REPUBLIC OF TUNISIA
MNISTRY OF AGRICULTURE

Republic of Tunisia
The Project for the Development of Irrigated Areas of Northern Tunisia

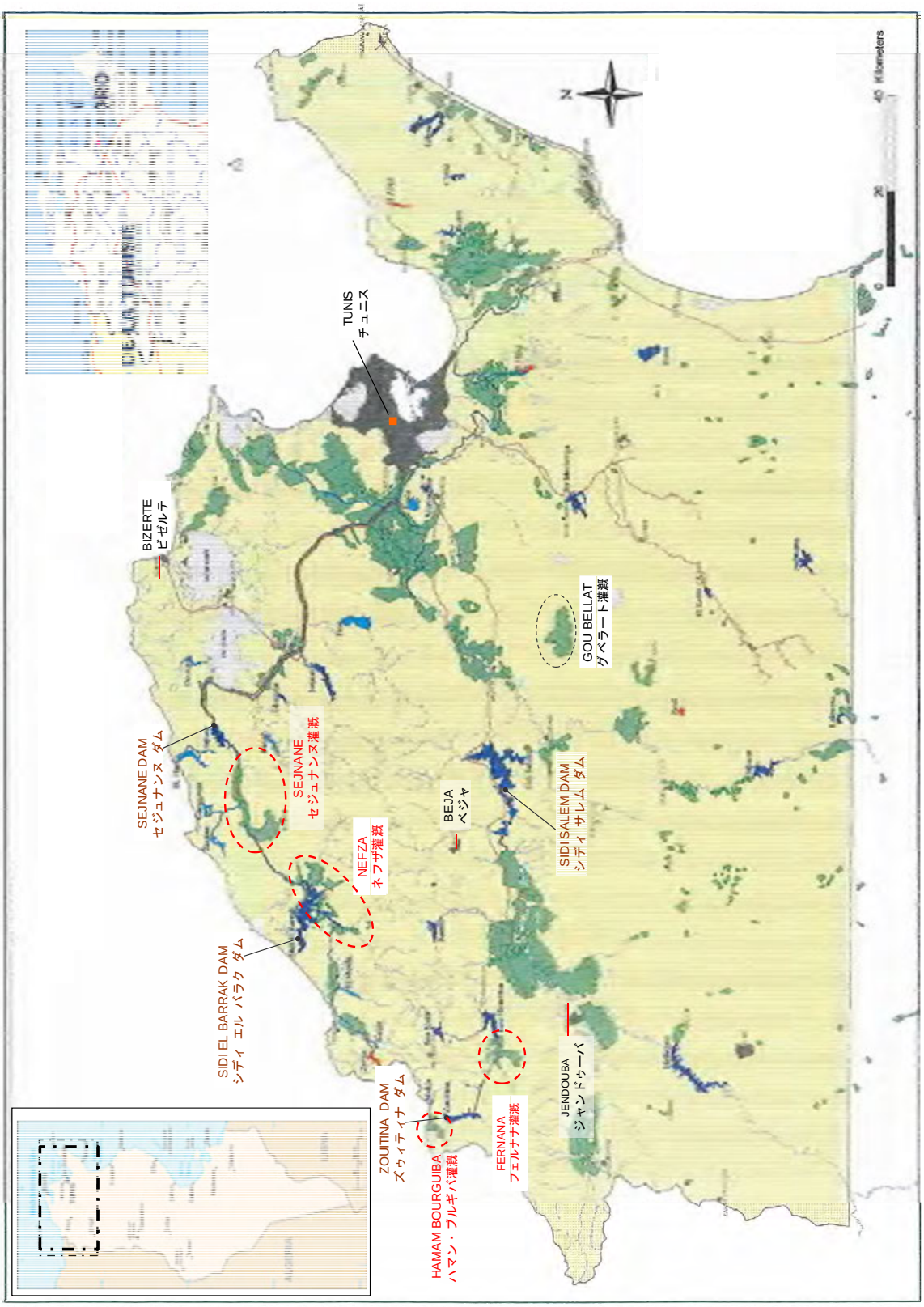
Final Report

Main Report

March 2015

Japan International Cooperation Agency (JICA)
NTC International Co., Ltd

Location Map



Pictures

Pepper seedlings in the Green house Nursery of a seedlings production and sales large company

Explanation on the installation, check and maintenance of flow meters to staffs of GDA and CRDA by the local consultant in Irrigation.

The local consultant in Agronomy explains and trains farmers of the demonstration farms in the planting of grafted seedlings of Melon in a drip irrigated field in Nefza.(May 2014)

The field engineer in irrigation in Sedjnane explains the cleaning of filter and maintenance of drip irrigation facilities to neighboring farmers on a Field Day.

The chief of Nefza CTV guides farmers outside of the Pilot Site to a demonstration farm of melon in Nefza and explains techniques of vegetables cultivation. (August 2014)

Technical training of GDA members (farmers) on plant protection and pest control of summer vegetables by an outside lecturer. (June 2014, Nefza)

A workshop held in Sedjnane : Results of farming and cultivation were shared and spreaded out enough (September 2014)

J. Yellow Canari variety of melon at a demonstration farm in Nefza as of August 2014.Yield is 26 to 40 ton/ha and exceeds average yield of surrounding area (23 ton /ha). Benefit is 6,500 to 12,000 DT/ha.

A demonstration farm in Fernana in September 2014. Matured tomatoes are shipped collectively for processing as ketchup. Yield is high (73 to 75 ton/ha; average yield of surrounding area is 64 ton).

Watermelon at a demonstration farm in Nefza as of August 2014. Maximum yield is 60 ton/ha (Average yield of surrounding area is 45 ton/ha) and maximum benefit is 15,000 DT/ha.

Pepper for processing at a demonstration farm in Fernana as of October 2014. Yield at a demonstration plot in Nefza is 46 ton/ha (Average yield of surrounding area: 21 ton/ha). Benefit is 17,000 DT/ha

Final seminar for sharing DPINT results in Tunis. Extension activities in Nefza were presented by the chief of Nefza CTV (December 2014).

Republic of Tunisia

The Project for the Development of Irrigated Areas of Northern Tunisia

Final Report

Table of Contents

List of Table

Appendix

Abbreviation

AFA	Land Matters Agency
A/P	Action Plan
AVFA	Agricultural Popularization and Training Agency
BLS	Baseline Survey
CRA	Agricultural Popularization Center
CRDA	Regional Directorate General for Agricultural Development
C/P	Counter Part
CTV	Local Unit for Agricultural Popularization
DGFIOP	General Direction of Finance and Investment for Professional Organization
DGGREE	General Direction of Rural Engineering and Water Management
DGPA	General Direction of Agricultural Production
DHER	Division for water and Rural Equipment
DPINT	The Project for the Development of Irrigated Areas of Northern Tunisia
FAO	Food and Agriculture Organization
FIOP	Finance and Investment for Professional Organization
GDA	Development Grouping for Agriculture and Fishery Sector
INRAT	National Institution of Agricultural Research at Tunis
IRESA	Institution of Agricultural Research and Higher Education
JICA	Japan International Cooperation Agency
MA	Ministry of Agriculture
SECADENORD	Water Channel and Conduits Development Company
SMSA	Mutual Society for Agricultural Services

1. Outline of the project

1.1 Background of the Project

Based on the request of the Government of Tunisia, JICA (Japan International Cooperation Agency) has started the technical cooperation : "The Project for the Development of Irrigated Area of Northern Tunisia" (hereinafter, the Project) from October 2010 to September 2013 with the aim of increasing efficiency of water use, agricultural productivity and the living standard of farmers. Due to the unexpected political turbulence in January 2011, JICA long-term experts were forced to suspend their activities for more than two months. Consequently, the Project was affected severely in many ways, causing the slowdown of its implementation to a great extent. In addition, the political turbulence affected the civil society, including the relationship between the Government and farmers, which was the crucial original basis of the Project. Hence, the Government of Tunisia has requested JICA to review and to reconstruct the Project.

Upon this request JICA dispatched a consultation team on the project operation and guidance in September 2011 to discuss with the Government of Tunisia measures to be taken for the purpose of reinforcing activities of the Project. As a result of the discussion, JICA will send a team of Japanese consultants who will employ Tunisian consultants under the Project in order to meet its agreed objectives and to enhance its implementation. Especially, it is decided that showing good practice and quick expansion of extension activities are promoted through activities of demonstration farms at pilot sites in three irrigation area, namely Nefza, Sedjnane, and Fernana.

In such circumstances, the Project was started by Japanese private consultants in February 2011 and it was decided that the Project was extended for two months up to November 2013. This Project aims to increase the rate of irrigation and the unit crops and intends to let farmers have incentives to challenge irrigated agriculture while focusing on the direct impacts on the income improvement by the improvement of farming at the farmer's level. Therefore, the Project has been working on the training for extension activities at the demonstration farms as a nuclear at the fields. As a result, the efforts at demonstration farm's level paid off and increase of unit crops and productivity were verified. However, extension to the pilot sites of the Project has not yet been realized. The effect of the Project was restrictive.

As the result of the survey on the project operation and guidance, the Project was extended for one year up to February 2015 due to the above situation. And, then, within this one year extended period, based on the request of Tunisian Government, JICA decided to assist for the several survey （establishment of SMSA, existing irrigation networks and facilities, drainage improvement, etc）

1.2 Overall Goal of the Project

A suitable irrigation is performed and an efficient agriculture is achieved in Nefza, Sedjnane, Fernana and Hammam Bourguiba, with desirable irrigated farming.

1.3 Objectives of the Project

In the pilot sites of Nefza, Sedjnane and Fernana irrigated areas, models of irrigated agriculture are achieved, and the extension system which can be adaptable in all the irrigated areas is developed.

1.4 Output of the Project

(a) Natural situation, agriculture condition, farming support and extension system supported by the Regional Directorate General for Agricultural Development (CRDA) and Agriculture and Fishery Sector Development Groups (GDA), etc. in 3 irrigated areas (Nefza, Sedjnane and Fernana) are grasped.

(b) The irrigated agriculture which serves as a model at pilot sites is established.

(c) The farming extension support system by CRDA and GDA is strengthened.

(d) The results of activities of the Project are shared among the persons/organizations related to the 4 irrigated areas (Nefza, Sedjnane, Fernana and Hammam Bourguiba).

1.5 Purpose of the Work

The objectives of the Project are to select and to promote useful activities under “The Water Pipeline Construction and Irrigation Project in the North of Tunisia” as well as “Barbara Irrigation Project” in order to help achieving outputs of both “b” that is establishing a model type of irrigated agriculture and “c” that is strengthening the extension services system of CRDA and GDA described in the R/D of the Project. Subsequently, the outputs “b” and “c” are expected to contribute in achieving the output “d” that will encourage sharing of expertise among farmers and authorities concerned.

1.6 Targeted Areas of the Work

The Project will be implemented in Nefza（2,931 ha）of Béja Governorate, Sedjnane (3,788 ha) of Bizerte Governorate, Fernana (1,300 ha) of Jendouba Governorate, and Hammam Bourguiba (802 ha) of Jendouba Governorate. Although the main Project activities will be carried out in the former three project sites, the subsequent project outputs will be extended to Hammam Bourguiba.

1.7 Administrative Organizations and Implementing Agencies

(a) Central Government level

- Ministry of Agriculture

  General Direction of Rural Engineering and Water Management (DGGREE)

(b) Regional Administration level (CRDA)

- Béja Regional General Direction of Agricultural Development
- Bizerte Regional General Direction of Agricultural Development
- Jendouba Regional General Direction of Agricultural Development

(c) Irrigation District level (GDA)

- Agriculture and Fishery Sector Development Groups in Nefza: 4 groups
- Agriculture and Fishery Sector Development Groups in Sedjnane: 4 groups
- Agriculture and Fishery Sector Development Groups in Fernana: 1 group

2. Activities

2.1 Achieved activity

Achieved activities of this Project in the first assignment period (February to December 2012), the first phase in the second assignment period (March to November 2013) and the second phase in the second assignment period (January 2014 to February 2015) are shown in Table 2-1 and 2-2 below.

Table 2-1 Achieved activities (The first assignment period and the first phase in the second assignment period)

Project year / Year / Month / Acitivity	The first assignment period												The first phasde of the second assignment period												
	2012												2013												2014
	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2
Domestic Work																									
Confirmation of Perspectives																									
Examination of Principles and Implementation																									
Preparation of Work Plan																									
Field Work																									
Explanation, Discussion and Submission on the Work Plan																									
Extension Activities on Farming & Irrigation																									
Preparation of Extension Materials																									
Trainings of extension staff																									
Demonstration Farms																									
Extension services and related activities on the pilot site																									
Visit to and observation of advanced irrigation district																									
Assistance on elaborating poster																									
Strengthening capacity of GDA in terms of human capitals																									
Understanging on situation and issues of GDA's management																									
Training of executives of GDA																									
Training of the staff of GDA and employees																									
Trainings for farmers concerned																									
Improvement of the Billing System																									
Improvement of Market Access																									
Holding the seminars																									
Holding the JCC																									
Domestic Work																									
Drawing up the Final Report																									
Submission of Reports			W/P									P/R			W/P										P/R

Legend : Domestic Work Fiel Work
Report - W/P : Work Plan, P/R : Progress Report

Table 2-2 Achieved activities (The second phase in the second assignment period)

Project year	1st phase	The second phasde of the second assignment period													
Year	2013	2014											2015		
Acitivity / Month	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
Domestic Work																
Preparaton on the draft Second Work Plan (Second assignment period)																
Field Work																
Preparaton, explanation and discussion on the draft Second Work Plan (Second assignment period)																
Dissemination of the model irrigated agriculture to farmers in pilot sites																
Implementation of technical guidance and trainings																
Implementation of sensitization and technical training of GDA members																
Assistance for the improvement of market access																
Introduction of a proper water fee and billing system																
Assistance of the study to the existing irrigation networks and facilities																
Assistance of the study to drainage improvement																
Implementation of seminars																
Implementation of seminars JCC																
Domestic Work																
Preparation of the final report																
Submission of Reports				W/P												F/R

Legend : Domestic Work Fiel Work
Report - W/P : Work Plan, P/R : Progress Report, F/R : Final Report

2.2 Explanation, discussion and submission of the work plan

2.2.1 Explanation and discussion of the draft work plan

The expert team (hereinafter referred to as “DPINT team”) elaborated the draft work plan in Japan and it was explained, discussed and confirmed with concerned Tunisian counter parts (hereinafter referred to as “C/P”) in Tunisia when the activities started each phase of the project. Although Tunisia C/P expressed their opinions and suggestions during the discussion, each draft work plan was understood and approved by Tunisian side after both sides exchanged their opinions.

Date of explanation and discussion about the draft work plan in each phase is shown in Table 2-3.

Table 2-3 Date of explanation and discussion about the draft work plan

Work plan	Period of project phase	Date of explanation and discussion	Target C/P
Draft work plan (The first assignment period)	February 2012 ~ December 2012	February 20, 2012	DGGREE
		February 21, 2012	CRDA Bizerte
		February 22, 2012	CRDA Béja
		March 1, 2012	CRDA Jendouba
Draft work plan (The first phase in the second assignment period)	March 2013 ~ November 2013	March 27, 2013	CRDA Jendouba
		March 28, 2013	CRDA Bizerte
		April 2, 2013	CRDA Béja
Draft work plan (The second phase in the second assignment period)	January 2014 ~ February 2015	February 6, 2014	CRDA Béja
		February 24, 2014	CRDA Jendouba
		February 27, 2013	CRDA Bizerte

Concerning the draft work plan in the first assignment period, it was finalized by modifying the following points on the basis of results of the discussion:

(a) A sentence of “C/P is positively involved in activities in the pilot site” is added.

(b) A sentence of “Number of demonstration farms will be 20 and average area is around 2 ha” is changed to “Number of demonstration farms will be from 30 to 40 and average area is around 1 ha”.

2.2.2 Submission of the final work plan

The draft work plan was explained and discussed to/with DGGREE and three CRDA. Afterwards, it was partly modified and submitted to C/P as the final work plan.

Table 2-4 Date of submission about the final work plan

Work plan	Period of project phase	Date of submission	Target C/P
Final work plan (The first assignment period)	February 2012 ~ December 2012	April 6, 2012	DGGREE
Final work plan (The first phase in the second assignment period)	March 2013 ~ November 2013	April 18, 2013	DGGREE
Final work plan (The second phase in the second assignment period)	January 2014 ~ February 2015	March 19, 2014	DGGREE

2.3 Extension activities on farming & irrigation

2.3.1 Preparation of extension materials

The draft version of the handbooks was edited in the first assignment period. The list of the handbooks is as follows:

Table 2-5 List of Handbooks

Manual	Language	Target	Usage
Irrigation			
Drip irrigation	Arabic	GDA and farmers	For training activities destined to GDA and farmers, and distribution to farmers of pilot sites
Maintenance of water delivering facilities	Arabic	GDA	
Crop husbandry			
Melon and Water melon	Arabic	farmers	For technical guidance from DPINT team and CTV destined to farmers of pilot sites
Tomato	Arabic	farmers	
Pepper	Arabic	farmers	
Sorghum	Arabic	farmers	
Alfalfa	Arabic	farmers	
Soil treatment			
Sustainable soil treatment	French	Extension staff	As a textbook for extension staff

Up to now, a systematic handbook about irrigation does not exist; therefore, GDA and farmer have fragmentary knowledge. About crop husbandry, there are existing handbooks; however, they are

simples one. Therefore, new ones were elaborated through this project on the assumption that crops are cultivated on north part in Tunisia. Regarding soil treatment, extension workers have worked with handbooks and/or manuals published in French so far. However, the project requested a Tunisian leading expert on soil treatment to elaborate handbooks which matches situation in Tunisia for extension workers.

These handbooks were utilized for trainings to extension workers and farmers and for guidance on the farming to farmers during the project. In addition, these were circulated and approved to/by DGGREE and CRDA. In the future, these texts are planned to be printed by Tunisian side and distributed to concerned person through CRDA. (Handbooks are referred to Annex B-1 ~ B-8 at the progress report in the first assignment period)

In the second phase in the second assignment period, in addition to the above handbooks, new materials were elaborated on farming/cultivation and irrigation for farmers on May to July 2014. Purpose of these new texts are let farmers in the pilot site understand merit and effectiveness of water saving irrigated agriculture examined at the demonstration farms, and promote irrigated agriculture. These textbooks were utilized at farmers' training (Field day) in this phase and it is expected that extension workers use them for farming guidance to farmers in the future. Prepared materials for farmers in Arabic are the followings: (see Annex B-9)

- Soil conservation by organic fertilization and crops rotation
- Plants nutrition and mineral fertilization
- Preparation of farm land for out season potato, role and utilization of NPK, planting, disease control.
- Installation and maintenance of irrigation facilities in drip and sprinkler irrigation system

2.3.2 Trainings of extension staff

The trainings to extension workers like CTV staff and CRA at targeted three irrigated areas were implemented in the first assignment period (2012) and the second assignment period (2013).

At the first assignment period, trainings on pedology were held by a local consultant on soil science. Firstly, classroom lecture for extension workers at three irrigated areas was held at Nefza during four days from September 11, 2012. From 10 to 14 per day, in total 44 extension workers attended. Then, field lecture was carried out at each irrigates area from September to November. Curriculums were planned to pick up topics that most extension workers desired. However, huge differences of knowledge among farmers were observed and, therefore, contents that covered from basic to practical items was selected (see Annex B-10 ~ B-13).

Table 2-6 Training to extension workers (Pedology : Classroom lecture, 2012)

Targeted extension workers	Place of training	Day of training	Curriculum
Nefza, Sedjnane, Fernana	CTV Nefza	September 11	Dynamic conception of soil science
		September 12	Soil and water
		September 13	Soil chemistry and biological activities
		September 16	Soil fertility suitability for cultivation

Table 2-7 Training to extension workers (Pedology : Field lecture, 2012)

Targeted extension workers	Place of training	Day of training	Curriculum
Nefza	Nefza	September 17~20	Classification of soil, Soil profile
Sedjnane	Sedjnane	September 25, November 2 and 29	
Fernana	Fernana	October 2 and 3, November 9	

In addition, trainings to extension workers on farming and irrigation were held after irrigation period in the first assignment period finished. Purpose of the trainings was to share results of activities on farming and irrigation techniques at the demonstration farms, and it was implemented as a workshop that involved some CRDA and GDA staffs.

Table 2-8 Training to extension workers (Farming and irrigation technique, 2012)

Targeted extension workers	Place of training	Day of training	Curriculum
Fernana	Fernana	November 6	・ Importance of grafting and selection of varieties ・ Role of fertilizer and fertilization ・ Main disease and pest ・ Basic technique of drip and sprinkler irrigation ・ Adjustment of water dose along with developing stage of crops
Sedjnane	Sedjnane	November 7	
Nefza	Nefza	November 8	

Considering training to extension workers in the second assignment period, it was held during three days from 21 to 23 in October at CTV Nefza Office with extension workers at three irrigated

areas. Trainees were chiefs of CTV and CRA at three irrigated areas and training subjects were vegetables' protection, soil science and water requirement of crops, which were requested by extension staff themselves.

