator 3-5 (Number of staffs who can maintain the library/sample bank is at least 1 respectively at CBBC, CBS and IRA, and achievements are 3,3 and 4 respectively but it should be noted that the figure shows number of staff members who can maintain library/sample bank to some extent) and Indicator 3-6 (A management manual for the library/ sample bank is developed, have not been completed at the time of Terminal Evaluation) have been moderately achieved. As for the integrated database, all of Indicator 3-1 (Number of species and information included in the integrated database is more than 60, 87 are listed, but it should be noted that the data lists does not include full information), Indicator 3-2 (Number of staff who can maintain the integrated database is at least 1 at each Tunisian institution, the number of staff members who can prepare data lists is more than the indicator but it does not means that they can operate integrated data system), and Indicator 3-3 (A management manual for the integrated database is developed, the manual has been drafted but it is still under revision at the time of Terminal Evaluation) have been moderately achieved.

(4) Output 4: Achieved

The research group for Output 4 has developed breeding methods of drought tolerant, salinity tolerant, and disease tolerant food crops using molecular markers.

Both of Indicator 4-1 (Number of publications and international conference presentations in the related field is at least 5 and 5 respectively, and the achievement is 14 in total.) and Indicator 4-2 (Number of researchers, students and technical staffs who have adequate knowledge to conduct the related analysis is at least 6 at INAT, and the achievement is 9) have been achieved.

(5) Output 5: Fairly achieved

Although commercialization of bio-resources has not become reality, the research group for Output 5 has developed two technologies which could be commercialized in the future.

Both of Indicator 5-1 (Number of publications, international conference presentation, and application of patent in the related field is at least 6, 8 and 1 respectively, and the achievements are 10,10 and 1 respectively) and Indicator 5-2 (Number of researchers, students and technical staffs who have adequate knowledge to valorize and commercialize bio-resources is at least 3 at each of CBBC, CBS and IRA, and the achievement is 9 in total) have been moderately achieved.

1-2. Project Purpose: Achieved

Although Indicator 1 (Overall research ability of implementing institutions) is devoid of numerical target, the Indicator is conceived as achieved. There are 40 original articles published jointly by Tunisian and Japanese researchers. There are six cases of joint patent application. Several research methods such as bio assay were newly introduced to the Tunisian institutions.

Indicator 2 (System of collaboration among implementing institutions) is also lack of numerical target, but it has been assessed as achieved. Tunisian research institutions had not experienced joint research among them before the Project. At present, the institutions have developed system of collaboration. For example, institutions which are operating similar equipment have been helping each other for trouble shooting of the equipment.

2. Evaluation Results

2-1. Relevance: High (High at the time of Mid-term Review.)

The Project is in consistency with the ten important issues for Tunisian development specified in the "Economic and Social Development Strategy 2012-2016", as well as the prioritized areas identified in the COuntry Assistance Policy of Japan for Tunisia. The Project is also responding needs of Tunisian research institutions which is "leading-edge research activities to contribute to economic development of Tunisia". The Project is also in line with policies of Tunisia and Japan.

2-2. Effectiveness: High (Potentially high at the time of Mid-term Review.)

The Project Purpose has been achieved by the time of Terminal Evaluation. Novel research methods have been introduced to Tunisian research institutes and it led to numbers of research publications. The logicality between the Project Purpose and the Outputs are appropriate, and the Project Purpose was achieved through the achievement of each Output. System of collaboration has been developed among the Tunisian research institutions and it enabled them to work together efficiently.

2-3. Efficiency: Moderately high (Moderate at the time of Mid-term Review.)

Expectancies of achieving the Outputs is high in general, expect for the Output 3.The integrated database has not been established yet though the situation is expected to be improved by the end of the Project. Inputs from Japanese and Tunisian were appropriate and most units of expensive equipment are currently functioning The Project faced several unexpected difficulties such as political change and social instability of Tunisia, traffic accident during transporting equipment, and the Great East Japan Earthquake in Japan. However, such delay has been recovered by efforts made by Tunisian and Japanese members.

2-4. Impact: Moderately high (Potentially high at the time of Mid-term Review.)

Tunisian research institutions have been already receiving several inquiries from private companies. The facts indicate the possibility of the Tunisian institutes being recognized as the center of excellence for valorization of bio-resources in the future and commercialization of bio-resources. ENIS has been developing an "environmental database" which was not planned at the beginning by using data obtained by the Project activities. Japanese researchers were enabled to access the Tunisian sites where collections were made.

There was no negative impact that came up during the project period

2-5. Sustainability: Moderate (Secured at the time of Mid-term Review.)

As mentioned above, the Project is in consistency with the policy in Tunisia, Sustainability on policy, organization and institution, are secured. Recruitment of researchers who have trained in Japan by the Tunisian research institutes is a challenge. There is no fear of environmental deterioration at this time but domestication of bio-resources might be undertaken to protect bio-resources in the future. Lack of rapidly responding maintenance services are crucial issues. Insufficient budget for maintenance of equipment and consumables procurement is another concern.

3. Supporting factors that promoted realization of effect

(1) Factors relevant to planning

- Training programs in Japan were carefully and appropriately designed. Trainees could acquire technologies in Japan and use them once back in Tunisia.

(2) Factors relevant to implementation process

- Visiting research institutes and Japanese industrial sectors, including those in Shodoshima island in Japan, inspired Tunisian researchers to valorize Tunisian bio-resources.

4. Factors that impeded realization of effect

(1) Factors relevant to implementation process

- Political change and social instability as a consequence of the revolution delayed to some extent research activities in Tunisia.
- Traffic accident delayed installation of some of research equipment.
- The Great East Japan Earthquake in 2011 hindered activities in Japan. Many samples for analysis had been deteriorated and foreign students had returned to their countries.

5. Conclusion

The Project has achieved its main purpose that is the setup of integrated technical basis for the valorization of bio-resources (prospection of useful compounds in olives, medicinal plants and halophytes; evaluation of their functionalities and commercialization potential).

The Tunisian institutions have benefitted of state-of-the-art equipment and developed their skills, and are now capable of performing up-to-date research activities. Collaboration among the Project partners has been intensified. As a result, numerous outcomes have been produced in terms of capacity building, technology transfer and potential of bio-resources valorization.

The Terminal Evaluation Team concludes that the Project can be terminated in May 2015, as it was planned.

6. Recommendations

(1) To the Japanese Side After the Project

- Continuous cooperation with Tunisian side
- Efforts to attract Japanese and foreign industries

(2) To the Tunisian Side After the Project

- Continuous cooperation with Japanese side

- Establishment and functionalization of a platform for academic-industrial alliance to accelerate valorization of research outcomes
- Ensure access to the Databases on useful functionalities of bio-resources to stakeholders
- Continuous involvement of Tunisian research personnel (especially for participants of training programs in Japan)
- Proper maintenance of equipment by holding maintenance contract with suppliers, provision of maintenance budget by MHESR, etc.

7. Lessons Learnt

- Valorization of bio-resources requires long periods with the inclusion of industrial partners.
- Combining traditional knowledge with scientific approaches enables to speed up discovering useful bio-resources
- Technology transfer can be accelerated by harmonizing training and equipment acquisition
- Clear assignment of roles and a strong leadership is essential to Enhance multi-institutional collaboration
- Prior discussion among research institutions and suppliers with local representation are the key issues for sustainability of Equipment.