Table 2-9 Training to extension workers (2013)

Targeted extension workers	Place of training	Day of training	Curriculum
Nefza, Sedjnane, Fernana	Nefza CTV Office	October 21	Vegetables' protection
		October 22	Soil science
		October 23	Water requirement of crops

Lectures selected by DPINT conducted the trainings. A person from Northern Crops Protection Station under the Ministry of Agriculture lectured on vegetables' protection, one from INAT lectured on soil science, and a local engineer hired by DPINT team lectured on water requirement of crops.

It is expected that extension workers can provide services that farmers request by using knowledge acquired at trainings and textbooks mentioned at 2.3.1 above. In fact, extension workers of CTV could show their abilities with leading position at farmers' training (Field day) in the second phase of the second assignment period.

Furthermore, CTA Nefza and Sedjnane planned training; extension workers of CTV and CRA in Béja and Bizerte visited the demonstration farms in August 2014. About 30 workers participated in each training and it contributed to spread irrigated agriculture to other areas outside the project targeted places.

2.3.3 Demonstration Farms

(1) Establishment of demonstration farms

Demonstration farms were established at the pilot sites in the three irrigated perimeters of Nefza, Sedjnane and Fernana to exhibit good examples of vegetable farming with drip irrigation and fodder cultivation with sprinkler irrigation system. Furthermore, it also be purposed to extend these new irrigation farming systems to inside and outside of surrounding farmers of the Project areas and to contribute to the improvement of irrigation rate. In the first assignment period (year 2012), 20 demonstration plots (8 at Nefza, 8 at Sedjnane and 4 at Fernana) were selected, and in the second assignment period (year 2013), 21 plots (7 at Nefza, 7 at Sedjnane and 7 at Fernana) were newly added. As a result, total 41 plots were arranged.

Regarding selection of demonstration farms, potential plots were selected along selection

criteria that were decided with CRDA staffs in the first assignment period. Finally, it were selected by the DPINT team, CTV and GDA through confirmation of conditions such as soil type, previous cultivated crops, condition of hydrants, etc. The criteria is described below. It is noticed that area of one demonstration farm was decided about 1 ha due to owned area of potential farmers.

Criteria of selecting demonstration farm:

- The owner of the demonstration farm owns the land or continues an agricultural activity at least 3 years if the land is a holding one.
- The owner of the demonstration farm understands farming techniques and is willing to accept and follow guidance given by the technical staffs who manage the project.
- The owner of the demonstration farm is a member of GDA and has no debt towards the GDA.
- The owner of the demonstration farm has an independent hydrant that provides enough pressure of irrigation water.
- The demonstration farm should be near a road and should have a good access.

A list of demonstration farms where monitoring and exhibition were conducted is shown in Table 2-10~12. Also, location maps of demonstration farms at each irrigated perimeters are attached as Appendix 1~3.

Table 2-10 List of demonstration farms (Nefza, 2014)

Plot No.	Farmers' name	GDA	Pilot site	Owned area (ha)	Soil type	2011/2012		2012/2013		2013/2014	
						Demonstration plot size(ha)	Demonstration crop	Demonstration plot size(ha)	Demonstration crop	Demonstration plot size(ha)	Demonstration crop
N 1	Hassen Zammali	Ennouhouth	Bouzena2	4.00	Clay loam	1.00	Pepper	1.00	melon	1.00	Melon
N 2	Mouldi Mstouri	Ennouhouth	Bouzena3	7.00	Clay	0.93	Melon	0.93	Pepper	0.93	Melon
N 3	Hamadi Zammali	Ennouhouth	Bouzena3	7.00	Clay	1.04	Pepper	1.00	melon	1.00	Melon
N 4	Noureddine Khouildi	Ennouhouth	-	8.00	Clay	0.50	Pepper	0.53	Pepper	0.53	Pepper
N 5	Taoufik Zammali	Touila	Touila	2.00	Clay	0.89	Pepper	0.66	Pepper	0.66	Tobacco
N 6	Farhat Atouani	Touila	Touila	1.75	Silty clay	0.43	Melon	0.89	watermelon	0.43	Melon
N 7	Mohsen Brahmi	Wifak	Jmila	3.00	Clay	0.90	Melon	0.90	Pepper	0.90	Melon
N 8	Kamel Ouchtati	Ouchtata	-	15.00	Sandy	1.10	Citrus	1.00	Citrus	1.00	Citrus
N 9	Mariem Ayadi	Wifak	Jmila	6.00	Clay	-	-	1.00	Pepper	1.00	Melon
N10	Nizar Mastouri	Wifak	Bouzenna 3	6.00	Sandy clay	-	-	1.00	melon	1.00	Pepper
N11	Bilel Rguii	Ennouhoudh	Bouzenna 2	2.00	Clay	-	-	1.01	Pepper	1.00	Melon
N12	Mohsen Garrouri	Ennouhoudh	Bouzenna 2	2.50	Clay	-	-	1.00	tomato	1.00	Melon
N13	Ridha Garrouri	Ennouhoudh	Bouzenna 2	4.00	Clay	-	-	1.00	melon	1.00	Pepper
N14	Mustapha Hmissi	Touila	Touila	1.50	Clay	-	-	0.59	Pepper	0.59	Watermelon
N15	Jalila Atouani	Touila	Touila	12.00	Clay	-	-	1.13	watermelon	1.14	Watermelon

Table 2-11 List of demonstration farms (Sedjnane, 2014)

Plot No.	Farmers' name	GDA	Pilot site	Owned area (ha)	Soil type	2011/2012		2012/2013		2013/2014	
						Demonstration plot size(ha)	Demonstration crop	Demonstration plot size(ha)	Demonstration crop	Demonstration plot size(ha)	Demonstration crop
S 1	Hakim Sahbani	Intilaka	CP 4	2.50	Sandy	0.30	Alfalfa	0.30	Alfalfa	0.60	Sorghum
						0.30	Sorghum	0.30	Sorghum		
S 2	Abdalla Sahbani	Intilaka	CP 4	2.50	Sandy lay	0.73	Water melon	0.73	Pepper	0.73	Watermelon
S 3	Taoufik Mechrgui	Imtiaz	CP 3	5.00	Clay loam	0.76	Sorghum	0.25	Alfalfa	0.25	Alfalfa
								0.55	Sorghum	0.55	Sorghum
S 4	Jalel Sahbani	Imtiaz	CP 3	2.00	Sandy clay	0.50	Water melon	0.57	Watermelon	0.57	Tomato
						0.57	Tomato	0.50	Pepper	0.50	Pepper
S 5	Mounir Ayari	Ennajah	CP 2	0.80	Clay	0.70	Tomato	0.70	Watermelon	0.70	Tom/pep/waterm
S 6	Boujomaa Saidani	Ennajah	CP 2	2.50	Clay-loam	0.30	Alfalfa	0.55	Sorghum	0.62	Sorghum
						0.35	Sorghum				
S 7	Amor Mechrgui	EL Baraka	CP 1 (RG)	7.00	Clay	0.93	Sorghum	0.25	Alfalfa	0.37	Alfalfa
								0.75	Sorghum	0.56	Sorghum
S 8	Massoud Saidani	EL Baraka	CP 1 (RG)	2.00	Clay	0.64	Tomato	0.42	Melon	0.42	Tomato
						0.21	Pepper	0.43	Watermelon	0.43	Pepper
S 9	YoussefSahbani	Inilaka	CP 4	1.00	clay	-	-	0.53	Sorghum	0.30	Alfalfa
										0.60	Sorghum
S 10	Naceur Sahbani	Inilaka	CP 4	1.50	clay	-	-	1.00	Tomato	1.00	Watermelon
S 11	Abdelkarim Sahbani	Inilaka	CP 4	2.50	clay	-	-	1.00	Watermelon	1.00	Pepper
S 12	Mehrez Malaoui	Imtiaz	-	2.00	silty clay	-	-	0.55	Alfalfa	0.55	Alfalfa
S 14	Mongi Abassi	Braka	CP 1 (RD)	1.50	clay	-	-	1.00	Tomato	0.50	Melon
										0.50	Watermelon
S 15	Abdelaziz Maalaoui	Enajah	CP 2'	1.43	clay	-	-	1.00	Watermelon	0.51	Tomato
										0.50	Pepper
S 16	Sadok Maalaoui	Enajah	CP 2'	0.90	clay	-	-	0.47	Tomato	0.90	Melon

Table 2-12 List of demonstration farms (Fernana, 2014)

Plot No.	Farmers' name	GDA	Pilot site	Owned area (ha)	Soil type	2011/2012		2012/2013		2013/2014	
						Demonstration plot size(ha)	Demonstration crop	Demonstration plot size(ha)	Demonstration crop	Demonstration plot size(ha)	Demonstration crop
F 1	Slah Aridhi	Oued Ghrib	Sidi Ammar	6.50	Loamy clay	2.00	Melon	1.00	Pepper	1.80	Watemelon
								1.00	Tomato		
F 2	Mounir Ochi	Oued Ghrib	Ain Beya	5.50	Loamy clay	0.93	Water melon	0.93	Watermelon	0.93	Watemelon
F 3	Mourad Bousaidi	Oued Ghrib	Ain Beya	3.00	Clay loam	0.77	Water melon	0.77	Pepper	0.77	Watemelon
F 4	Ahmed Ghazouani	Oued Ghrib	Oued Ghrib	5.00	Clay loam	0.84	Tomato	0.43	Melon	1.85	Tomato
						0.99	Pepper	1.40	Watermelon		
F 5	H'mida Ghazouani	Oued Ghrib	Oued Ghrib	1.00	clay	-	-	0.92	Tomato	0.92	Watermelon
F 6	Ouael Ghazouani	Oued Ghrib	—	2.00	clay	-	-	0.65	Watermelon	0.65	Melon
F 7	Abdelbasset Jaouadi	Oued Ghrib	Sidi Ammar	3.00	clay	-	-	1.14	Watermelon	1.14	Tomato
F 8	Kais Boussaidi	Oued Ghrib	Ain Beya	3.80	Clayey silt	-	-	1.03	Potato	1.03	Watermelon
F 9	Hamadi Ghazouani	Oued Ghrib	Oued Ghrib	2.17	clay	-	-	0.92	Pepper	0.45	Melon
										0.45	Watermelon
F 10	Belgacem Khmiri	Oued Ghrib	Fernana	3.00	clay	-	-	0.81	Pepper	0.40	Melon
										0.40	Watermelon
F 11	Abdelkarim Mejri	Oued Ghrib	Fernana	6.00	clay	-	-	0.82	Watermelon	0.82	Pepper

(2) Supply of irrigation equipment and farming input

1) Irrigation equipment

About the 41 demonstration farms, topography, design of irrigation facilities, installation of irrigation equipment, and operational tests were conducted at the time of selection for demonstration farms in the first and second assignment period. These works were carried out by a local company and supervised by the DPINT team.

The types of irrigation equipment were a drip type at 35 plots for crops and a sprinkler type at 6 plots for fodder.

During installation of the equipment in the first assignment period and the first phase of the second assignment period, farmers and GDA staff were involved and trained by the contractor. About re-installation of equipments in the first and second phase of the second assignment period, farmers themselves installed the equipment and local consultants of the DPINT team gave guidance and confirmed the installation, when necessary. The installation at most demonstration farms was conducted in May each year; however, it delayed to the beginning of June due to delay of water distribution at a part of demonstration plot of Sedjnane irrigated area in 2014.

Farmers themselves removed all irrigation equipment between September and October at the end of the irrigation period each year. The DPINT team gave instructions to farmers about the maintenance of the equipment and notices about its storage so that it could be properly used the following year. As a result, all equipment was properly kept by each farmer.

2) Farming material

All necessary seeds, seedlings, fertilizers and pesticides were procured and provided by the DPINT team to 20 farmers who were involved in the demonstration plots at the first assignment period in 2012. However, farmers themselves purchased all inputs for 20 plots in 2014, third year of their participation. About the 21 demonstration plots, half amount of seeds and seedlings were paid by farmers and fertilizer and pesticide were procured by DPINT team in 2014, second year of their involvement in 2014. In addition, this regulation of bearing inputs was decided through discussion between DPINT team and targeted farmers.

Table 2-13 Regulation of bearing inputs

Project year / Targeted farmer / Inputs	The first assignment period (2011/12)	The first phase of the second assignment period (2012/13)		The second phase of the second assignment period (2013/14)	
	Farmer in the first year	Farmer in the first year	Farmer in the second year	Farmer in the second year	Farmer in the third year
Seed / Seedlings	DPINT (100%)	DPINT (100%)	DPINT(50%) Farmer(50%)	DPINT(50%) Farmer(50%)	Farmer(100%)
Fertilizer / Pesticide	DPINT (100%)	DPINT (100%)	DPINT (100%)	DPINT (100%)	Farmer(100%)

The cost of land preparation, manure application, hired labor, irrigation fees and marketing cost was borne by the demonstration farmers 'side.

Seedlings delivery to farmers after preparation of demonstration farm was carried out at Fernana and Nefza from the beginning to middle of May and at Sedjnane from the end of May to the beginning of June. However, the delivery at a part of demonstration farms at Sedjnane in 2014 was delayed due to delay of water distribution; thus, seedlings were delivered in the middle on June. As a result, growth and yield of crops were affected. On the other hand, seeds of fodder were distributed to farmers in Sedjnane in April.

In addition, fertilizers and agricultural chemicals were calculated based on the application standard of AVFA and opinions from local extension workers. Then, these inputs were provided to the three irrigated areas in April and farmers kept them on their own. These inputs were used by farmers along growth stages of crops by following the guidance of the project team.

(3) Preparation of demonstration farms

1) Plowing and leveling

Deep plowing for irrigated crops in summer season at north Tunisia is subject to rainfall in March, slope of the ground and quality of soil (whether it is clay soil). In the first assignment period (2012), plowing and leveling of selected farms were done by farmers at the three irrigated areas, namely Nefza, Sedjnane and Fernana by the middle of May.

In the first phase of the second assignment period (2013), these works were completed by each farmer in Fernana from March to April because of relatively minor influence by rainfall in winter. About Nefza, these works were conducted by the middle of May because preparation of farming wad delayed at most demonstration farms due to influence by heavy rain and characteristics of clay soil.

Concerning Sedjnane, both works were completed at the end of May because preparation of farming was delayed due to recorded rainfall (as twice as average of past 50 years : 721 mm from January to April totally) and clay soil in southern Tunisia.

In the second phase of the second assignment period (2014), plowing and leveling were completed in April at Fernana due to average rainfall. On the other hand, rainfall in March at Nefza and Sedjnane were much than previous years, namely 190 mm and 215 mm. As a result, preparation of farms was delayed more than one week and it was finished from the middle of May to the beginning of June at these areas.

2） Planting and seeding

In the first assignment period, seedlings were planted in order of Fernana, Sedjnane and Nefza along the conditions of dryness / leveling of soil and procurement progress of seedlings. Planting was started in the middle of May and finished in the beginning of June. Also, seeding of fodder in Sedjnane was completed in the end of June.

In the first phase of the second assignment period, seedlings were planted in order of Fernana, Nefza and Sedjnane. Planting was started in the end of April and finished in the beginning of June. Also, seeding of fodder in Sedjnane was completed from the middle to end of May.

In the second phase of the second assignment period, seedlings were planted in the beginning of May at Fernana due to proper progress of land preparation. At Nefza, planting was finished in the end of May due to delay of land preparation. At Sedjnane, planting was done from the beginning to middle of June because water distribution was delayed due to debt of water fee at the end of May. Seeding in Sedjnane also be delayed and done from the beginning to middle of June.

Furthermore, newly selected farms in the first assignment period and the first phase of the second assignment period were provided technical guidance by local consultants of DPINT during period of land preparation.

3） Soil Diagnosis

In order to set bench marks of selecting irrigation crops and farming methods at selected demonstration farms, soil diagnosis was conducted at the beginning stage in the first assignment period and the first phase of the second assignment period. It was led by a local consultant on pedelogy of DPINT team and collaborated by extension workerss of CTV at each farm. In addition, the soil laboratory of INRAT（Institut National de Recherche Agronomique de Tunis) assisted in the

analysis of the soil samples. Then, the results were utilized as data for the soil diagnostic carried out during the cultivation stage at each year.

The results of soil diagnosis at demonstration plots of each irrigated areas are shown below. The soil in the farms is mainly clay soil and partly includes silt and sand.

Table 2-14 Soil classification of demonstration farms

Irrigated area (Number of demonstration farm)	Soil classification (Number of demonstration farm)
Nefza （15）	Clay (11), Ash clay (1), Silty clay (1), Sandy clay(1), Sandy soil(1)
Sedjnane （15）	Clay (10), Silty clay (3), Clayey sandy soil (1), Sandy soil (1)
Fernana （11）	Clay (6), Silty clay (2), Clayey silt (3)

(3) Guidance on crop selection and cultivation methods

Japanese experts and local consultant in Agronomy of DPINT team decided on the demonstration crops and cultivation methods through consultations with farmers at the demonstration farms and extension workers in CRDA and CTV, and gave guidance on farming. Daily guidance on farming to farmers on the demonstration plots was implemented by field engineers on the demand of farmers and opportunity to strengthen knowledge and skills was provided through Field Day (Farmers' Training).

Concerning selection of crops, crop rotation, a technique to select different types of crops compared to ones at last crop season to avoid replant failure, was instructed to farmers. However, some farmers preferred the same crops to different ones. In this case, planting the same crops were accepted if farmers grow them at adjoining land of previous farmlands. In addition, production volume, marketability and profitability about previous crops were considered on the selection of planted crops at the first and second phase of the second assignment period. About melon and watermelon, grafting was recommended and provided by the Project.

Selected crops at demonstration farms in the second phase of the second assignment period are shown in the list of demonstration plots below, Table from 2-10 to 2-12. The same crops were selected at six farms (Nefza: 4, Fernana 2) among all 41 demonstration farms and farmland were shifted to adjoining land.

(4) Guidance and monitoring on water and farm management at demonstration farms

Water management by water saving irrigation and techniques of farm management were

instructed and necessary monitoring was conducted continuously because the demonstration farms are bases for expansion of effects on water saving irrigation to farmers in the pilot sites. Technical instruction was accordingly provided to farmers at the demonstration farms by Japanese experts and local consultants on irrigation and farming, cooperated with extension workers of CTV. Equipments were distributed to these farmers at 22 demonstration farms in second year to be fare with ones at 19 demonstration farms in third year.

DPINT team hired and dispatched one irrigation engineer and one agronomist to each of the three perimeters. These were sent to 13 demonstration plots that consist of one plot from each pilot site every day, intrusively instructed by the Project team. In addition, 9 demonstration farms were monitored once in a couple days. Concerning other 19 demonstration farms in the third year of their experience were accordingly monitored mainly by C/P such as CTV and assisted/instructed by DPINT. As the monitoring, the irrigation management, cultivation management, pest control and marketing were recorded. The Japanese experts and CTV extension workers also visited all perimeters as frequently as possible. Through this activity, hearing from farmers put priority and satisfaction of farmers was concerned; then, if necessary, instruction on irrigation and farming were provided.

1） Monitoring of water consumption on irrigation

Consumed daily volume of water, water pressure at hydrants, and irrigation duration were monitored and recorded everyday or once in a couple of days by the field irrigation engineer at each demonstration farm. The necessary volume of water for each crop in the demonstration farms was calculated each month, based on rainfall data, and proper irrigation was instructed to each farmer. Specifically, time duration of dairy watering is guided concerning drip irrigation and the number of interval days and time duration of one time watering are taught concerning sprinkler irrigation for grasses. The operational condition of the irrigation equipment was monitored as well, and guidance on operation or maintenance was given, when necessary.

The details of these activities were recorded on a field report every month by the field engineer and submitted to the DPINT team. Recorded items are water volume for each month, irrigation schedule, actual volume of provided water, pressure and operational condition of equipments at each hydrant, and problems and suggestion of solutions about irrigation operation.

2） Accuracy confirmation of the flow meters

At the first and second assignment periods, the accuracy of the flow meters, DN50, that were newly installed at demonstration farms and occupied important roles within irrigation equipments

were tested. This test was conducted by two field engineers and GDA staffs at each irrigation area during irrigation period from June and August. The average error on the flow volume in the test was from ±5% to 10% at demonstration plots in the three irrigated areas, suggesting that the flow meters were significantly accurate for irrigation.

In addition, the accuracy of existing flow meter at outside of demonstration farms was also tested at Nefza in the first assignment period and at Sedjnane in the first phase of the second assignment period. According to results of the accuracy test with random sampling about existing flow meters installed by CRDA at Nefza, big error from 30% to 40 % was recognized. This result was reported to CRDA Béja and CRDA started to make budget allocation in 2012 to procure and install new flow meters that is as same type as the DPINT project installed.

Furthermore, the accuracy of the flow meters, DN65, owned by Bizerte CRDA, which were planned for installation on the hydrants of the farming plots in the future was also tested in some areas at Sedjnane. The results showed an error of 2%, suggesting a sufficient accuracy of the DN65.

3） Monitoring on techniques of agronomy/cultivation

At each demonstration farms, data on agronomy/cultivation (varieties, planting density, amount of fertilizer, growing conditions, records of damages from diseases and insects, etc.), cost of inputs, yields and volume of sales are monitored and recorded by the field engineer in agronomy. As same as the field engineer in irrigation conducted, the 13 demonstration farms were monitored everyday and other 9 plots were monitored once in a couple of days with extension workers in CTV if necessary. Results of the monitoring was recorded in monthly field report and submitted to the DPINT team.

The yield and sales per hectare about crops cultivated at all demonstration farms of the three irrigated area, namely Nefza, Sedjnane and Fernana, in 2014 is shown in Table 2-13. Summary of the results are the followings:

- In case of tomatoes cultivation in Sedjnane, since transplanting to the irrigated farm delayed to the middle of June and Ramadan and the time of weed and chemical control came to the same time. In addition, the plants were damaged by weed and Tomato leaf miner. As a result, the yield came down to 32-50 tons/ha (about half amount of expected yield of 60-75 tons/ha). On the other hand, Tomatoes were planted in appropriate time in Fernana and management were completely done. The yield was very high of 73-73 tons/ha which is nearly expected yield. However, amount of sales income in Sedjnane and Fernana is around 10,000 DT/ha and there are not big different from both irrigated perimeter, because of the difference of the unit selling price between vegetable use (two times of processing use) and processing use. Farmers in Sedjnane sold

tomatoes in the local market as vegetable use but farmers in Fernana sold them in the farm as processing use.

- In case of melons, 13 demonstration farmers planted in the irrigated farm and the yield was quite satisfied level that 7 farmers got about 24 to 30 tons/ha, 4 farmers got about 30 to 35 tons/ha and 2 farmers got more than 40 tons/ha as the yield. First to third of selling income are F10, N11 and N1 and the amount is a little more than 19,000 DT/ha to a little less than 16,000 DT/ha.
- In case of watermelons, the yield was enough satisfied level that 2 farmers got about 19 to 21 tons/ha, 5 farmers got about 30 to 40 tons/ha and 3 farmers got more than 50 to 80 tons/ha as the yield. First to third of selling income are F10, N15 and F9 and the amount has a big ranges from a little more than 23,000 DT/ha to a little less than 13,000 DT/ha.
- In case of peppers, 8 demonstration farmers planted in the irrigated farm and 4 farmers in Sedjnane could get enough neither yield nor selling income, caused by shortage of irrigated water and shortage of vegetative growth period, but 3 farmers of them in Nefza and one farmer in Fernana were quite satisfied level of 35 to 45 tons/ha. First to third of selling income are F11, N4 and N10 and the amount is a little more than 26,000 DT/ha to a little less than 19,000 DT/ha.

The main reason of low yield in a part of Sedjnane seems to be the delay of transplanting time caused by the delay of irrigation water. It caused using weak old seedling and swamping the time for weeding and pest control and Ramadan; therefore, the luck of the workers caused scrambling the soil moisture with enormous weeds and damages by insect pests occurs.

The summer fodder crop farming in Sedjnane by sprinkler irrigation system looks like disadvantages that are small efficiency of water use and sales income in comparison with vegetable farming by drip irrigation system. However, it has very important social role in Sedjnane irrigation perimeter because there are many small scale farmers and raising animals are very popular there. Maximum yield of Sorghum is 112.8 tons/ha and selling income was 5,640 DT/ha that was 2 to 3 times of them in Sedjnane. Maximum yield of alfalfa was 64.8 tons/ha and selling income was 4,536 DT/ha that was satisfied level more than that of surrounding area.

4) Benefit analysis

Benefit of each demonstration farm of 3 irrigation perimeters in 2014 is shown in table 2-16 (see Appendix 6~7 for ones in 2012 and 2-13).

As a result of hearing from demonstration farmers who experienced second and third year's planting in demonstration farms, DPINT got the following result in 2014. Through reflection of an

effect for farmers' training such as field day, most of farmers at demonstration farms could get high yield of nearly expected yield and satisfied enough to the benefit of demonstration farms. And then, from the monitoring data such as numerical data of selling income minus input cost, high return of the irrigated vegetable farming also was supported, too.

Since sampling number of each vegetable farming is small as a total, the benefit should not be affirmed, however, it can be said, at least, most of the farmers at demonstration farms in 3 irrigation perimeters understood and practiced completely irrigated vegetable cultivation by drip irrigation system and fodder cultivation by sprinkler irrigation system. It seems that they have few specified technical issues to be solved.

Several numbers of demonstration farms of each vegetable got very high yield and big benefit, through diligence of Tunisian farmers and guidance and support by CRDA, CTV, GDA and DPINT. This fact shows that the relevance of drip irrigation farming for vegetable farming and sprinkler irrigation farming for fodder crops and the big capacity of farmers at these irrigation perimeters were verified. And, these facts seem to be enough to suggest the possibility of popularization of above mentioned irrigation farming techniques and improvement of irrigation farming rate in near future.

Shown the benefit, selling income minus input cost, of each irrigation perimeters, the first is 15,602 DT/ha: watermelon farming at N15, second is 13,990 DT/ha: pepper farming at N4, and third is 11,795 DT/ha: melon farming at N4 in Nefza. In Sedjnane, the first to third big benefit was tomato farming. The first is 6,670 DT/ha at S4, the second is 5,942 DT/ha at S8, and the third is 5,782 DT/ha at S15. In Fernana, the first big benefit was pepper farming, 17,024 DT/ha at F11. The second is 16,771 DT/ha: watermelon farming at F10 and the third is 12,416 DT/ha: melon farming at F10.

Benefit of each vegetables and fodder crops are also showed on table 2-17, as an information, but from this table, there is no more than showing that suggestion of how much of selling income and how much of cost of input and benefit.

Table 2-15 Results of monitoring on yield (ton/ha) and sales (DT/ha) of each demonstration farms (2014)

Irrigated Perimeter	Plot No.	Farmers'name	Name of Crop	Area (ha)	Harvesting Period	Yield (ton/plot	Yield (ton/ha)	Average selling price (DT/ton)	Total sales (DT/plot)	Total sales (DT/ha)
Nefza	N 1	Hsan Zammali	Melon	1.00	Sept.	35.1	35.1	466.4	16,370	16,370
	N 2	Mouldi Mastouri	Melon	0.93	July-Aug.	25.5	27.4	463.0	11,805	12,695
	N 3	Hamadi Zammali	Melon	1.00	Sept.	25.5	25.5	467.8	11,930	11,930
	N 4	Nouredine Khouildi	Pepper	0.53	July-Nov.	19.8	37.3	606.4	11,993	22,629
	N 5	Tawfik Zammali	Tobacco	0.66	July-0ct.	No data				
	N 6	Farhat Atouani	Melon	0.43	Aug.-Sept.	14.2	33.0	408.8	5,805	13,500
	N 7	Mohsen Brahmi	Melon	0.90	Aug-Sept.	24.4	27.1	467.2	11,378	12,642
	N 9	Meriem Ayadi	Melon	1.00	Aug-Sep.	33.2	33.2	426.9	14,153	14,153
	N 10	Nizar Mastouri	Pepper	1.00	Aug-Nov.	38.4	38.4	501.6	19,251	19,251
	N 11	Bilel Rguii	Melon	1.00	Aug.-Sept.	40.1	40.1	438.1	17,569	17,569
	N 12	Mohsen Garrouri	Melon	1.00	July-Aug.	30.9	30.9	403.0	12,430	12,430
	N 13	Ridha Garrouri	Pepper	1.00	Aug-Nov.	34.8	34.8	480.4	16,701	16,701
	N 14	Mustapha Hmissi	Watermelon	0.59	Aug.-Sept.	20.4	34.5	333.2	6,782	11,494
	N 15	Jalila Atouani	Watermelon	1.14	Aug.-Sept.	68.2	59.8	360.8	24,604	21,582
Sedjnane	S 1	Hakim Sahbani	Sorghom	0.60	July-Oct.	67.7	112.8	50.0	3,384	5,640
	S 2	Abdalla Sahbani	Watermelon	0.73	August	15.6	21.4	253.2	3,950	5,411
	S 3	Tawfik Mechrgui	Alfalfa	0.25	July-Sept.	16.2	64.8	70.0	1,134	4,536
			Sorghom	0.55	July-Sept.	37.3	67.8	50.0	1,865	3,391
	S 4	Jalel Sahbani	Tomato	0.57	Sept.-Oct.	24.4	48.8	243.7	5,943	10,427
			Pepper	0.50	Aug-Oct.	3.3	6.5	688.8	2,241	4,482
	S 5	Mounir Ayari	Tom/pep/waterm	0.70	July	No data : Out of the project				
	S 6	Boujomaa Saidani	Sorghum	0.62	July-Oct.	31.0	49.8	50.0	1,542	2,488
	S 7	Amor Mechrgui	Alfalfa	0.37	JulyAug.	18.2	49.1	70.0	1,272	3,437
			Sorghom	0.56	Aug.-Sep.	18.4	32.9	50.0	920	1,643
	S 8	Massoud Saidani	Tomato	0.42	Sept.-Oct.	11.0	31.5	310.5	3,424	9,782
			Pepper	0.43	Sept.-Oct.	2.7	10.6	461.3	1,223	4,890
	S 9	Youssef Sahbani	Alfalfa	0.30	July-Aug.	10.0	33.4	70.0	702	2,339
			Sorghum	0.60	July-Aug.	42.3	70.5	50.0	2,114	3,523
	S 10	Naceur Sahbani	Watermelon	1.00	August	Est.40.000	Est.40.000	Flat sale	7,800	7,800
	S 11	Abdelkarim Sahbani	Pepper	1.00	Aug.-Nov.	22.7	22.7	568.0	12,867	12,867
	S 12	Mehrz Maalaoui	Alfalfa	0.55	July-0ct.	Abundoned by water shortage				
	S 14	Mongi Abassi	Melon	0.50	August	Est.14.000	Est..28.000	Flat sale	4,200	8,400
			Watermelon	0.50	August	Est.15.000	Est.30.000	Flat sale	2,700	5,400
	S 15	Abdeaziz Maalaoui	Tomato	0.51	Aug.-Oct.	25.1	50.2	222.0	5,574	10,930
			Pepper	0.50	Aug.-Oct.	9.8	19.6	451.4	4,420	8,839
	S 16	Sadok Maalaoui	Melon	0.90	Aug-Sept.	23.6	26.2	404.2	9,520	10,577
Fernana	F 1	Slah Aridhi	Watermelon	1.80	August	35.2	19.6	260.0	9,153	5,085
	F 2	Mounir Ochi	Watermelon	0.93	July	No data : abundoned				
	F 3	Mourad Boussaidi	Watermelon	0.77	July-0ct.	No data : abundoned				
	F 4	Ahmed Ghazouani	Tomato	1.85	August	135.0	73.0	145.9	19,700	10,649
	F 5	Hmida Ghazouani	Watermelon	0.92	July-August	34.3	37.3	246.7	8,463	9,199
	F 6	Ouael Ghazouani	Melon	0.65	July-August	16.1	24.7	379.3	6,088	9,366
	F 7	Abdelbasset Jawadi	Tomato	1.14	Sept.	85.7	75.2	149.3	12,798	11,226
	F 8	Kais Boussaidi	Watermelon	1.03	July-August	33.3	32.3	273.3	9,100	8,835
	F 9	Hamadi Ghazouanli	Melon	0.45	July-August	13.0	29.0	396.5	5,167	11,482
			Watermelon	0.45	July-August	21.9	48.7	263.2	5,765	12,811
	F 10	Belgacem Khemiri	Melon	0.40	July-Sept.	17.3	43.1	434.4	7,494	18,735
			Watermelon	0.40	July-August	32.1	80.3	292.1	9,375	23,438
	F 11	Abdelkarim Mejri	Pepper	0.82	July-Nov.	37.5	45.7	582.2	21,828	26,620

*) Exchange rate as of December 2014

1US$ = 1.82 DT =119 Yen

1DT = 65.4 Yen

Table 2-16 Benefit of demonstration farms (2014)

Irrigated Perimeter	Plot numbers	Farmers'name	Vegetable Plants	Area (ha)	Harvesting Period	Yield (ton/ha)	Sales (TD/ha)	Input (TD/ha)	Machines (TD/ha)	Labor (TD/ha)	Water charges	Total cost (TD/ha)	Benefit (TD/ha)
Nefza	N 1	Hsan Zammali	Melon	1.00	Sept.	35.1	16,370	3,814	200	1,050	272	5,336	11,034
	N 2	Mouldi Mastouri	Melon	0.93	July-Aug.	27.4	12,695	3,753	188	989	272	5,202	7,493
	N 3	Hamadi Zammali	Melon	1.00	Sept.	25.5	11,930	3,793	200	1,050	272	5,315	6,615
	N 4	Nouredine Khouildi	Pepper	0.53	July-Nov.	37.3	22,629	6,121	212	2,000	306	8,639	13,990
	N 5	Tawfik Zammali	Tobacco	0.66	July-0ct.	No data							
	N 6	Farhat Atouani	Melon	0.43	Aug.-Sept.	33.0	13,500	4,537	262	1,047	272	6,118	7,382
	N 7	Mohsen Brahmi	Melon	0.90	Aug-Sept.	27.1	12,642	4,261	167	1,067	272	5,767	6,875
	N 9	Meriem Ayadi	Melon	1.00	Aug-Sep.	33.2	14,153	4,514	156	880	272	5,822	8,331
	N 10	Nizar Mastouri	Pepper	1.00	Aug-Nov.	38.4	19,251	5,862	175	2,040	306	8,383	10,868
	N 11	Bilel Rguii	Melon	1.00	Aug.-Sept.	40.1	17,569	4,514	138	850	272	5,774	11,795
	N 12	Mohsen Garrouri	Melon	1.00	July-Aug.	30.9	12,430	4,514	150	1,000	272	5,936	6,494
	N 13	Ridha Garrouri	Pepper	1.00	Aug-Nov.	34.8	16,701	5,772	163	1,800	306	8,041	8,660
	N 14	Mustapha Hmissi	Watermelon	0.59	Aug.-Sept.	34.5	11,494	4,569	169	1,119	272	6,129	5,365
	N 15	Jalila Atouani	Watermelon	1.14	Aug.-Sept.	59.8	21,582	4,603	175	930	272	5,980	15,602
Sedjnane	S 1	Hakim Sahbani	Sorghom	0.60	July-Oct.	112.8	5,640	897	234	214	602	1,947	3,693
	S 2	Abdalla Sahbani	Watermelon	0.73	August	21.4	5,411	2,765	96	434	322	3617	1,794
	S 3	Tawfik Mechrgui	Alfalfa	0.25	July-Sept.	64.8	4,536	168	0	416	722	1,306	3,230
			Sorghom	0.55	July-Sept.	67.8	3,391	289	198	175	722	1,384	2,007
	S 4	Jalel Sahbani	Tomato	0.57	Sept.- Oct.	48.8	10,427	1,758	175	1,412	412	3,757	6,670
			Pepper	0.50	Aug- Oct.	6.5	4,482	3,364	200	498	574	4,636	-154
	S 5	Mounir Ayari	Tom/pep/water	0.70	July	No data : Out of the project							
	S 6	Boujomaa Saidani	Sorghum	0.62	July-Oct.	49.8	2,488	316	193	235	285	1,029	1,459
	S 7	Amor Mechrgui	Alfalfa	0.37	JulyAug.	49.1	3,437	85	0	314	723	1,122	2,315
			Sorghom	0.56	Aug.-Oct.	32.9	1,643	252	250	123	723	1,348	295
	S 8	Massoud Saidani	Tomato	0.42	Sept.- Oct.	31.5	9,782	1,995	357	871	617	3840	5,942
			Pepper	0.43	Sept.- Oct.	10.6	4,890	3,473	300	692	540	5,005	-115
	S 9	Youssef Sahbani	Alfalfa	0.30	July-Aug.	33.4	2,339	509	197	267	553	1,526	813
			Sorghum	0.60	July-Aug.	70.5	3,523	415	132	280	550	1,377	2,146
	S 10	Naceur Sahbani	Watermelon	1.00	August	Est.40.0	7,800	3,491	210	324	266	4,291	3,509
	S 11	Abdelkarim Sahbani	Pepper	1.00	Aug.-Nov.	22.7	12,867	5,416	120	1,902	457	7,895	4,972
	S 12	Mehrz Maalaoui	Alfalfa	0.55	July-0ct.	Abundoned by water shortage							
	S 14	Mongi Abassi	Melon	0.50	August	Est.28.0	8,400	4,492	240	210	294	5,236	3,164
			Watermelon	0.50	August	Est.30.0	5,400	3,894	240	210	294	4,638	762
	S 15	Abdeaziz Maalaoui	Tomato	0.51	Aug.-Oct.	50.2	10,930	3,297	137	1,294	420	5,148	5,782
			Pepper	0.50	Aug.-Oct.	19.6	8,839	5,188	140	1,426	524	7,278	1,561
	S 16	Sadok Maalaoui	Melon	0.90	Aug-Sept.	26.2	10,577	3,965	144	483	423	5,015	5,562
Fernana	F 1	Slah Aridhi	Watermelon	1.80	August	19.6	5,085	773	167	550	353	1,843	3,242
	F 2	Mounir Ochi	Watermelon	0.93	July	No data : abundoned							
	F 3	Mourad Boussaidi	Watermelon	0.77	July-0ct.	No data : abundoned							
	F 4	Ahmed Ghazouani	Tomato	1.85	August	73.0	10,649	3,747	216	1508	460	5,931	4,718
	F 5	Hmida Ghazouani	Watermelon	0.92	July-August	37.3	9,199	4,507	299	967	385	6,158	3,041
	F 6	Ouael Ghazouani	Melon	0.65	July-August	24.7	9,366	4,999	269	1000	479	6,747	2,619
	F 7	Abdelbasset Jawadi	Tomato	1.14	Sept.	75.2	11,226	4,092	373	1202	476	6,143	5,083
	F 8	Kais Boussaidi	Watermelon	1.03	July-August	32.3	8,835	4,274	340	864	351	5,829	3,006
	F 9	Hamadi Ghazouanli	Melon	0.45	July-August	29.0	11,482	4,465	244	911	409	6,029	5,453
			Watermelon	0.45	July-August	48.7	12,811	5,007	244	1022	409	6,682	6,129
	F 10	Belgacem Khemiri	Melon	0.40	July-Sept.	43.1	18,735	4,579	313	1138	289	6,319	12,416
			Watermelon	0.40	July-August	80.3	23,438	4,978	313	1088	288	6,667	16,771
	F 11	Abdelkarim Mejri	Pepper	0.82	July- Nov.	45.7	26,620	6,384	427	2,305	480	9,596	17,024

Table 2-17 Comparison of benefit of each crop at demonstration farms

Tomato

Plot Numbers	Cropping period	Irriation experience	Sales (DT/ha)	Cost (DT/ha)	Benefit (DT/ha)
S4	June to Oct.	3rd year	10,427	3,757	6,670
S8	June to Oct.	3rd year	9,782	3,840	5,942
S15	June to Oct.	2nd year	10,930	5,148	5,782
F4	May to Aug.	3rd year	10,649	5,931	4,718
F7	May to Sep.	2nd year	11,226	6,143	5,083

Pepper

Plot Numbers	Cropping period	Irriation experience	Sales (DT/ha)	Cost (DT/ha)	Benefit (DT/ha)
N4	May to Nov.	3rd year	22,629	8,639	13,990
N10	May to Nov.	2nd year	19,251	8,383	10,868
N13	May to Nov.	2nd year	16,701	8,041	8,660
S4	June to Oct.	3rd year	4,481	4,636	−154
S8	June to Oct.	3rd year	4,890	5,005	−115
S11	June to Nov.	2nd year	12,867	7,895	4,972
S15	June to Oct.	2nd year	8,839	7,278	1,561
F11	May to Nov.	2nd year	26,620	9,596	17,024

Melon

Plot Numbers	Cropping period	Irriation experience	Sales (DT/ha)	Cost (DT/ha)	Benefit (DT/ha)
N1	May to Sep.	3rd year	16,370	5,336	11,034
N2	May to Aug.	3rd year	12,695	5,202	7,493
N3	May to Sep.	3rd year	11,930	5,315	6,615
N6	May to Sep.	3rd year	13,500	6,118	7,382
N7	May to Sep.	3rd year	12,642	5,767	6,875
N9	May to Sep.	2nd year	14,153	5,822	8,331
N11	May to Sep.	2nd year	17,569	5,774	11,795
N12	May to Aug.	2nd year	12,430	5,936	6,494
S14	June to Aug.	2nd year	8,400	5,236	3,164
S16	June to Sep.	2nd year	10,577	5,015	5,562
F6	May to Aug.	2nd year	9,366	6,747	2,619
F9	May to Aug.	2nd year	11,482	6,029	5,453
F10	May to Sep.	2nd year	18,735	6,319	12,416

Watermelon

Plot Numbers	Cropping period	Irriation experience	Sales (DT/ha)	Cost (DT/ha)	Benefit (DT/ha)
N14	May to Sep.	2nd year	11,494	6,129	5,365
N15	May to Sep.	2nd year	21,582	5,980	15,602
S2	June to Aug.	3rd year	5,411	3,617	1,794
S10	June to Aug.	2nd year	7,800	4,291	3,509
S14	June to Aug.	2nd year	5,400	4,638	762
F1	May to Aug.	3rd year	5,085	1,843	3,242
F2	May to July	3rd year	−	−	−
F3	May to July	3rd year	−	−	−
F5	May to Aug.	2nd year	9,199	6,158	3,041
F8	May to Aug.	2nd year	8,835	5,829	3,006
F9	May to Aug.	2nd year	12,811	6,682	6,129
F10	May to Aug.	2nd year	23,438	6,667	16,771

Sorgho

Plot Numbers	Cropping period	Irriation experience	Sales (DT/ha)	Cost (DT/ha)	Benefit (DT/ha)
S1	June to Oct.	3rd year	5,640	1,947	3,693
S3	June to Sep.	3rd year	3,391	1,384	2,007
S6	June to Oct.	3rd year	2,488	1,029	1,459
S7	June to Sep.	3rd year	1,643	1,348	295
S9	June to aug.	2nd year	3,523	1,377	2,146

Alfalfa

Plot Numbers	Cropping period	Irriation experience	Sales (DT/ha)	Cost (DT/ha)	Benefit (DT/ha)
S3	June to Sep.	3rd year	4536	1306	3230
S7	June to Aug.	3rd year	3437	1122	2315
S9	June to Aug.	2nd year	2339	1526	813
S12	June to Oct	2nd year	−	−	−

2.3.4 Extension services and related activities on the pilot site

(1) Geographical conditions in three irrigated areas and recent situation of farming

In three irrigated areas such as Nefza, Sedjnane and Fernana, pilot sites were established per each irrigated area for promotion activity of irrigated farming. This section gives an outline of the geographical conditions in three irrigated areas and the recent situation of farming.

The GDAs provide irrigation water to all the three schemes only from spring to autumn. Hence, winter farming depends on natural rain falls. Generally, land preparation, namely, plowing, harrowing and flatting, is done by hired tractor, and cultivation and harvesting are done by hired female labors. Although almost farmers' management styles in three irrigated areas are independent farming, there are some peasantries and independent peasantries.

1) Nefza

- Nefza irrigation scheme is located in a hilly area, and has some streams. The farms located in the lowland near streams or in poorly-drained areas are not productive in the rainy season; hence, farming is limited only in the dry season, using irrigation. Furthermore, winter and spring cropping can be done at farms located away from streams and with low groundwater level.
- The westernmost area in Nefza irrigation scheme produces citruses with well-drained sandy soil.
- The area has a problem of diseases caused by high humidity, because of the closeness of the dam reservoir. And crops are damaged every year by wild boars living in the forests surroundings the reservoir. (Jmila which is one of the pilot sites corresponds to this situation.)
- Recent irrigation system is generally classified into two systems. One is that irrigation areas such as Ennouhoudh and El Wifek sectors which conduct water supply by natural pressure from balancing reservoir after conveyance to balancing reservoir (Capacity: 33,000 m^3) established high place and inside the area through conduit controlled by SECADENORD, the other is that irrigation areas such as Touila and Ouechtata sectors which conduct water supply directly from dam lake (Lake Sidi El Barrak) by pump controlled by CRDA. In some areas of these irrigated areas using direct pump supply, irrigation system which uses balancing tank is adopted but these system cannot work sufficiently in terms of hydraulic aspect because capacity of tank is small (500 m^3), and there are some issues that is difficult to secure necessary water volume due to falling of water pressure in water tap which locates in high place in beneficiary area. On the other hand, there are almost no issues concerning water supply in irrigated areas using natural pressure

because water supply and demand are balanced due to utilization of balancing reservoir which has sufficient capacity.

2) Sedjnane

- Sedjnane irrigation scheme is located along a stream, and a major part of the scheme is located in the flood plain. Inundated farms cannot be cultivated in the rainy season, and the excessive soil moisture limits the growing period and the crops to be grown.
- That is why the livestock industry has been thriving well prior to the introduction of irrigation. Hence, a lot of farmers in Sedjnane are producing not only cash crops but also fodder crops to sustain livestock breeding.
- In Sedjnane, ratio of irrigated cultivation is high overall. Hence, almost arable land without irrigation is fallow.
- Irrigation system in Sedjnane controls 8 blocks (sectors) corresponding to whole area, in 4 pumping plants controlled by SECADENORD which diverts from Sedjnane River in the area, and all of these systems adopt pump supply system using balancing tank which is located in high place in the area. However, capacities of these balancing tanks are extremely small (300 m^3). Therefore, there are some issues that balancing function cannot work sufficiently, diameter of water pipe are too small and posting of water tap is inappropriate.
- There are also some issues concerning lack of water volume by pump supply in comparison with necessary water volume in peak time of irrigation. These problems come from difference between planned cultivated crops and actual cultivated crops. Namely, necessary water volume increased because fruits which were predicted to be cultivated were not cultivated but vegetables were much more cultivated actually.

3) Fernana

- Fernana irrigation scheme has a long growing period, even though the terrain condition is hilly such as in Nefza. Fernana has also streams, but the valleys are deeper than in Nefza. Hence, the groundwater level is generally low. In Fernana, rain fed agriculture can be undertaken in the winter season.
- In Fernana, farmers from other areas like Sat Foura rent lands and cultivate out season potato and green peace. Especially, potato is prosperous product and cultivated area of it occupies some

percentage. However, farmer from other areas are reluctant to cultivate out season potato because of poor drainage and submersion by heavy rain in recent years; hence, utilization of irrigation facilities does not proceed well.

- Numbers of farmers who conduct crop rotation between wheat and beans by utilizing rain are generally many in Fernana.
- Irrigation system in Fernana pumps up water from a river at pump station managed by CRDA. Then, water is stored once at two water reservoir located at high place. After that, water is distributed to beneficial areas by natural pressure. Although water resource is a river discharged by a pump of SECADENORD, problem that water in the river is shortage at necessary season for pump station because time duration discharged by SECADNORD is short and operation time of pump managed by CRDA is not considered. In Fernana, irrigation system adopts reservoir method. Therefore, it is prerequisite that pump is operated for a long time from the economical view point and capacity of pump facility is smaller than volume of water flow at peak time. Thus, it is difficult to secure necessary volume of water due to short duration of pumping time.

(2) Selection of pilot sites

Pilot sites were partitioned and delineated in location maps in June (See Appendix 1~3). And the profile (farm area, planted vegetables, irrigated or not) of farmers in each pilot sites was made on the basis of the location maps of the three irrigation perimeters. By the request for quick response to Tunisian side, establishment of demonstration farms and activities in the farms are prioritized because of in the second year, Tunisian side appreciated the good result of the first year and requested the expansion of almost same number of 21 demonstration farm. As a result, it took a long time to establish pilot sites finally up to June in second year.

When CRDA, CTV and GDA partitioned the sites, administrative boundary, irrigation pipe network, terrain condition and place of irrigation hydrants were considered. And some employees of the project, extension staff of CTV and GDA staff made the farmers list cooperatively. Finally, 14 pilot sites were set at the three irrigated areas, namely 4 sites at Nefza, 6 sites at Sedjnane, and 4 sites at Fernana)

The selection criteria of the pilot sites, which were decided with the parties concerned such as DGGREE, are shown below.

- Each pilot site is set within areas where each GDA have jurisdiction. One pilot site does not belong to several GDAs (One GDA have jurisdiction over one or several pilot sites).

- One GDA takes charge of at least one pilot site (GDA Ouechtata in Nefza is excluded from this policy because fruits are grown). However, one GDA may have responsibility of more than two pilot sites because the areas are divided into several parts in case that the size of a hydraulic sector is big or there are topographical constraints like segmentations by a river or very long and narrowly shaped areas.
- Perimeters are chosen so that the demonstration farm is located at the central part of the pilot site as far as possible.
- Farmers in the pilot site are both irrigating and non-irrigating farmers. However, most of them should be irrigating farmers in the current situation. Furthermore, pilot sites shoul be established divided by the same condition of infrastructure and non-irrigating farmers must own a hydrant (or common hydrant) and be ready to start irrigated agriculture in future.

(3) Technical instruction

1) Instruction for soil diagnosis, and fertilization management, etc

On the soil diagnosis to farm households in the pilot sites with mentioned training at 2.3.2 for extension workers, training was intensively conducted at the first assignment period by local consultant on Pedology hired by the DPINT. The training in a few days with 10 persons was conducted on the demonstration farms in each irrigation perimeter from October to December.

Table 2-18 Training on soil diagnosis for the farmers in the pilot site (year 2012)

Irrigation Perimeter	Rerated GDA	Date of Training	Participated farmers
Nefza	Ouchtata	10th of October	12
	Touila	11th of October	10
	El Nouhoudh	12th of October	10
	El Wifak	16th of October	7
Sedjnane	Baraka	4th of December	14
	El Intilak		
	Ennajah	7th of December	13
	El Imtiyaz		
Fernana	Oued Ghrib	19th of October	12

Instruction on the fertilization managements for the farmers in pilot site were conducted concentrated at the time of field day farmers training program in the 2nd and 3rd year.

2) Demonstration of advanced farming case

In the first year (year 2012), grafted seedlings were introduced for melon and watermelon and instructed effect of them to CRDA, CTV and a few farmers in the pilot sites. And as a result, they understood that outbreak of mildew disease of them was controlled..

In the second year (year 2013), companion plants were introduced and exhibited. Eggplant family and squash family have a possibility of damages by nematode However, soil disinfection for the technique of coping is unrealistic and cultivating other crops that nematode hate in the field has a potential to reduction of damage by nematode. Therefore, experimental mixed cropping of some plants that was known as repellent effect and exhibition it was determined.

Marigold and basil were mix planted as companion plants in the demonstration plots of tomato and red pepper, water melon and melon were mix planted as banker plants in the demonstration plots of maize and sorghum were planted around of the plots. However, as acknowledge the meaningfulness of companion plants is difficult in the condition where irrigated agriculture is established, the techniques were only introduced.

Furthermore, advanced methods of pruning and fruit thinning for melon and water melon to improve qualities were introduced at small parcels in the demonstration plots. and exhibited for farmers in pilot sites.

3) Utilization of irrigation facilities, soil moisture management, and cultural control method

Farmers introducing irrigation in the plot sites, were provide guidance of soil moisture management, and cultural control method to extend and acquire techniques of irrigated agriculture. These extension and technical guidance were implemented in farmers training program (field day) that were held by field engineers and person in charge of CTV as will become apparent below.

(4) Implementation of extension activities through farmers' training program

Extension activity of irrigated agriculture in pilot site was carried on a full-scale operation from 2nd year (2013). Especially in 2014, a lot of farmers' training programs through mainly field day were implemented and extension activity of model irrigated agriculture was developed for farmers in pilots sites.

Project team focused on 13 plots from 41 plots and provided technical guidance intensively in extension activity in 2014. These 13 plots were set as model plots in pilot site and became training site for farmers to develop activity effectively.

1) Farmers' training program (field day)

Training programs about irrigation and cultivation were held for farmers in pilot sites by employee in this project and Chief of CTV in the CTV office and demonstration plots of irrigated area. Furthermore, we encouraged for non-irrigated farmers to participate the training and to take a interest in irrigated agriculture.

The status of the implementation of farmers training for farmers (field day) in the pilot sites in 2nd year is listed in the following Table 2-19.

Table 2-19 Training for farmers in the pilot sites (2013)

PPI	Site	Date	Contents of training	No.of Attendants
Nefza	Jimila	7 May	Equipment of water saving irrigation, Management of crops	13
	Bouzenna	23 May	Equipment of water saving irrigation, Management of crops	16
	Nefza	4 July	Irrigation and pest control for solanaceous crops	11
	Nefza	9 July	Irrigation and pest control for cucurbitaceous crops	32
	Nefza	4 July	Equipment of water saving irrigation, Management of crops	15
Sedjnane	Intilaka	28 May	Equipment of water saving irrigation, Management of crops	30
	Sedjnane	5 July	Irrigation and pest control for solanaceous crops	20
	El Barka	5 July	Equipment of water saving irrigation, Management of crops	8
	Sedjnane	24 Sep.	Alfalfa production, advantage of leguminous crops	33
Fernana	-	-		-

∗ Training in Fernana had been planed twice in April and Julu, but it had postponed because of heavy weather and trebles between farmers and canceled finally.

Field day in 3rd year were implemented in a planted way and model irrigated agriculture were exhibited and extended by farmers, extension staff and DPINT project as a whole. In the training, extension materials and text books for farmers were prepared and provided. Additionally, contents of training program, such as the utilization and maintenance of irrigation equipment through plant growth, importance of grafted seedling and attention for transplanting, input for fertilizer and chemicals, farm managements such as weeding and harvesting and attention for products selling, were quite useful for improvement of irrigated farming . It was held in 3 demonstration plots in irrigated area at total 23times and 219 farmers joined.

The contents of field day in 3rd year are listed in the following Table 2-20.

Table 2-20 Implementation Status of Field Day at Pilot Sites (2014)

Contents of training	Irrigataed perimeter	Pilot Site	Name of farmers Number of demonstraion plot	Date	Number of particpated farmers
1. Soil protection by organic fertilization and crop rotation 2. Installation and maintenance of drip irrigation facilities at the plot	Fernana	Oued Ghrib	H'mida Ghazouani	2014.04.24	12
	Nefza	Bouzenna 2	Bilel Rgui （N 11）	2014.05.02	10
		Touila	Must. Hmissi （N 14）	2014.05.06	8
		Bouzenna 3	Nizar Mastouri （N 10）	2014.06.07	6
		Touila	Must. Hmissi （N 14）	2014.06.09	7
1. Protection of soil through organic fertilization and crop rotation 2. Installation and maintenance of irrigation facilities at the plot	Sedjnane	CP 4	Abdelkarim Sahbani (S 11)	2014.04.29	13
		CP 2	Sadok Maalaoui （S 16）	2014.05.05	14
		Out of perimeter	Mehrez Maalaoui （S 12）	2014.05.07	4
		CP 1(RG)	Mongi Abassi （S 14）	2014.05.19	18
1. Plant nutrition and mineral fertilization 2. Need plants for irrigation water and irrigation frequency	Fernana	Ain Albeya	Kais Boussaidi （F 8）	2014.05.08	9
		S. Ammar	Abdel. Jawadi (F 7)	2014.05.19	6
	Nefza	Touila	Mustapha Hmissi (N 14)	2014.06.02	6
		Jimila	Mariem ayadi (N 9)	2014.06.10	10
		Bouzenna 3	Nizar Mastouri (N 10)	2014.06.15	6
		Bouzenna 2	Bilel Rgui (N 11)	2014.06.23	5
	Sedjnane	CP 1(RG)	Mongi Abassi (S 14)	2014.06.18	8
		CP 2	Sadok Maalaoui (S 16)	2014.06.23	9
		CP 4	Abdelkarim sahbani (S 11)	2014.06.23	9
	Fernana	O. Ghrib	Hmida Ghazouani (F 5)	2014.06.13	8
		A. Albeya	Kais Boussaidi (F 8)	2014.06.17	12
		S. Ammar	Abdelbasset Jawadi (F 7)	2014.06.20	6
Crop management of seed selection and priming and plantation for out season potato	Fernana	O. Ghrib	GDA Office	2014.08.21	13
Preventive and curative control of Late blight and cutworm for out season potato		S. Ammar	GDA Office	2014.09.29	20
Times of implemetation and Total attendants			23 times		219 farmers

2) Training for farmers in lecture learning

Training in lecture learning was implemented in training center in Testour in Béja district, which targeted farmers at demonstration farms and farmers without irrigation facility. Some external instructors were invited in the training. Contents of the training are shown in the Table 2-21 below.

Table 2-21 Training for farmers in training center in Testour (2013)

Date	Subjects of training	Number of participants
8th October	Crop rotation in irrigated area	20
	Outline of drip irrigation	
	Prevention of damage from disease and harmful insects	
9th October	Necessary condition of introduction of drip irrigation	15
	Water requirement for cultivation	
	Examples of water requirement calculation per soil type	
10th October	Outline of overhead irrigation	15
	Cost in introduction of drip irrigation	

Training for farmers in the second phase of the second assignment period was implemented in June. The training targeted farmers in three irrigated areas, which dealt with prevention of damage from disease and harmful insects of summer vegetable in lecture learning. In this training, external instructor who belongs to Northern Crops Protection Station under the Ministry of Agriculture (NCPSMA) was invited, and approximately 30 farmers and stakeholders participated in the training per each day. In Fernana, the same instructor implemented lecture concerning protection of fall potato in September.

Table 2-22 Implementation situation of training for farmers in lecture learning style (2014)

Irrigated area	Location of training	Implementation date	Number of participants	Curricula
Fernana	GDA Fernana	24th June	27	・Measures against powdery and downy mildews of watermelon and melon ・Prevention of tomato's damage from disease and harmful insects ・Measures against powdery mildew and cutworm of red pepper
Sedjnane	CTV Sedjnane	25th June	22	
Nefza	CTV Nefza	27th June	37	
Fernana	GDA Fernana	29th September	approximately 20	・Measures against blight and cutworm of fall potato

3) Workshop / Seminar

In the first assignment period (2012), workshop for information sharing was held on 18th October, which aimed at information sharing of farming in each demonstration farm and outcome of activities concerning irrigation technology.

Although main target of the training was farmers in pilot site, stakeholders related to promotion matters, GDA and CRDA staffs also participated the training (see Table 2-23).

Participants such as farmers and C/Ps realized that effectiveness of water-saving irrigation technology which was introduced in demonstration farms has been verifying gradually through these workshops. At the same time, the various participants shared each other some issues such as inadequacy of irrigation facilities, poor drainage, unpaid water charge and lack of water supply and extension staff that are predicted to be obstacle to promotion of irrigated agriculture.

Table 2-23 Holding of workshop involving farmers

Irrigated area	Location of training	Implementation date	Number of participants		Main theme
			Farmer	C/P	
Fernana	Fernana	6th November	23	3	・Importance of variety selection and grafting ・Function and usage of fertilizer ・Main damage from disease and harmful insects ・Introduction of data concerning yield in demonstration farms ・Basic knowledge of irrigation facilities and technology ・Control of watering volume conforming to growth stage of crop
Sedjnane	Sedjnane	7th November	23	9	
Nefza	Nefza	8th November	24	7	

∗ Stakeholders are CTV/CRA, GDA and CRDA.

In the first phase of the second assignment period, workshop was held for promotion of activities' outcome in pilot site, and meeting and accompanying seminar for strengthening of project activities were held in Nefza in September. Various organizations and institutions such as DGGREE, CRDA Béja, CTV Nefza, four GDA, a part of farmers in demonstration farms and professionals of DPINT participated in this activities, and they exchanged their opinions concerning activities' result until now and activities by Tunisia from now on. Approximately 15 stakeholders participated in the meeting.

As the stakeholders of CRDA Jendouba couldn't attend the third JCC held in November 2013, the seminar for sharing the outcome of the Project was held in 12th November at the office of CRDA Jendouba and 10 stakeholders from it participated.

In the second phase of the second assignment period, workshop was held under the initiative of CTV in the end of September and in October, which aimed at discussion about outcome and issues of irrigated farming, and sharing of the information. Approximately 30 farmers and stakeholders participated in the workshop per each workshop. In workshop in Fernana, participants were not so many in first time (9 people). Hence second workshop was held in another day.

In the workshop, participants discussed measures for the future through the verification of cause and disposal of outcome focused on result from activities in demonstration farms especially.

Holding situation of the workshop is shown in the Table 2-24.

Table 2-24 Holding of workshop under the initiative of CTV (2014)

Irrigated area	Location of training	Implementation date	Number of participants		Main theme
			Farmer	C/P	
Fernana	Fernana	23rd September	9	6	・Outcome and issues in demonstration farms ・Yield and selling price, and cost of input ・Character and tendency of cultivation and growth ・Significance and effect of organic fertilizer use and crop rotation ・Importance of botanical nutrition and microelement ・Input of agricultural chemicals for melon, watermelon, tomato and red pepper, and prevention of damage from disease and harmful insects ・Importance of weeding
Sedjnane	Sedjnane	24th September	21	15	
Nefza	Nefza	14th October	13	6	
Fernana	Fernana	17th October	19	5	

∗ Stakeholders are CTV, GDA and DPINT.

4) Last seminar

In 11st December 2014, seminar related to outcome of field activities was held under the initiative of general director of DGGREE in conference room of Africa Hotel in Tuni city. In the seminar, outcome of field activities of DPINT in 2014 such as monitoring of farming in demonstration farms, promotion activities, support for establishment of SMSA and support for setting up of new accounting charge system was shared amongst stakeholders in Tunisia such as DGGREE, DGFIOP, DGPA CRDA and CTV. In addition, seminar was held, which aims to implement last JCC in February 2015 smoothly and transfer the project to Tunisia C/P with securing sustainability.

In the last seminar, some outcomes from activities were shared such as support and enlightening activities of DGGREE, CRDA in each district, stakeholders in CTV and GDA in three years project activities, development of software for payment in water use, follow-up in demonstration farms, support for establishment of SMSA and implementation of survey contribute to improvement of irrigation facilities and drainage. In the end of the seminar, general director of DGGREE disclosed that

Tunisia needs to maximize outcome of the project continuously, and concluded that some stakeholders such as DGGREE, CRDA, CTV and GDA are standing a starting point to ensure the project's outcome under the collaboration.

We requested DGGREE to share the information about the project's outcome to stakeholders in Hamman Bourguiba through CRDA Jendouba because they did not participate in this seminar.

5) Other training

Given 2014 is a last year of this project, it was important, as a viewpoint of a plan, to practice promotion activity by CTV in three irrigated areas such as Nefza, Sedjnane and Fernana in terms of sustainability after completion of the project.

Under the sponsorship of CTV in Nefza and Sedjnane, training through inspection of demonstration farms of vegetable and pasture cultivation by irrigation was implemented in August 2014 for neighboring farmers who do not belong to pilot site, and approximately 20 farmers participated. In the training, mainly opinions concerning cultivation technology and variety selection were actively exchanged. In addition, similar training through inspection of demonstration farms was implemented in August, which targeted extension staffs of CTV and CRA in whole Béja and Bizerte districts. Approximately 30 stakeholders per each organization related to promotion participated in the training.

These training through inspection had participants realized their accumulated knowledge concerning cultivation technology, at the same time it is guessed that there were effect to promote their motivation to expand irrigated planted areas. Briefing session concerning significance of the project, practical management of demonstration farms in drop irrigation and cultivation and production of vegetable was dealt with in interview and news in local radio station (Kef). It is expected that effect for promotion of irrigated farming to not only selected project sites but also other various areas.

At the same time, it was extremely significant that project's extension staffs planned and practiced these promotion activities by their own actively, and it seemed that these activities become significant outcome which encourages promotion of promotion system hereafter.

(5) Guidance and support to water management at a common hydrant

Although rotational irrigation was planned for the common hydrant which targets a part of irrigated areas in Sedjnane, Fernana and Nefza after the first phase of the second assignment period, it was not realized because the operation time of the pump at each irrigation area was limited and water

volume provided by pumps was much less than planned due to the unpaid water fees and the continued non-deliverance of water to each farm. As a result, there were risks of clashes between farmers and CRDA, which did not deliver the planned water volume, even if the project gathered farmers, who utilized the common hydrants, to introduce rotational irrigation (Actually there was a request of cancellation from CRDA in Béja in the situation of notification of contents of plan). Therefore, this activity was postponed because the project judged that it was impossible to take actions, organizing water management farmers group without settling the water supply problem.

Instruction of rotational irrigation was difficult in Fernana as well as Sedjnane because pump supply from SECADENORD is extremely short as 2 hours per day, and gross weight of irrigation is absolutely lacked. Moreover, activity was difficult to implement in a part of Nefza which is supplied directly by pump due to problem of water supply system in facility.

The project did not target two irrigation sectors in Nefza irrigated area which utilize balancing reservoir because there was no problem in particular in using situation of hydrant.

The irrigation water source of each irrigated area, as mentioned at (2.3.4(1)), heavily depends on SECADENORD water as follows:Nefza

- Ennouhoudh, El Wifek : Pipe supply to beneficiary site by natural pressure after diversion of water by pump supply controlled by SECADENORD to balancing reservoir which has a large capacity.
- Touila, Ouechtata : Supply to beneficiary site by direct pump supply controlled by CRDA.

- Sedjnane
  - All area : Supply to beneficiary site by direct pump supply controlled by SECADENORD.
- Fernana
  - All area : Supply to beneficiary site by natural pressure after diversion of water by pump supply under the control of CRDA to balancing reservoir. However, water source is a river by pump controlled by SECADENORD.

The project has often suggested to CRDAs in Sedjnane and Fernana to have discussion with SECADENORD on the water supply timing. Then, Jendouba CRDA submitted a request letter dated July 17, 2013 to SECADENORD as regards the problem of water supply timing for Fernana. Following that, a discussion was held between the two parties. As a result, the water supply time was increased from the current two hours to four hours, adjusting properly the water supply peak time of water from rivers, i.e. the peak time was delayed, and the volume of water delivered increased.

However, plan of rotational irrigation by utilizing of common hydrant is difficult to implement because 4 hours water supply is short.

Although other irrigated perimeters have the same problem with SECADENORD, the cause is relating here to the water fees debts. Moreover, there were many farmers who had to give up planting by irrigation because commencement of pump supply in seedling planting season was delayed substantially in Sedjnane in 2014. Therefore, it seems that discussion, including a solution of this problem, between GDA and CRDA, and CRDA and SECADENORD is continuously needed. It is essential for planned use of rotational irrigation of common hydrant to implement water supply appropriately.

(6) Training of farmers without irrigation facility

For the project, the farmers who do not own irrigation facilities are particular targets to be interested in irrigated farming and to start to practice irrigated farming. Therefore, we prepared opportunity that farmers without irrigation facility attend the trainings and lectures at pilot sites with farmers with irrigation facility, and also prepared opportunity for them to attend farmer's training which was held in training center in Testour. Moreover, we called farmers without irrigation facility and prepared opportunity for them to attend other activities referred to in "2.3.6 Visit to and observation of advanced irrigation districts".

These trainings made non-irrigation farmers be interested in irrigation farming, and it was confirmed that most these farmers would try irrigation farming if they are financially able to purchase irrigation equipment through implementation of questions and answer, and exchange of opinions in each training. Hence, effect from implementation of these trainings was significant.

2.3.5 Survey for irrigated area and farming rate at Pilot Sites

(1) Irrigated area and farming rate at Pilot Sites

Survey results of irrigated area and farming rate during three years of the project is shown below. Its results were acquired through survey on registered irrigated area and farmers at each pilot site of the three irrigated areas in the first and second phase of the second assignment period. Concerning the irrigated area, results of two years, namely 2012 and 2013, was obtained in the first phase of the second assignment period. In addition, the survey was conducted through cooperation with CTV and GDA.

1) Survey results and problem analysis

Results of irrigated area and analysis of irrigated farming rate at Pilot Sites during three years from 2012 to 2014 are indicated at Table 2-25. Observing the changes in irrigated farming rate, a considerable fluctuation of the rate is found each year. This special situation can be explained by the reasons observed at some irrigation perimeters such as; unexpected heavy rain damages (in 2012 and 2013) at a part of Fernana perimeter, damages by boars at a part of Nefza perimeter and long delay of water distribution at Sedjnane perimeter in 2014, etc.

Table 2-25 Area and rate of irrigation farming at Pilot Sites (2012~2014)

Perimeter	Pilot site	Total Area (ha)	Irrigated Area (ha)			Irrigated Farming Rate (%)		
			2011/2012	2012/2013	2013/2014	2011/2012	2012/2013	2013/2014
NEFZA	BZ2	261	93.7	102.3	108.6	36%	39%	42%
	BZ3	125.6	51.8	56.7	71.9	41%	45%	57%
	Jmila	122.7	26.2	26.6	26.4	21%	22%	22%
	Touila	162.5	62.5	56.4	49.9	38%	35%	31%
	Total	671.8	234.3	242.0	256.8	35%	36%	38%
SEDJNANE	CP1 (RD)	81.5	37.1	51.6	34.64	46%	63%	43%
	CP1 (RG)	254	101.2	149.1	67.72	40%	59%	27%
	CP 2	122.8	52.5	77	55.37	43%	63%	45%
	CP 2'	75.7	32.5	35.8	13.56	43%	47%	18%
	CP 3	83	25.5	26.7	24.1	31%	32%	29%
	CP 4	167	77.2	70.3	50.2	46%	42%	30%
	Total	784	326	410.5	245.59	42%	52%	31%
FERNANA	Ain El Baya	125.6	32.7	32.7	18.8	26%	26%	15%
	Sidi Ammar	114.7	52.3	62.7	37.8	46%	55%	33%
	Fernana	142.1	18.7	20.6	48.2	13%	14%	34%
	Oued Ghrib	218.2	29.6	66.7	70.3	14%	31%	32%
	Total	600.6	133.3	182.7	175.1	22%	30%	29%

* : Figures that are calculated by including the impeding factors against irrigated agriculture

In order to consider irrigated farming area and farming rate as an indicator of the extension of irrigation farming, it will be necessary to exclude the above mentioned factors that affect the trend of the evolution of irrigated area and farming rate. Therefore, calculating "Irrigated area and farming rate in the Pilot Sites," the Pilot Sites which include these farmlands will be excluded from the calculation of irrigated farming rates.

Hereinafter are enumerated the various constraints impeding irrigated farming at Project Sites during the project period.

- Nefza perimeter: Damages by boars in Pilot Site Jmila

  Because of its location (nearby forest and river), boars commonly appeared in P/S and damaged crops frequently in recent years; which made, rental farmers, who have been conducting large-scale irrigated farming for a long period, shift to other irrigated areas by fear of the boar damages.

- Sedjnane perimeter: Delay of water distribution in 2014

In 2014, due to delay of water distribution, resulting from unpaid water bills, at the planting season in spring, farmers who planed irrigated cropping (i) abandoned irrigated summer cropping, and opted for fallow lands (Seedlings were not purchased. / Seedlings were lack and expensive at the purchase season.) and (ii) changed crops into fodder (Area of fodder will be small because amount of fodder is needed for only own livestock). Therefore, irrigated area has decreased significantly.

- Fernana perimeter: Farmer avoided cropping out-season potato, because of the past damage of heavy rain

  The main reason of low irrigated rate (13%) at P/S Fernana and Oued Ghrib in 2012 is drastic decrease of seed potatoes' production, caused by flood damages to out-season potato which is a major crop at both P/S. (Irrigated rate at Oued Ghrib restored to 30% in 2013 due to absence of drainage failure influence.) In addition, main reason of low irrigation rate in Pilot Site Fernana in 2013 is that rental farmers from other areas worried about drainage failure and avoided cropping.

- Fernana perimeter: Avoid renting by farmers who are worrying about the irrigation water supply duration, judged to be rather insufficient

At Fernana irrigation perimeter, the time of water supply by one CP was problematic in 2013. (The time of water supply was too short, 2 hours per day). To solve this problem, SECADENORD and CRDA discussed repeatedly, and decided to extend the duration 4 hours at last.) Consequently, rental farmers, who worried about the pumping duration, avoided irrigation farming at Pilot Sit Ain El Baya in 2014.

2) Calculation results of irrigated rate

Based on the above definition, the irrigated rate at Pilot Sites of each perimeter for three years are shown in Table 2-26.

Table 2-26 Area and rate of irrigation farming at Pilot Sites, excluding impeding factors (2012~2014)

Perimeter	Pilot site	Total Area (ha)	Irrigated Area (ha)			Irrigated Farming Rate (%)		
			2011/2012	2012/2013	2013/2014	2011/2012	2012/2013	2013/2014
NEFZA ※1	BZ2	261	93.7	102.3	108.6	36%	39%	42%
	BZ3	125.6	51.8	56.7	71.9	41%	45%	57%
	Jmila	※1	※1	※1	※1	※1	※1	※1
	Touila	162.5	62.5	56.4	49.9	38%	35%	31%
	Total	549.1	208.1	215.4	230.4	**38%**	**39%**	**42%**
SEDJNANE	CP1 (RD)	81.5	37.1	51.6	※2	46%	63%	※2
	CP1 (RG)	254	101.2	149.1	※2	40%	59%	※2
	CP 2	122.8	52.5	77	※2	43%	63%	※2
	CP 2'	75.7	32.5	35.8	※2	43%	47%	※2
	CP 3	83	25.5	26.7	※2	31%	32%	※2
	CP 4	167	77.2	70.3	※2	46%	42%	※2
	Total	784	326	410.5	※2	**42%**	**52%**	※2
FERNANA	Ain El Baya	125.6	32.7	32.7	※3	26%	26%	※3
	Sidi Ammar	114.7	52.3	62.7	37.8	46%	55%	33%
	Fernana	142.1	※4	※4	48.2	※4	※4	34%
	Oued Ghrib	218.2	※4	66.7	70.3	※4	31%	32%
	Total	600.6	85.0	162.1	156.3	**35%**	**35%**	**33%**

※1	P/S of Jmila in Nefza is not counted due to the damages on production caused by boars.
※2	Delay of water distribution happened in 2014 in Sedjnane and farmers didn't use irrigation services.
※3	Farmers avoided irrigation farming due to the shortness of time of water supply by a pump of Ain El Baya
※4	Farmers avoided irrigated farming for out-season potato, caused by damage of heavy rain at Oued Ghrib and Fernana

According to the table, average irrigated farming rates at Pilot Site in each perimeter in the latest year is 42% in Nefza (2013/2014), 52 % in Sedjnane (2012/2013) and 33% in Fernana (2013/2014). These data shows increasing tendency, except in Fernana.

The decline at Fernana in 2014 was resulted from drastic decrease of irrigated rate at Sidi Ammar, one of pilot sites in Fernana; and the decrease in Sidi Ammar was explained as below:

i) Farmers were reluctant to adopt out-season potato cropping due to the decrease of season potato selling price.

ii) For application of crop-rotation, wheat and beans rates increased and irrigated crops decreased.

3) Calculation results of number and rate of farmers using irrigation

Survey results about number and rate of farmers using irrigation for three years of project period is indicated at the Table 2-27.

Number of farmers using irrigation tends to increase overall form 2012 to 2014. This shows that irrigation agriculture at Pilot Site has progressed. However, it decreases slightly because of water delay at Sedjnane in 2014, except one of Pilot Sites.

Table 2-27 Number and rate of farmers using irrigation

(1) NEFZA

Pilot Site	Total Farmers	Number of Farmers (Using irrigation)			Rate of Farmer using irrigation (%)		
		2011/2012	2012/2013	2013/2014	2011/2012	2012/2013	2013/2014
BZ2	**203**	104	104	126	51%	51%	62%
BZ3	**67**	27	26	48	40%	39%	72%
Jmila	**123**	47	46	60	38%	37%	49%
Touila	**171**	79	82	79	46%	48%	46%
Total	**564**	**257**	**258**	**313**	**46%**	**46%**	**55%**

(2) SEDJNANE

Pilot Site	Total Farmers	Number of Farmers (Using irrigation)			Rate of Farmer using irrigation (%)		
		2011/2012	2012/2013	2013/2014	2011/2012	2012/2013	2013/2014
CP1 (RD)	**99**	50	58	53	51%	59%	54%
CP1 (RG)	**309**	169	214	150	55%	69%	49%
CP 2	**82**	41	56	59	50%	68%	72%
CP 2'	**108**	47	53	39	44%	49%	36%
CP 3	**80**	28	37	34	35%	46%	43%
CP 4	**198**	119	118	115	60%	60%	58%
Total	**876**	**454**	**536**	**450**	**52%**	**61%**	**51%**

(3) FERNANA

Pilot Site	Total Farmers	Number of Farmers (Using irrigation)			Rate of Farmer using irrigation (%)		
		2011/2012	2012/2013	2013/2014	2011/2012	2012/2013	2013/2014
Ain El Baya	**106**	30	26	19	28%	25%	18%
Sidi Ammar	**68**	34	41	25	50%	60%	37%
Fernana	**129**	11	21	35	9%	16%	27%
Oued Ghrib	**206**	17	22	47	8%	11%	23%
Total	**509**	**92**	**110**	**126**	**18%**	**22%**	**25%**

4) Results of pre-survey on irrigated areas and irrigated farming rate

i） Comparison between expected and actual irrigated area and farming rate in 2014

In February, DPINT project team implemented a pre-survey on irrigated area in Pilot Site of the three irrigation perimeters. The survey was based on farmers' interviews. The data analysis permitted to calculate the irrigated area and the farming irrigated rate in 2014. The results of the survey are mentioned in the following table:

Table 2-28 Expected irrigated area and rate of Pilot Sites in three irrigation perimeters on pre-survey（Scheduled planting in 2013/2014）

Irrigation perimeter	Pilot Site	Beneficiary area（ha）	Irrigated area（ha）	Irrigated rate (%)
Nefza	Bouzanna 3	125.6	65.1	51.8
Sedjnane	CP 4	166.8	85.2	51.1
Fernana	Oued Ghrib	218.2	23.7※	10.9※

(Interviewed survey conducted in February 2014)

※ On pre-survey, irrigated area at Oued Ghrib does not include planted acreage of out-season potato. (Eventually, planted acreage of out-season potato in 2013/2014 covered 22% of the beneficiary area)

On the other hand, here is the result of field survey of irrigated area at the all Pilot Sites, implemented from September to October in 2014.

Table 2-29 Measured irrigated area and rate of Pilot Sites in the three irrigation perimeters （Planting in 2013/2014）

Irrigation perimeter	Pilot Site	Beneficiary area（ha）	Irrigated area（ha）	Irrigated rate (%)
Nefza	Bouzanna 3	125.6	71.9	57.0
Sedjnane	CP 4	166.8	50.2	30.0
Fernana	Oued Ghrib	218.2	70.3	32.0

Comparison of results:

- There is not so much difference between expected and actual value in Nefza and Fernana perimeter.

- About Fernana perimeter, adding 22% of irrigation rate about out-season potato of the expected value, it totally reaches 32.9%, which almost the same as the actual one.
- While, the irrigation rate in Sedjnane perimeter dropped considerably because of the delay of water distribution at the beginning of the irrigation period in 2014, the actual value decreased 20% comparing to the expected one.

As shown by the above results, in the case of representing Pilot Site in Sedjnane perimeter, there was quite difference between the pre-survey estimation and the actual irrigation rate due to unexpected and unusual problems. It is to confirm that there is no record of such discrepancy in Nefza and Fernana. Therefore, the pre-survey to farmers, implemented in January and February in 2015, is reliable and significant to estimate planed irrigation area of that year.

ii） Survey results conducted in 2015

Accordingly, the same pre-survey is implemented in January and February 2015 and the results of the survey are utilized to estimate irrigated area and farming rate in 2014/2015 period. As a result, it is expected that irrigated farming rate is high in Nefza and Fernana. Also, farmers seem to be reluctant to conduct irrigated agriculture due to significant delay of water supply experienced at cropping season in 2014.

Table 2-30 Expected irrigated area and rate of Pilot Sites in three irrigation perimeters on pre-survey（Scheduled planting in 2014/2015）

Irrigation perimeter	Pilot Site	Beneficiary area（ha）	Irrigated area（ha）	Irrigated rate (%)
Nefza	Bouzanna 3	125.6	79.6	63.0
Sedjnane	CP 4	166.8	74.0	44.0
Fernana	Oued Ghrib	218.2	54.9※	25.0※

(Interviewed survey conducted from January to February 2015)

※ On pre-survey, irrigated area at Oued Ghrib does not include planted acreage of out-season potato. (Eventually, planted acreage of out-season potato in 2012/2013 and 2013/2014 covered 20% and 22% of the beneficiary area, respectively)

(2) Yield of irrigated crops at Pilot Sites

Yield of main crops at Pilot Sites are recorded by extension staff at CTV and survey results of average yield per hectare in 2012/2013 and 2013/2014 are shown in Table 2-31.

Table 2-31 Yield of irrigated crops at Pilot Sites

Irrigation Perimeter	Pilot Site	2012/2013 （ton/ha）						2013/2014 （ton/ha）				
		Tomato	Pepper	Watermelon	Melon	Sorghum	Alfalfa	Tomato	Pepper	Watermelon	Melon	Fodder
Nefza	Bouzenna I	35	19	-	31			-	30	-	33	
	Bouzenna II	39	22	-	35			50	35	50	36	
	Jemila	33	17	12	26			-	28	-	28	
	Touila	30	15	-	23			-	25	55	25	
Sedjnane	CP1(RD)	50	20	40	28	50	-	48	24	28	30	60
	CP1(RG)	50	18	30	25	50	30					
	CP2	50	18	30	30	55	35	48	24	26	25	58
	CP2'	50	25	25	30	50	-					
	CP3	45	20	30	25	50	40	50	22	25	22	55
	CP4	45	15	30	25	50	35	48	23	27	24	54
Fernana	Oued Ghrib	60	15	30	12			65	25	32	15	
	Fernana	-	14	25	-			62	10	25	22	
	Sidi Ammar	60	-	29	-			68	30	33	25	
	Ain Beya	50	13	35	-			60	20	31	-	

Compared average yield in last two years, 2012/2013 and 2013/2014, about common main four crops such as tomato, melon, watermelon and pepper at Pilot Sites, it tends to increase generally . However, average yield in Sedjnane is lower than one in other two areas due to water shortage in 2014 but difference between average yield this and last year are small. In addition, significant increase is observed about fodder.

Although it is difficult to evaluate effect of the project through comparison of results in two years, outputs of extension activities like Field Day on irrigation agriculture, conducted in the last year, is paid attention significantly by farmers surrounding demonstration farm in Pilot Sites. Therefore, extension of techniques and knowledge seems to be proceeded.

2.3.6 Visit to and observation of advanced irrigation districts

Although visit to advanced irrigation districts on faming and management of GDA, targeted to farmers and Counter Parts in the Pilot Sites , was planed initially, planned data was overlapped with busy farming season; therefore, one advanced area was selected and visited in September 2013. However, fortunately, participants could observe advanced example both farming and management of GDA at Rass Djebel. They consist on representative of farmers in the three irrigated areas targeted by DPINT, staffs of CTV and ones of GDA, and total 37 participants joined in a day bus tour to the above mentioned area.

Rass Djebel is well known for potato and horticulture production, and tour attendants listened attentively to the presentation done by CRDA Bizerte, CTV Rass Djebel and GDA Rass Djebel. The

lively questions-and-answers session was very fruitful. The attendants visited and were attracted by sweet potato cultivation which is not yet so common in Tunisia, and one big scale farmer who owned private facility for post harvest.

Outlines of the visit are described below:

- In the plot of a sweet potato farmer, the Head of CTV Rass Djebel made a brief presentation of the irrigated perimeter of Rass Djebel. He presented the historical background of irrigated farming in the area, and its progress; he focused on the similarities between Rass Djebel and the project three irrigated perimeters, notably Nefza, Sedjnane, and Fernana. He explained to farmers that though this area started irrigation almost after the independence, it has almost the same problem of small plots. He explained that according to soil features the irrigated perimeter is divided into three parts. He added that Rass Djebel is famous more for potato than vegetables and arboriculture.
- The GDA technical director explained that Rass Djebel perimeter is managed by one GDA, and that they do not face real difficulties of unpaid water charges. Also, explanations below were mentioned;
    - Compromises are always done with farmers who delayed their payments.
    - In Rass Djebel, common hydrants are frequent, one hydrant can be used by several farmers, and there is rarely problem of management.
    - In case one farmer refuses to pay his consumption, we need just to cut water to common hydrants for that farmer.
- A representative of Bizerte CRDA continued the presentation to underline the fact that Rass Djebel farmers could reach a successful level of irrigated farming thanks to their hard work and sacrifice. He focused on the role of manure in Rass Djebel and explained that farmers were obliged to buy manure for their lands.

  When one farmer complained about the difficulty of acquiring cows, for they are expensive, the CRDA representative explained that you can start by buying goats; as such, you start by providing your own manure, diversify your farming income, and accordingly improve your living conditions.
- The hosting farmers showed the visitors the sweet potato, which was unknown of the other farmers. Farmers were curious and interested in this new product, and asked several questions such as: cost, selling price, planting period, commercialization easiness, and potential market, etc.
- The following step was a visit to another plot belonging to the same farmer, in which he cultivated at the same time fruit trees, cabbage and cauliflower. CTV head insisted on the importance of every single piece of land, and explained to farmers the efficiency and profitability of stage cropping, that is to say, cultivating at the same time: vegetables, and fruit trees.
- The last step was the visit to a 13 ha farmland, which was a kind of a combined project belonging to

two brothers. The project included table grapes, and other fruit trees, as well as a storage house, and a freezer.

2.3.7 Assistance in issuing posters

In the 1st assignment period, the project made three types of posters in Arabic and French languages for extension activities. The posters have been delivered to each CRDA office and already posted on bulletin boards in CTV offices of the three CRDA. The contents of these posters are explained to farmers who visit CTV office by extension staff of CTV, where necessary. Hence, it contributes to increase farmer's interest for irrigation agriculture.

2.4 Capacity building of GDA

2.4.1 Understanding management status and problems of GDA

Current status of management and problems of GDA were grasped through interviews to persons being in charge of Fernana irrigation area at CRDA Jendouba, Nefza irrigation area at CRDA Béja and Sedjnane irrigation area at CRDA Bizerte during two months from March to April 2012 in the first assignment period. Board members of GDA and farmers at three irrigated areas were also interviewed. The followings are the results of the interview.

- In recent years, the GDA Sections have no budget for training the Board members (CA) of GDA. In addition, these Sections do not have sufficient equipment to properly conduct the work of awareness training (sensitization). The members of the GDA do not receive the training to acquire necessary knowledge for managing the irrigation systems under their responsibility.
- The CA members of GDA, particularly those of Sedjnane, do not have sufficient knowledge that board members should have about the mission and tasks of the GDA and their real prerogatives and responsibility. The deficiencies primarily affect the financial and administrative management, debt recovery monitoring of water fee, resolving conflicts between farmers, and preventive maintenance, etc.
- Farmers, in their vast majority, have no experience in irrigation; they are also not familiar with the notions of GDA, the rights and duties of membership, water subscription contracts, etc. Most farmers sign water subscription contracts without understanding them. Difference of understanding on the contracts is found between farmers on the one hand, and between farmers and GDA, on the other hand.

- At Fernana, since April 2011, conflicts have been found between farmers and board members in GDA, especially president, GDA has stopped their activities and not functioned. Also, each 4 GDA at Nefza and Sedjnane do not function well because changing board members through democratic election have not implemented since the establishment.

- At any irrigation area, women play an important role in irrigated agriculture. They are employed as agricultural laborers; few women, namely in Nefza manage plots, either on their own behalf or on behalf of their parents and some are members of the GDA. However, they are not fully involved in the lives of the GDA. On the other hand the Technical Director in Fernana is a woman and she is a positive factor that could contribute effectively to better involve women in the GDA.

- Interviews and diagnosis carried out in Nefza, Fernana and Sedjnane showed the interest of women to participate actively in the life of the community and especially to irrigated agriculture which they are convinced of the profitability and the importance to improve family income. According to our proxy interviews, women want to join the GDA and have responsibilities within the CA.

Based on the results of the interview, trainings on institutional strengthening, including assistance on rebuilding of GDA, and capacity development of board members of GDA were conducted. Also, sensitization and trainings to farmers on importance of GDA about development of agricultural activities were implemented.

These activities were carried out with local consultant in sociology hired by the DPINT project.

2.4.2 Activities related to human and organizational capacity development of GDA

(1) Activities in the first assignment period (2012)

1) Activities related to improving organization of the GDA

Activities, mainly meetings, were conducted on revitalizing GDA to all 9 GDA (Nefza:4, Sedjnane:4, Fernana:1) at the three irrigated areas from March to April 2012. Main purposes of the activities are the followings:

- Diagnostic of GDA situation;
- Revitalization of GDAs so that they will be able to undertake good management of the irrigation schemes they manage;
- Urge to pay debts of water fee toward CRDA

Specific challenges of GDA at each irrigation area and necessary actions that were clarified at the meetings at each irrigated areas are mentioned below.

i） Nefza irrigation area (4GDA)

Challenges:

- Person in charge of the Technical Director at the both GDA, Ennouhoudh and El Wifak, has strong personality and dominates all members of the two Board of Directors of the said GDA.
- The President of GDA El Wifak and the treasurer and other board members rarely attend meetings.
- The exploitation rate of the schemes managed by the three GDA Ennouhoudh, El Wifak and Touila is very low, ranging around 25% to 30%. The current recovery rate is around 5% for the same three GDA, whose debts are very high.
- The GDA Touila has no office to meet and keep its documentation.
- There are no women in the GDAs of Nefza, yet involvement of women farmers is important.
- Members of oversight committee attached to the GDAs do not provide any control work on accounting and management of GDA

Countermeasures:

- In the future training sessions to be provided to members of CA and farmers, it will be useful and necessary to focus on:
  - The development of community spirit and improving the role and status of the GDA as a Community body, responsible for ensuring sustainable development in its area of intervention.
  - The intensive training of controllers who do not currently play any role as members of the board.
  - The involvement of all board members in the activities of the GDA, practicing a division of labor and empowering each board member and developing a team spirit among all members.
  - The recognition of the importance of the role of women in the life of the community.

ii） Sedjnane irrigation area (4GDA)

Challenges:

- Compared with the GDAs of Fernana or Nefza, the situation of Sedjnane GDAs have no budget,

no legal registers for accounting or Board Assembly meetings and that technical directors does not receive any necessary training to perform their duty properly.

- The debt of GDAs is highly leveled; it reaches today 487, 000 TND, half to be paid by the only GDA of El Baraka.

Countermeasures:

- To enable the four GDAs of Sedjnane to correctly manage and control irrigated perimeters under their responsibility, all of them will need activities such as training on monitoring, training and sensitization.

iii）Fernana Irrigation area (1GDA)

GDA has not practically function as organization in Fernana since April 2012. Therefore, as the project activities, assistance on rebuilding of organization was prioritized and, then, capacity development was assisted.

The detail of the rebuilding of GDA Fernana in 2012:

a) We hold meetings in the three agricultural sectors of Fernana, Sidi Ammar and Oued Ghrib; 150 farmers among 250 assisted at the meetings. On Thursday 22 of March 2012, a general information meeting was organized in the premises of Fernana-Barbara GDA with the participation of the GDA working group chief and one representative of operating department in Jendouba, Mr. Chaabane Bangagi. 40 farmers attended this meeting.

b) On Thursday 29th March 2012, the Elective Assembly was held at the headquarters of Fernana GDA; at least 80 farmers participated at the meeting, as well as the Fernana delegate, the GDA Section chief and a representative of the irrigation schemes operation Department in Jendouba CRDA. A new Board of Directors composed of 6 members and a Control Committee composed of 3 members were unanimously elected by the attendants. Jendouba CRDA and Fernana Delegate signed the minutes of the Elective Assembly.

c) Procedures to re-open the bank account of GDA which was once blocked was taken, so that GDA could proceed to payment of its employees who did not receive any salary since April 2011, collect water consumption charges and pay 20 % of the debt as required by CRDA.

Countermeasures:

- Trainings to president, treasurer, member and technical director for making them understand their tasks are implemented, so that newly established GDA can carry out their work properly.

2) Trainings to board members of GDA

In order to strength ability of cooperation with farmers for managing irrigated area, trainings to GDA board members were conducted at Nefza, Sedjnane and Fernana to understand the organization, role and powers of GDA. These trainings were held in the course of the months of July-August 2012 in two sessions for all GDA.

Table 2-32 Participation status of trainings to board members of GDA (2012)

Irrigation area	Number of GDA	Training venue	Targeted trainee	Date	Number of participants (person)
Nefza	4 GDA	CRDA Béja	President, treasurer, other members	July 26	8
				August 1	6
Sedjnane	4 GDA	CTV Sedjnane	The same above	July 18	11
				July 24	11
Fernana	1 GDA	GDA Fernana	The same above	July 23	4
				July 30	5

Themes:

- Concepts of GDA. Assignments and role of the GDA
- Regulations and official documents of the GDA
- Composition of the Board of the GDA and the term of office of Members
- Steps for preparing General Meetings: ordinary and extraordinary
- Prerogatives or Powers of the Board
- Distinction between beneficiaries and members
- Relationships with members: rights and duties
- Tasks of the President, Treasurer, and Members

Main evaluation by board members of GDA who participated in the trainings are the followings and some effect are observed.

Evaluations made by attendants on the trainings:

The trainings enabled them

- To establish group solidarity to make actions together
- To be clear about the concepts and roles of GDA
- To be clear about the roles of a Technical Director

- To understand the allocation of tasks and show solidarity to tackle the problems of farmers
- To have a good opportunity to meet in a friendly spirit and openness
- To be able to revitalize GDA because the tasks of GDA was understood

3) Activities related to training/sensitization of farmers groups

Group meetings were held with GDA members at the three irrigated areas (farmers' group) to raise awareness of the importance of the role of GDA in the development of their farming activities and trainings were planed and conducted.

i) Organization of training

For the organization of training, a meeting was first held with GDA(s) officials, President and other board members, in the presence of CRDA staff in charge of GDA to plan the training sessions: Identifying a venue for the training, deciding on a schedule of intervention (place, time, and farmers 'groups).

ii) Objective of the training and expected results

- Provide the opportunity for farmers to collectively address the current situation of GDA and their expectations for the project,
- Provide information elements that can help farmers better understand the role and importance of the GDA in the life of the farming community,
- Identify ways of improving the situation,
- Farmers (men and women) better understand their rights and duties,
- They adhere to GDA with conviction,
- They pay their membership and water fees
- They avoid conflicts between them.

Training schedule, participants and type of trainings to farmers' group at each irrigated area are shown below. These trainings were implemented on the basis of the results of the meetings in 2012, mentioned above.

Table 2-33 Participation status of trainings to GDA members (farmer's group) (2012)

Irrigated area	GDA	Type	Date	Participants (Person)		
				Man	Woman	Total
Nefza	Ennouhoudh and El Wifak	Mixed	October 1, 9, 23, 24	40	49	89
		Only man	October 8, 11	60	-	60
		Only woman	October 9	-	10	10
	Ouchtata	Mixed	October 24	2	8	10
		Only man	October 2, 4, 5	88	-	88
	Touila	Mixed	October18	29	3	32
		Only man	October 16, 17, 19	74	-	74
Sedjnane	El Baraka	Only man	November 19, 21, 23	55	-	55
	El Imtiyaz	Mixed	November 26	8	29	37
		Only man	November 28	13	-	13
	El Intilaka	Mixed	December 3	9	6	15
		Only man	November 30	16	-	16
		Only woman	December 6	-	19	19
	El Ennajah	Only man	December 11, 12	27	-	27
Fernana	Oued Ghrib	Mixed	November 9	23	4	27
		Only man	November 5, 7	36	-	36
		Only woman	November 16	-	33	33
Total				480	161	641

(2) Activities in the first phase of the second assignment period (2013) and in the second phase of the second assignment period (2014)

Regarding capacity building of GDA, the following activities are mainly implemented in the first phase of the second assignment period (2013).

(a) Train / sensitize new board members recently elected to build their capacity
(b) Train / sensitize farmers in GDA where debt recovery rate still remained at low levels, following the request of CRDA.
(c) Train technical staffs of GDA, including technical director, treasurer and water guards, for a better management of the irrigation schemes
(d) Conduct a visit to advanced areas, specifically the area of Rass Jabel, to promote exchanges between farmers and staffs of GDA.
(e) Assistance on improvement of the billing system about water fees

Concerning a visit to advanced areas, refer to section 2.3.6.

Among above-mentioned activities, (c) Trainings for technical staffs of GDA and (e) Assistance on improvement of the billing system about water fees were continued at the second phase of the second assignment period (2014). About the assistance of improvement of the billing system, refer to section 2.5.

In addition, useful training materials that consist on organization, finance, and administration were elaborated and distributed to each GDA in 2014 so that board members of GDA can strengthen their knowledge continuously about management of GDA (See Annex B-14).

1) Activities related to training/sensitization of the new board members

These activities have concerned the GDA at Nefza, namely Ennouhoudh, El Wifak, Ouchtata and Touila, which held their General Meeting in 2013 and renewed members of their CA; hence, needing training for them.

i） Objective of the training

The overall objective of this training is in line with that of previous trainings, which is to inform and sensitize new members of the Board of GDAs in order to encourage their full participation in the conduct of all activities related to the irrigation schemes.

Under the specific objectives, we note:

- Training to the respective duties of the President, the Treasurer, and members to empower GDA to properly carry out their tasks.
- Capacity building of the former members of the boards of GDAs for them to be able to perform their roles.
- Developing exchange between them with an objective of mutual reinforcement and introduction of a rewarding and ongoing dialogue between members.

ii） Organization of training

The training to CA in Nefza was carried out in March 2013. The new boards of directors and control committee members took part in these workshops.

The following table summarizes the outline of trainings:

Table 2-34 Participation status of trainings to board members of 4 GDA at Nefza (2013)

GDA	Training venue	Targeted trainee	Date	Number of participants (person)
Ennouhoud	CTV Nefza	President, treasurer, other members	March 21	4
			March 22	3
El Wifak	The same above	The same above	March 21	4
			March 22	2
Ouchtata	The same above	The same above	March 27	2
			March 28	2
Touila	The same above	The same above	March 27	4
			March 28	3

iii） Themes

- Concepts of GDA, powers and role of the GDA
- Composition of the Board of the GDA and term of office of members
- Prerogatives of the Board
- Roles of members
- Necessary documents of the GDA
- General Meetings: definition and preparation steps

iv） Expected Results

The expected results are to enable participants to gain knowledge about all aspects of the life of a GDA and increase their involvement in this area. At the end of the training, participants will be better equipped to understand their tasks and be able to manage their irrigation systems and to resolve conflicts and problems they face.

v） Key Findings and Conclusions

The debate on the role of members referred to the operational difficulties faced by former CA, which are mainly due to ignorance of the law and to the non-definition of the roles. From this exercise emerged a dynamic, which has helped to foster an awareness of the importance of the division of labor within each CA and especially highlighted the importance of the involvement of each member. It is worth noting that the majority of the participants had the intimate conviction that most tasks are the responsibility of the President and that there was no division of labor between them up to now. The workshop helped to generate interest for the participants expressed through active participation.

The experience of this training leads to a conclusion that one should probably work for two years or more with the same group to anchor the learning of a new way of thinking and to question the way the members of the board of directors act to make them more accountable.

2) Activities related to training /sensitization of farmers in GDA where debt recovery rate still remained at low levels (under the request of CRDA).

In the first phase of the second assignment period, these activities concerned only the GDA of Sedjnane, namely Baraka, El Intilaka, El Ennajeh and El Imtiyaz where rates of debt collection have always remained low despite the growing season due to start. Then, trainings and sensitization to encourage farmers to pay debts were conducted under the request of GDA.

i） Objective of the training

For this mission, the focus was on educating farmers about the need for payment of past due debts and water consumption.

The Ministry of Agriculture has agreed to exempt farmers 30% of their debts relating to the use of irrigation water with STEG (Tunisian Company of Electricity and Gas) and the CRDA. Deferral measures for debts payment were taken in favor of farmers, meaning an immediate payment of 20% of the debts, the remaining debt (50%) would be repaid over five years (Notification by Minister, dated on March 28, 2012).

However, these measures had no impact on the mobilization of farmers for payment on water fee and on achievement of collecting water charges from the GDA. As a guide, the debts of the GDA in Sedjnane are shown at the table below. From the table, it is observed that collecting water charge hardly proceed against debts.

Table 2-35 Debt for water charges at 4GDA in Sedjnane (2012)

GDA	Debt (thousand dinars)		Collected amount in 2012 (thousand dinars)
	As of the end of 2011	Only in 2012	
Baraka	244	189	12
El Intilaka	92	114	9
El Ennajeh	34	43	6
El Imtiyaz	117	111	11
Total	487	457	38

(Source: CRDA)

ii） Achievement of training

The meeting with the farmers took several forms: group meetings, door to door, individual meetings. Some meetings were mixed; some were exclusively male or female.

The meetings were held on the following dates:

Table 2-36 Meeting with farmers of 4GDA in Sedjnane (2013)

GDA	Date	Type of meetings / Number of participants (person)			
		Group meetings		Door to door	
		Men	Women	Men	Women
Baraka	April 16	48	-	-	-
	April 18	-	-	10	5
El Intilaka	April 23	-	-	9	12
	April 24	38	-	-	-
El Ennajah	April 17	-	25	-	-
	April 25, 26	-	-	35	21
El Imtiyaz	April 19	-	-	15	6
	May 2	-	-	21	-
Total		86	25	90	44

iii） Themes of training

The sensitization program was applied to the groups of farmers based on the following themes:

- Role of the project and purpose of the mission

- Definition of the GDA, its role, powers, prerogatives (rules, statute, etc.).
- The rights and duties of members to the GDA: payment of membership and water fees, participation in elections and decisions
- Relations between farmers and the GDA
- Roles of farmers in promoting their schemes and the development of agricultural activities

iv) Expected Results

- Farmers (men and women) better understand their rights and duties,
- They pay their membership and water fees
- They avoid conflicts between them.

v) Conduct of Meetings

To understand the behavior of farmers regarding their reluctance to the payment of their debts to the GDA and identify the reasons for their behavior and attitudes, we asked the following questions.

- What are the issues that concern you the most?
- Why do many of you refuse or have not paid their debts?
- What solutions do you propose to the problems that concern you?

A general conclusion emerges from our visits: farm debt and the financial difficulties of GDA are not essentially financial. They are the result of multiple reasons.

Main points in the meetings are described below.

- Leaks and technical failures (poor workmanship, high rate of loss) are reflected in water cuts that encourage recipients to not pay their bills.
- The method of flat rate billing and the lack of meters promote theft and questionable practices regarding the quantities actually consumed and paid amounts.
- Low self-management of the GDA: lack of technical expertise, operation based on family relationships

- The relationships with the GDA are relationships of clientelism rather than that of belonging. This lack of sense of belonging to the GDA is due to the lack of consultation and transparency as a guarantee of sustainability and profitability of the irrigation schemes. The farmers believe that the CA is formal and plays virtually no role either in managing or in representing the interests of farmers.
- The unequal treatment between the poor and big farmers is observed.

vi) Conclusions and recommendations

Faced with this situation, the CA of the GDA mobilized and considered the following alternatives

- Hold meetings in each zone or sector to encourage the participation of influential people
- Make farmers sign documents, recognizing their debts
- Turn off the water to farmers who do not want to pay
- Install meters for those who pay, pending generalizing it in all irrigation schemes

The following points are suggested by the DPINT team to Board members of GDA and CRDA in order to stimulate the participation of farmers in the short term.

- Organize and hold General Meetings regularly
- Improve the management of the GDA. In order to realize it, trainings are planned and implemented by the project.
- Encourage new board members to apply the payment of the membership fee through assistance of the project
- Strengthen the sense of responsibility with regard to the GDA and the belief in the goals of the associative work
- Apply the law in case of violation and stubbornness of farmers.

Debt for water charges in Sedjnane (2014):

Debt for water charge of each GDA in Sedjnane irrigated area before cultivation is started in 2014, paid amount by farmers just before water delivery is started and remaining debts are indicated below.

Table 2-37 Paid amount by GDA when water delivery was started and remaining debts in 2014

Irrigated area	GDA	Debts before irrigation season in 2014 (TND)	Debts paid at the beginning of irrigation season in 2014 (TND)	Remaining debts (TND)
Sedjnane	El Barka	104,243	8,000	96,243
	El Intilaka	21,270	11,500	9,770
	Ennajah	50,946	13,000	37,946
	El Imtiyaz	39,152	5,700	33,452
	Total	215,611	38,200	177,411

About the start of water distribution in 2014, meetings were held six times totally among CRDA, GDA and SECADENORD from April to May and it was confirmed that each GDA paid minimum amount of debts. As a result, water distribution was started at the beginning of June. In addition, area managed by GDA El Baraka that has the biggest amount of debts among 4 GDA has severe problems about irrigation hydraulic system and a lot of conflicts between CRDA and GDA/farmers are observed.

3) Trainings of technical staffs of the GDA (Technical Directors and Treasurers)

This training was designed for technical directors and treasurers of the 9 GDA of Nefza, Sedjnane and Fernana, and it took place in June 2013. Furthermore, additional trainings were requested from Nefza and Sedjnane; therefore, they were also conducted in February 2014.

At Nefza, four GDA are led by three technical directors (Ennouhoudh and El Wifak have one technical director). At Fernana, the GDA is led by a female technical director, and, at Sedjnane, there are three technical directors including two newly recruited. The GDA El Imtiyaz has not currently a technical director. The former technical director left due to a conflict with the Board of Directors.

The training program was focused on:

- The role of a technical director
- Regulations the GDA must comply with as related to taxes and social security
- The method of preparing a budget at the beginning of the year
- The method of preparing a financial statement at year-end
- Analysis of differences between forecasts and achievements
- Subsidiary issues addressed at the request of the GDA of Nefza, including the method of

preparing a payroll for GDA employees.

i） Objective of the training

- Improve the management capabilities of technical directors and treasurers
- Strengthen abilities of staffs and the structures of GDA
- Assess the effects induced by the required training on technical directors and treasurers
- Identify training topics to meet the needs of the beneficiaries and those that may be dealt with in other training sessions.

ii） Implementation of training

The training in 2013 was administered through workshops of 12 days in total, which were unevenly distributed across the GDA (See Table 2-27).

Table 2-38 Training status for technical directors and treasurers of GDA (2013)

Training dates	GDA	Date	Number of participants
Nefza	Ouchtata	June 5, 19	8
	Touila	June 6	3
	Ennouhoudh & El Wifak	June 7	5
	4 GDA	June 10, 11	10
Sedjnane	4 GDA	June 17, 24, 26	27
Fernana	Oued Ghrib	June 13, 14, 21	16
計			69

Training was conducted totally four days to each four GDA at Nefza and Sedjnane (See Table 2-28). At these trainings, budgetary issue and balance sheet were mainly lectured. Also, sensitization to president and board members of GDA in order to reconfirm importance of duty on water fee payment by GDA members were implemented.

Table 2-39 Training status for technical directors and treasurers of GDA (2014)

Irrigated area	GDA	Date	Number of participants (persons)
Nefza	4 GDA	February 24, 25	9
Sedjnane	4 GDA	February 25,26	9

※The president and board members of GDA are included to the participants

iii） Evaluation by the participants at the end of the training

After the trainings, the topics covered and the quality of the trainer was evaluated by the participants (See Annex B-15about evaluation results). The main requests for the future training were as follows:

- The time allotted for the training is deemed insufficient. A longer session would be appreciated
- To help the GDA acquire software to manage their accounting records more efficiently (including debts recovery and payroll for staff)
- To help analyze the gaps between forecasts and achievements at year-end
- To develop concrete cases of budgets and financial statements
- To visit pilot GDA to gain new experience
- To individually train technical directors, listening to their specific concerns and issues

iv） Conclusions and recommendations

The content of the training of technical directors and treasurers as well as administrative staff of GDA was greatly appreciated and followed diligently by the beneficiaries who were mainly motivated by practical case studies, including the development of budgets and financial statements.

4) Training to Technical Director and Water Guards

i） Training for installation and maintenance of irrigation facilities

This actually consisted of training in maintenance and proper installation of facilities at irrigation

network. It took place at Nefza on September 26, 2013 and was attended by 17 participants including the 10 Water Guards of the 9 GDA of the Project, 5 Technical Directors, 1 President of GDA and 1 representative of Beja CRDA .

It was provided by a SOCOPEC engineer, a Tunisian Consultants Firm, and focused on how to weld polyethylene pipes using the tools provided by JICA, stressing on the importance of cleaning the interior and the pipe surface before starting welding. Participants also learned how to maintain suction cups and how to attach pipes to the suction cups and meters of an irrigation network.The session ended with a demonstration on the use of the Backhoe loader given by JICA.

In addition, proper installation of newly installed water meter and accessories such as stabilizer and filter, etc. was instructed to Technical Director and Water Guard at Nefza from May to June in 2014. Installation and maintenance of drip irrigation equipments were also instructed. At Nefza, person concerned at GDA, including maintenance staff at CRDA, were trained about proper installation of water meter and accessories by DPINT local staff because pilot project to introduce a billing system with measured rate was started by CRDA.

To strengthen the skills of Water Guards which are in fact the backbone of irrigation systems, it would be useful to increase the training sessions designed for them, providing them with better control of the irrigation networks they are assigned to by person concerned at CRDA continuously, and as such, the training program should specify:

- All tasks of the water guards
- The installation and verification of water meters
- How to command the installations of the network
- How to control and reduce water losses
- The introduction to pipe maintenance

As Water Guards are also involved in the collection of water fees, it would be needed to give them additional training and initiation to billing and bill collection management.

In addition, described later, new billing system that is adaptable to the three irrigated areas was framed and introduced to people concerned by the project. In order to be expected that new system would be launched near future, it is needed to conduct trainings to adapt it.

ii） Training of GPS

Training was implemented about ways to use and how to use the GPS for technical directors and water guards of GDA in July 2013. Training was conducted with schedule below and simple method for measuring the cropped areas by the GPS was performed.

Table 2-40 Training status about GPS (2013)

Irrigation area	Date	Number of participants (Persons)	Participants
Fernana	01/07/2013	7	President of GDA (1) Technical director (2) Water guard (4)
Nefza	09/07/2013	11	Technical director (3) Water guard (7) Staff of CRDA (1)
Sedjnane	22/07/2013	16	President of GDA (3) Technical director (4) Water guard (6) Staff of CTV (3)

2.5 Assistance to improving the billing system related to water fees

(1） Grasping current problems

As activities in the first assignment period, in order to assist improving the current billing system, problems about current billing system at three irrigated areas are revealed through meetings and interviews with CRDA, staffs of GDA, and farmers.

Main problems are as follows:

- It is difficult to say that water resource is provided enough at all irrigated areas. Especially, at a part of Sedjnane, it is severe situation that required amount of water in summer exceeds supplied one. This means that farming planting which is actually implemented by farmers exceeds the initial irrigation plan.
- Current billing system, namely water charge system, for water consumption is mainly calculated on the basis of the amount of water consumption by crops per hectare. However, in some cases, it is calculated based on a lump-sum basis per hectare without considering the variety of the crops and water consumption (Sedjnane irrigation perimeter). Therefore, calculated results are different with actual volume of consumed water, and this is a bottle neck of utilizing limited tear resource effectively.

- Although a flow meter is installed at each hydrant of irrigated plots in Nefza and Fernana, these flow meters have low accuracy (30 ~ 40% of error is observed at Nefza) or have not been working in some cases (Especially, at Fernana). As a result, measured results of consumed water by flow meter are not believed by farmers.

- Flow meters have not been installed at irrigated plots located in Sedjnane and actual volume of consumed water is not grasped.

The parties concerned finally reached a common understanding that it was essential to introduce a billing system with measured rate that was reliable for farmers and led them to effective water use, based on installing high accuracy flow meters to solve these problems.

(2) Activities and recommendations

It was proved through accuracy test assisted by DPINT team during the first assignment period and the first phase of the second assignment period that the accuracy of the flow meter, DN50, which was used at DPINT demonstration farms, was highly reliable with an error around 5%. As a result, the flow meter, DN65, provided by CRDA has been installed since September 2013 at the irrigation plots of Sedjnane, where flow meters were not installed at hydrants before. Prior to that, it was proved by DPINT that this flow meter had high accuracy with proper utilization.

Thus, budgetary planning to install flow meters that have been gradually changed to DN50, which is more accurate, at Nefza, is started because the existing flow meters have low accuracy and are not suitable for a billing system based on measured rate in the future. At Fernana, the CRDA showed a budget plan, changing all flow meters in 2014 with a gradual implementation given that many flow meters are broken.

Relating to the installation of accurate flow meters, the necessity to procure accessories such as stabilizers and filters, and the importance of a proper installation were suggested and advised by DPINT to staffs of GDA on the site in the first phase of the second assignment period. When flow meter is installed, some straight section is needed at upstream and downstream portions so that water flow in pipeline is not disturbed. Thus, stabilizer is needed to be installed. However, stabilizer and filter have not been considered in current budgetary plan because each CRDA do not enough understand importance of these accessories.

Furthermore, the following items are suggested to CRDA:

- It takes time to completely shift to a billing system based on flow meters measured rate. Although the current lump-sum method is used in some areas, it is needed to shift to a new

billing system, applying a proper calculation method, which considered the consumed water volume of a particular crop at a given period of the season. In order to realize this, easy measurement method, utilizing a GPS, to measure cultivated area is effective.

- It is proposed to promote the use of high accuracy flow meters, including accessories like stabilizer and filters, at each irrigated area and the need to plan an installation schedule and budget allocation. Moreover, to install deliberately, it's important to notify the roles and duties of stakeholders relevant to installation, operation, and maintenance of necessary devices.
- It is also needed to install flow meters at the branch pipelines in the future so that results of measured volume of water at hydrants managed by GDA and volume of water flow at pipeline ,that control irrigation areas, managed by CRDA can be compared.

At the three irrigated areas, a billing system based on water consumption of each crop at each season is introduced against the current method based on a lump sum (area × water consumption per hectare). And, finally, one would shift to a billing system based on measured water rate by utilizing accurate water meters in the second phase of the second assignment period.

- Béja CRDA planned a Pilot Project, making a trial on a new billing system by using accurate water meters in an area of Nefza, Bouzanna 1, which has 60 ha and 70 hydrants. The CRDA made the preparations for that since April 2014, and DPINT gave its support. Although the CRDA purchased the necessary numbers of water meters with its budget in 2013, it did not have the budget to acquire accessories such as stabilizers and filters to secure the accuracy of the water meters. Therefore, DPINT provided those.
- The installation of equipment, including water meters, at 70 hydrants was initiated by the CRDA and GDA, and it was achieved from May to June.
- The monitoring of water quantities by GDA have started since July, and have taken place twice a month. DPINT have collaborated with the GDA to conduct test and to confirm the accuracy of the installed water meters. Besides, GDA elaborated water meters localization map, including the beneficiaries' names, and measured the cultivated surfaces using the GPS in August. Also, these data were utilized to develop new model of the billing system.

(3) Framing new billing system

A model of new billing system that is adaptable to the three irrigated areas, based on the existing system that is used by GDA at Nefza, was finally elaborated in the second phase of the second assignment period. At the process of framing this system, discussion was conducted with staffs of

GDA at Nefza and CRDA Béja and it was decided that the existing billing system such software or data base was improved. Besides, discussion was also held with staffs at other irrigated area, namely Sedjnane and Fernana, where necessary, and new model was developed with a consensus.

- Results of analysis and challenges about the existing billing system used by GDA at Nefza
- Introduction of merit and function of new billing system that improved the existing one (see Annex B-16)

Diagnosis of the current system (Nefza existing system)

- Adherent tables in MS EXCEL
- Utilization of invoices tables in MS WORD
- Absence of a procedure of calculation of water consumption
- Absence of a management database for the adherents management
- Absence of work ergonomics
- Absence a calculation of water consumption tool in accordance with the surface area and the type of crops
- Absence of a payment follow-up system
- Slow invoicing procedure
- Absence of a research tool

Objective of assistance by the project:

Setting a billing system with measured rate for GDA in the three irrigated areas, namely Nefza, Sedjnane and Fernana.

1) Advantages of new system

- Setting the GDA members data base
- Setting data base of water consumption per crop
- Management of the lump sum invoicing system in accordance with the area and the crops

- Management of an invoicing system based on water meter recordings
- Keep the archives of old invoices or intermediate invoices
- Reliable system through safe date base and connection
- Easy system for group invoicing

2) Functions of new system

- Invoicing with date
- Invoicing per farming year
- Calculation of the monthly consumption
- Printing invoices
- Follow-up of invoices
- Statistics :
    - Invoiced amounts
    - Total consumption, debts, and advance payments
    - Volume of consumed water per GDA member

About framing the billing system with measured rate, provisional calculation software was developed through discussion with persons concerned and the system was adaptable to the three irrigated areas. In the future, it is expected that installation of hardware like flow meter is conducted with specific plan and new system is launched fully.

2.6 Improvement of Market Access

2.6.1 Background

Mutual Society for Agricultural Services (SMSA) are in charge of service delivery to their agricultural communities. These services include marketing of agricultural products, acquisition and distribution of agricultural inputs, provision of agricultural mechanization, collection and marketing of milk, etc. SMSA is expected to assist farmers on financial issue, promoting irrigation agriculture in

this project.

According to the model statutes relating to SMSA, which are promulgated by Decree No. 2007-1391 of 11 June 2007, approving the model statutes of basic mutual societies of agricultural services, the mutual societies of agricultural services are to provide the following services, which are necessary for the activity of its members:

- The purchase on behalf of its members for raw materials and inputs for agriculture and fisheries.
- The preservation, processing, storage, packaging, transportation and sale of agricultural, fishery and aquaculture products from the activities of its members in the framework of the activities of the mutual society and within the limits of the actual needs of its members.
- The acquisition of agricultural machinery, tools and equipment necessary for fishing and aquaculture and their optimal management, taking into account the tools belonging to members.
- The storage and sale of fuels in favor of members
- The supervision and extension for the benefit of its members

According to information obtained at the General Directorate of Finance and Investment for Professional Organizations (DGFIOP), it is imperative to precede the creation of a SMSA with a technical and economic study to evaluate its technical and economic feasibility. Normally private consultants are hired for the feasibility study. Also, according to the same DGFIOP and the Finance and Investment for Professional Organizations (FIOP) Section of Beja CRDA, many SMSA created in 2005 are now non-functional, and the reason seems to be the reticence of farmers to implement them, thinking that they might be just like the old cooperatives and they would eventually fail like them. That is why the DPINT project included the social aspect in the establishment of a SMSA as is the case with the GDA, making it necessary to initiate the establishment of a SMSA with a social study.

At the first assignment period, the DPINT project proposed to help in the creation of Mutual Societies of Agricultural Services in the three areas of intervention in northern Tunisia, namely Fernana, Sedjnane and Nefza.

It has developed an implementation strategy of SMSA which revolves around four steps:

- First step: Undertake a social survey of farmers in the target area to comment on the possibility of creating a SMSA (social feasibility of the SMSA)

- Second step: Undertake a technical and economic study to assess the profitability in the short to medium term of the possible SMSA (techno-economic feasibility of the SMSA)
- Third step: Undertake a sensitization program for future beneficiaries to better build on the role and prerogatives of the SMSA and encourage them to join by subscribing to its capital.
- Step Four: Engage the legal and administrative procedures for the implementation of the SMSA

At the first assignment period, the social study was conducted to examine the social feasibility of a SMSA at Fernana. At the second assignment period, the same social study that implemented at Fernana in the first assignment period was carried out at Nefza and Sedjnane.

2.6.2 Implementation of the social surveys

(1) Outline of the surveys

1) Objective of the surveys

The specific objectives of the social surveys are:

- Define the willingness of farmers to participate in a Mutual Society of Agricultural Services (SMSA) in their area
- Evaluate their willingness and ability to participate in the financial capital of the company
- Define the fields of activity of the SMSA

2) Questionnaire of the surveys

The questionnaire used at the survey includes 40 questions organized around four major themes: (See Annex B-17)

- Socio-cultural data on people surveyed: age, gender, education level, type and area of farming, use of agricultural equipment, other non-agricultural activities and average annual income
- Knowledge of Mutual Societies of Agricultural Services: This component includes a series of questions designed to test the level of understanding of those surveyed on agricultural organizations and more particularly on SMSA (their roles, activities and mechanisms for adherence to these companies)

- Interest on Mutual Societies of Agricultural Services: This component tests the interest farmers could have on SMSA and whether they are willing to join once created and buy shares to contribute to its capital. This is a component that tests the motivation and financial capacity of those surveyed
- Fields of intervention of Mutual Societies of Agricultural Services: This section examines the expectations of farmers in relation to the SMSA and preferences (whether they opt for a versatile SMSA which accomplishes several tasks at once or for a SMSA, specializing in one activity)

3) Sampling

The survey included 100 farmers at Fernana and 200 farmers at Nefza and Sedjnane. The sample size was motivated by the number of farmers of the target population, which consisted of farmers practicing irrigated and dry farming, in each target area. The sample was distributed randomly in space, taking into account the distribution of the agricultural area in key areas.

(2) Results of the survey

i) Interest of farmers on SMSA

When asked about the importance they attach to the implantation of SMSAs in their areas, almost all farmers have expressed interest (Fernana: 100%, Nefza: 100%, Sedjnane: 97%). Also, they in fact wish to participate in activities of SMSA (Fernana: 98%, Nefza: 98%, Sedjnane: 92%). This revealed that farmers in all three irrigated areas to wish establishing the SMSA. On the other hand, almost all the farmers surveyed said they would advise their neighbors to join the new SMSA when it is created.

ii) Chances of success of an SMSA

When asked about the chances of success of the projected SMSAs, farmers respond in 91% at Fernana, 95% at Nefza and 85% at Sedjnane of cases that the chances are large. And 9 % at Fernana, 6 at Nefza and 11% at Sedjnane believe the chances are medium (see Appendix 8).

iii) Recognition of the duties of an SMSA member

A relative majority of farmers surveyed (40%～49%) do not know at all how to belong to a

SMSA and the duties of the members, another significant proportion of 39 to 44% equates accession procedures to SMSA, to those used in the GDA (Annual Membership or possibly lump sum contributions), a minority of only 12 to 17% knows that it is buying shares. (see Appendix 9)

iv) Willingness to buy shares in a SMSA

Sizeable majorities said it is willing to buy shares in the projected SMSAs: a third of those surveyed (31~35%) refuse, which overlaps with previous results under which farmers believe that the SMSA is a non-profit organization

Table 2-41 Willingness to buy shares of SMSA

Willingness to buy shares	Number			%		
	Fernana	Nefza	Sedjnane	Fernana	Nefza	Sedjnane
Yes	59	130	110	59	65	55
No	34	62	70	34	31	35
Do not know	7	8	20	7	4	10
Total	100	200	200	100	100	100

v) Payable amount to a share

Nearly 2/3 of those surveyed who said they would buy shares promise to buy shares in a range of 10 DT to 50 DT, a minority of about 20% up to 100 DT and another smaller minority (14 to 19%) may exceed 100 DT (see Appendix 10)

vi) Expectations with regard to a SMSA

Without exception all farmers want a versatile SMSA, offering farmers diversified services ranging from the supply of inputs to the marketing of agricultural products on the market at reasonable prices, which contributes to improving the incomes of farmers.

Their expectations for the SMSA range from providing inputs, to facilitating the marketing of products, along with the mobilization of agricultural tools, and giving small loans (see Appendix 11)

(3) Analysis of results

- The agricultural population in the three areas surveyed, namely Fernana, Nefza and Sejnane is a fairly old population living on its historical experience, without any real access to innovations and techniques of modern agriculture, which is the major cause of the low productivity of farmland and low-income farmers that result. The youth, although almost permanently unemployed are not motivated to agricultural activities which they judge the revenues ridiculously small ; they spend their time dreaming of a permanent and remunerative employment without any risk for them; yet agriculture requires young blood and technological skills that will take it from its current subsistence situation by improving productivity and introducing new farming techniques.

- The level of education of respondents is overall modest, which corresponds to their age. No farmer has a university level. The illiteracy rate represents between 25.5% of the population at Nefza to 29.5% at Sedjnane, which is higher than the national average of around 20%. More than half have the primary level. And those with a secondary education represent 15% of the population at Sedjnane, 16% at Fernana and 18% at Nefza.
  Nefza is in better shape than the other two delegations on education.

- The three areas surveyed are dominated by small scale holdings whose size does not exceed 3 ha; the middle scale holdings whose size is between 4 to 7 ha of land represent 24% of the area at Fernana and 36% at Nefza and Sedjnane, and large scale holdings (over 7 ha) represent only 9% to 14%, so a significant number of poor farmers are forced to use a second non-agricultural activity to supplement their monthly income. The poor peasantry is observed mainly at Fernana where the rate of farmers who are forced to resort to a second non-agricultural activity represents 24% of the population against 16.6% and 14% at Nefza and Sedjnane, respectively.
  This dual activity is one of the main causes of low agricultural yields and consequently, the low revenues from them.

- The vast majority of farmers surveyed in the three projects are not satisfied with the current mode of supply of inputs and raw materials. The reasons for dissatisfaction are mainly related to the excessive prices charged by local dealers, the non-availability of inputs when farmers need them, and finally the poor quality of inputs served to farmers.

- 2/3 of those surveyed believe they encounter difficulties in marketing their agricultural products; contrariwise, about the third of that in the three delegations seem to be satisfied with the prevailing market conditions in the area. The latter are generally farmers with large landholdings and personal transportation, enabling them to escape the demands of traders and local intermediaries.
  The main difficulties faced by small and medium scale farmers are linked to:

- The lack of transportation due to their low incomes.
- The low prices imposed by traders and local intermediaries who are still trying to increase their margins at the expense of producers and consumers
- The small size of the local market, consisting of a population generally poor; hence, with a low purchasing power.

The lack of transportation causes farmers to leave their rotting agricultural products, namely at Sedjnane where the main agricultural production consists of tomatoes, an agricultural product which rots very quickly, especially given the lack of resources for conservation.

- Nearly all farmers surveyed expressed an interest in the SMSA; this rate is lower at Sedjnane; they want to see a SMSA actually created in their area. They are almost all willing to join or, if applicable, to use the services when the SMSA is created.
- When asked about the chances of success of the projected SMSA, farmers are overall optimistic, especially at Nefza and Fernana where the proportions of those who believe that the chances of success of an SMSA are big represent 95% and 91%, respectively.
- The biggest problem the creation of a SMSA may face in the surveyed areas, especially at Sedjnane, is that a relative majority of farmers surveyed did not know at all how to belong to a SMSA; another proportion as important assimilates procedures for joining a SMSA to those used in the GDA (annual memberships and contributions); only a small minority understands that it is contributing to the share capital of the SMSA by purchasing shares.
- Almost two thirds of those surveyed who said they wanted to buy shares promise to buy shares in a range of 10 DT to 50 DT; a minority of 20% can buy up to 100 DT and another smaller minority (15%) may exceed 100 DT.

  The techno-economic study to be carried out later shall determine the minimum threshold required for the financial situation of the SMSA to be viable.
- According to data collected in the three areas of intervention, Nefza area seems to be the most appropriate to start a pioneering activity of the SMSA, especially given that the proportion of farmers who are engaged exclusively in agriculture is more important than in the other two areas considered. At Fernana, motivation is high, but the purchasing power of the peasantry is much lower than at Nefza. On the other hand, nearly a quarter of the farmers have a second activity, which reduces their availability for agriculture. At Sedjnane, the motivation of farmers for the SMSA is lower than at Nefza and Fernana, and the spirit of handouts there is more dominant, and this does not facilitate the launch of a SMSA that needs a substantial participation in the social capital and a spirit of initiative, weakly seen in this area.

(4) General conclusions and recommendations

- As it is an agricultural population with low purchasing power where a sizeable part continues to apply for assistance, one should develop in the next phase of sensitization the right understanding of the SMSA and benefits that farmers could get for a reasonable participation in its share capital. One should also fight the mentality of assistantship, especially at Sedjnane where the dependant on the aid has been fostered among farmers as GTZ (German Technical Cooperation Agency) has been conducted the livestock promotion project for 15 years. Hence, the spirit of self-reliance rather than waiting forever for providential aid must be necessary for the success of the SMSA.

- The biggest problem that may face the creation of an SMSA in the three agricultural areas is that a relative majority of farmers surveyed did not know at all how to belong to a SMSA. The next sensitization program will provide significant efforts to explain to farmers the significant difference between GDA, a charitable or voluntary organization, on the one hand, and SMSA as corporation, on the other.

- Support for the granting of credit is not a specific task to SMSA but to micro-credit organizations and institutions that are actually lacking in the area.
  The next sensitization program will seek to clarify the problem and to distinguish between an SMSA and a micro-credit organization to avoid misunderstandings that could later be detrimental to the SMSA.

- The Project should also raise the awareness of the institutional environment in the area of the three delegations concerned (Fernana, Nefza and Sedjnane) to initiate mechanisms of micro-credit in the area that would help small and medium scale farmers to get a working capital at the beginning of the agricultural season. One should also accelerate procedures of reconciliations of the land situation in the three areas, involving the Agricultural Land Agency (AFA) to complete the work of agrarian reform and to enable farmers to have a title to avail themselves with the banks or microfinance institutions, because the issue of working capital at the beginning of the crop year is crucial.

- The income of farmers is generally quite modest; it is notoriously lower at Fernana and Sedjnane than at Nefza, which is due to the low productivity of plots and ridiculous exploitation rate; and this can only be improved through increased extension activities in the area, spread of water-saving techniques, proper use of chemical fertilizers and crop rotation that is currently lacking due to the dominance of small agricultural properties. The institutional environment is expected to play an important role in this matter.

In general, the following types of actions should be undertaken to ensure the success of the

projected SMSA:

- A detailed techno-economic studies to correctly grasp the field of intervention and potential activities of the SMSA , the minimum social capital required for its development, the capacity of local and regional markets, the expected volume of production and the applied pricing.
- A targeted awareness raising activity, allowing farmers to understand the role and responsibilities of a SMSA
- An intervention of the institutional environment to clarify the land situation, implement the mechanisms of micro-credits, which are currently lacking, and put in place a training and extension work that is currently largely deficient.

2.6.3 Implementation of technical and economic survey

The technical and economic feasibility study as the second step of building SMSA in the second phase of the second assignment period were launched in the two intervention areas, namely Nefza and Sedjnane. Fernana was excluded from the project site since SMSA was officially set up and registered in December 2013 with support from CRDA Jendouba.

(1) Introduction

A technical and economic feasibility study has been entrusted to a team of Tunisian consultants, consisting of an agricultural economist, an accountant and a sociologist. Interview and questionnaire survey targeting beneficiary farmers in Nefza and Sedjnane were undertaken on April 2014 as a preparation for a feasibility study, F/S, to establish SMSA. Moreover, the latest information and data were collected on crop production, purchasing/selling prices, support organizations from CRDA/CTV, other organizations such as ODESYPANO, seedlings traders at Teskraya and so on.

(2) Implementation and evaluation of the technical and economic feasibility study

The technical and economic study will evaluate the feasibility (or not) of the SMSA in both areas concerned, based on the required share capital, a detailed investment plan, forecast balance sheets and possibly the technical, economic and financial constraints that may impede the proper operation of the SMSA and the suggested solutions to overcome them.

The two feasibility study reports were finalized, in June for the SMSA of Nefza and September for that of Sedjnane, taking into account the comments of DGGREE and DGFIOP at the central level, and two FIOP sections of respectively Beja and Bizerte CRDA.

The two indicators: 1) annual net income; and 2) Self-funding gross cash flow capacity or annual cash flow determined from the study indicated that:

- The projects of establishing the SMSA of Nefza and Sedjnane are profitable
- The SMSA has a relatively good cash flow capacity enabling them to paying back loans and funding new projects.

The economic profitability, RE = (annual net income / invested capital) * 100, of 80.2% for the SMSA of Nefza and 20% for that of Sedjnane shows much higher values than the interest rates, suggesting that the projects of establishing the two SMSA are economically viable.

From another point of view, the financial profitability, RF = ((Net invested income -annual interest) / shares) * 100, of 235% for Nefza and 43. 7% for Sedjnane is much higher than the economic profitability. The subsidy effect has thus played positively. This shows that the financing method for the projects of establishing the SMSA is financially viable.

In addition, the values given by the study on the net actual value (VAN = 380053TD and 214754 TD), the profitability index (IR = 4, 48 and 2, 38> 1) and the internal rate of return (IRR = 49% and 50%) at 10% discount rate for Nefza and Sedjnane, respectively also show that the projects of establishing the SMSA are financially and economically very viable.

The SMSA planned for Nefza and Sedjnane presents the following:

- The activities seem to be achievable; they answer perfectly to the producers needs
- The project cost is reasonable
- All economic indicators are viable and motivating
- The adherents' participation represents a determining factor in the set-up and the starting of the SMSA.

Project' success conditions:

- A high adherence rate at the project starting phase, and 200TD/month and 150TD/month of individual subscription for Nefza and Sedjnane, respectively.
- A proper implementation of the SMSA activities

In order to realize these conditions, a successful sensitization campaign was implemented.

2.6.4 Activities of training and sensitization

Subsequently to the study regarding the technical and economical possibility of a SMSA in Nefza and Sedjnane, a comprehensive sensitization programme was also conducted.

This program introduces farmers to the types of SMSA, their powers, their mode of operation and the laws and legislations that govern them. It also helps train a competent, solid and homogeneous team at the head of each SMSA, who will be able to mobilize farmers around quantifiable targets in terms of production, sales and procurement. This team should be sufficiently dynamic and competent to take advantage of all the laws and legislations that promote the SMSA (tax benefits, various credits, and other economic benefits, etc.).

Contact was made in the field with SMSA models (e.g. Bousalem SMSA and Utique SMSA) to grasp on-the-job operating mechanisms, which may help the DPINT team, to better manage the sensitization program. Provisional Committees in each delegation (Nefza and Sedjnane) was formed before the start of the program to help the DPINT team target farmers who may subscribe to the share capital of the SMSA and constitute relays of the program in various sectors of the delegation.

The comprehensive sensitization activity was carried out in relatively good conditions in June and September 2014.

Followings were proved by the sensitization activities;

- Participants were sensitive to the message and the majority seems motivated to create a versatile SMSA in terms of purchase and sale of agricultural crops that helps them cope with the challenges of the market (buying and selling).
- However, the spirit of assistantship continues to prevail in an important number of farmers, accustomed all their lives to State aid. From this point of view, there was some resistance to the subscription, particularly in Sedjnane.

Following sensitization, there will be the assistance to the actual constitution of the SMSA through the preparation of the documents of establishment, selection of an interim committee that will collect subscriptions from farmers for the share capital of the Company, preparation of a statute, holding of a general assembly and election of a Board of Directors for a term determined in the statute.

2.6.5 Activities of SMSA establishment

Provisional committees have been set up in Nefza and Sedjnane. Activities of assistance in the establishment of the SMSA by DPINT team lasted three months (August to October 2014). DPINT team prioritized Nefza since the financing progressed.

(1) Situation of SMSA establishment at Nefza

The Provisional Committee appointed in Nefza continued the work of collecting money during the first half of October. Meanwhile, an announcement has been launched in national newspapers to keep farmers informed about the project to establish a SMSA in Nefza. It is a legal obligation that has to be announced publicly 15 days prior to the elective general assembly whose date was set for Monday, October 13.

The Constitutive General Meeting to create the Mutual Company for Agricultural Service of Nefza, was held Monday morning, October 13, 2014 at the city hall of the delegation, chaired by Mr. Youssef Azzabou, Divisional Head at CRDA Beja, representing the CRDA, who was helped by two assistants, namely Nouaili Bassam and Ridha Saidi, designated by the General Assembly, and the Secretary of the meeting, Mr. Mohamed Maddouri, from FIOP section of Beja CRDA. Other officials who attended the meeting were the Delegate of Nefza, the Chief CTV of Nefza, and M. Rachid Ayachi, Chief Arrondissement FIOP of Beja CRDA.

The day of the Assembly, the number of members of the SMSA has reached 42 and the collected share capital amounted to 12,000 dinars, or 60% of the agreed capital. The regulation requires the collection of 50% of the capital in the first year and allows thereby holding the elective general assembly. Also 28 subscribers of the SMSA, or 60% of all members attended. The legal quorum for the holding of the meeting is 50%; it was far exceeded.After reviewing the decree 1391 dated 11 June 2007, relating to the bylaws of SMSA, the meeting was to elect 6 members of the Board of Directors. The meeting also completed the appointment of an Account Commissioner for a period of 3 years. The SMSA was called “Al Mostakbal ".

Following the above mentioned assembly, the FIOP section of Beja will assist members to complete all the formalities specified by the legal brief of the SMSA, namely:

- To provide copies of model statutes, signed by the members of the Board of Directors to the tax office to receive a business license
- Registration of the SMSA in the commercial register
- Publication of the creation or establishment of the SMSA in the Official Journal
- Preparation of a complete brief to inform the Governor

Following completion of these tasks, the SMSA was established legally at the date of 30 October 2014. The problem of office (headquarters) was temporarily solved by a special effort of CRDA and local authorities that offered to the SMSA one of the administrative offices available in the area.

(2) Situation of SMSA establishment at Sedjnane

The situation of Sejnane SMSA has not yet unraveled though the provisional Committee had formed to prepare the Constitutive General Assembly to appoint a legal Board of Directors. The conflict between the Local Union of Farmers and the CTV does not seem to be absorbed. Each party develops a vision of the SMSA. : The UTAL considers it would lower the value of the shares at 5 DT and multiply the number of farmers to meet the amount of the social capital. CTV is rather aiming to efficiency by requiring a minimum number of farmers in the startup phase and building on their spirit of volunteerism to substantially contribute to the social capital of the SMSA, which is perfectly legal.

The blocked bank account opened for the SMSA is always empty (at the date of 12 November 2014).The Provisional Committee promised that he would collect the money shortly.

Although establishment of SMSA in Sedjnane was not achieved during the project period, it was confirmed at the last JCC held at February 16, 2015, that C/P assists the establishment of the SMSA after the project finished.

2.7 Assistance to the implementation of study suggested on the basis of the action plan formulated by Tunisia

2.7.1 Assistance to the study of the existing irrigation networks and facilities

(1) Implementation method and Objective of the study

Based on the Base Line Survey conducted during the first mission of the project, a hydraulic study was implemented to examine the problem of the existing irrigation facilities at Nefza and Sedjnane in final year (2014~2015). The results of the study were analyzed and evaluated afterwards, and suggestions on measures to improve the facilities were given to the Tunisian side.

The study was conducted by local consultant companies that had sufficient knowledge, skills and experience. Candidate companies were selected from a short list prepared by the Tunisian side, and contractors were decided along procedures of the guideline prescribed by JICA.

(2) Study contents

Studies for 3 areas of following was implemented. Study contents were described below.

1) Study about the hydraulic system in Nefza

- A hydraulic study is carried out to identify problems of the existing hydraulic system at the level

of sectors ofTouila and Ouchetata, where water is delivered through a pumping station installed at Sidi Barrak dam. Pipeline which is object of the study is made up of pumps, main/branch pipelines, and regulation tanks. As an analysis, current and planned water requirements are simulated.

- The current hydraulic system is diagnosed and evaluated based on the results of the study, and necessary measures for improvement are suggested to the CRDA.
- The best solution emanating from the results of the analysis is decided through a comparative review. In addition, drawings are elaborated at the level of basic design and approximate cost is estimated. These results are organized as a report and necessary advices are provided to the Tunisian side in order to secure a budget and carry out the improvement of the facilities.

2) Study about the water supply and distribution networks in Sedjnane

- Hydraulic analysis is conducted and problems of the current hydraulic system are revealed about the pipeline networks supplying water from four complex pumping stations supplying eight irrigation sectors in Sedjnane. As an analysis, current and planned water requirements are simulated. Facilities which are mainly targeted at the study are pumps, main/branch pipelines, and regulation tanks.
- Current hydraulic system is analyzed and evaluated on the basis of the results of the analysis. Then, the improvement of the hydraulic facilities such as pipelines and regulation tanks, and the management system relating to the operation and maintenance of the facilities, are suggested to CRDA, if necessary.
- The best solution is decided through a comparative review of the facilities needing improvement. In addition, drawings are elaborated at the level of basic design and approximate cost is estimated. These results are organized as a report and necessary advices are provided to the Tunisian side in order to secure a budget and carry out the improvement of the facilities.

3) Study for the reinforcement and distribution of irrigation hydrants in Sedjnane

- The current situation is analyzed and evaluated through the hydraulic analysis of the areas where the location of hydrants, including common hydrants, is not conformed to the current land reform and has hydraulic disadvantages. Based on the results of the analysis, solutions to solve problems are recommended to the CRDA about a proper location plan of the hydrants to allow a stable irrigation water supply at hydrants.

- The best improved location plan is drawn on a map, which includes hydrants whose location is not proper, as concluded in the analysis. In such a case, the best solution, including relocation, is considered because operation and maintenance become complicated if new hydrants are set. Furthermore, approximate cost is estimated for securing budget as well as studies mentioned above.

(3) Results of the studies

Table 2-42 Result of the study about the hydraulic system in Nefza（Touil and Ouchetata sectors）

Description	Study components	Cost
Nefza perimeter covers a net area of 2548 ha, and is made up of five irrigation sectors (S1 to S5), with various areas. The study concerns only two sectors Touila et Ouachtata, covering a net area of 895 ha. These tow sectors are supplied in irrigation water from the same hydraulic system, which includes: - A floating pumping out station; - A relay station; - A transmission-distribution pipeline; - A regulation reservoir (capacity 500 m3); - Transmission-distribution network (concrete/PET); - Sluice devices, air valves, irrigation hydrants Touila and Ouechtata sectors are facing the following problems: - Important water loss at the level of the network (frequent breaks of the transmission pipeline) - Network emptying after stopping the pumping station - Pressure drop at high areas in Touila sector - Reservoir low capacity (lack of water reserve) - Limited irrigation hours - Most of the control devices are defective - Lack of water meter necessary to measure water consumption in most of the irrigation hydrants.	- Repair, and maintenance of the non-operating pumping groups - Reinforcement of the two pumping out stations - Operation and programming of the automatic operation of the relay station - Maintenance of the transformation MT/BT of the pumping complex - Separation of distribution from the transmission by adding a pipeline section between the reservoir and the connecting part of the supply pipeline : L= 254 m ; DN = 800 mm - Setting a storage reservoir of 10 000 m3 - Reinforcement of the existing distribution network (4800 ml of PEhd pipelines Ext. dia. 90 to 400) - Replacement of defective pipeline sections (visible; breaks, and leakages) - Rehabilitation and creation of ancillary devices	1,437.613 DT including VAT

Table 2-43 Result of the study about the water supply and distribution networks in Sedjnane

Description	Study components	Cost
Sedjnane perimeters covers a net area of 3749 ha and is made up of 8 independent irrigation sectors (from S1 to S8) and are located from the two sides of Sedjnane river with variable areas. The hydraulic system is similar in all the sectors and it includes: a pumping out station, a relay station, a transmission-distribution pipeline, a regulation reservoir of 300 m3, and transmission-distribution network (concrete/PET). Sedjnane irrigated perimeter is facing a water deficit because of: - Wrong dimensions of the hydraulic systems - Very small water reservoir comparing to peak demands - Ill distribution of irrigation hydrants - Short period of daily irrigation - Most of the control devices are defective - Lack of water meter to measure the appropriate water consumption.	- Reinforcement of the various pumping complex by one pumping out group and a relay group in each sector - Replacement of undersized transformers comparing to the new operation conditions - Reinforcement of the transmission pipelines by redoubling them in the 8 sectors and separating the transmission from the distribution - Reinforcement of the distribution network of each sector - Setting a storage reservoir in each sector (5.000 m3 for S1 et S8 and 10.000 m3 for the other 6 sectors) - Reinforcement and improvement of the irrigation hydrants distribution - Rehabilitation of the ancillary devices and creating of other reinforcement devices	・ Sectors S1 and S2 = 5,568,205 DT including VAT ・ S3, S4 and S8 = 6,389,948 DT including VAT ・ S5 and S7 = 5,996,072 DT including VAT ・ S6 = 2,071,948 DT including VAT ・ Total = 20, 026,173 DT including VAT

Table 2-44 Result of the study for the reinforcement of irrigation hydrants in Sedjnane

Description	Study components	Cost
The diagnosis revealed that over the 1122 equipped hydrants only 956 are operating and 151 hydrants are non-operational, and that for several reasons, namely: - Wrong location of the hydrant - Hydrants out of the irrigated perimeter - Two or several hydrants are exploited by the same farmer - Non-utilized hydrants because of conflict between beneficiaries	- Rehabilitation of the hydrants rural engineering - Reorganization of the irrigation hydrants : adding and removing irrigation hydrants - Reinforcement of the hydrants number and removing others. - Connecting hydrants and intensification of the number - Improvement of the conditions of the broken hydrants	Total cost: **1 423 940** including VAT, which is equivalent to **971 DT/ha equipped** (over an area of 1800 ha)

2.7.2 Assistance to the study of drainage improvement

Similarly to the study on the irrigation networks and facilities, drainage studies at Sedjnane and Fernana were conducted by local consultant companies.

(1) Study contents

1) Study on improvement of the drainage network at Sedjnane

- Necessary surveys to confirm the current situation and the drainage analysis, including a runoff analysis, are conducted for poorly drained areas in Sedjnane. Then, the problems of the current drainage networks are examined, and improvement plans are suggested to the CRDA.
- A Basic Design (B/D) including estimated project costs and standard design of the drainage network are implemented in this survey. After the survey, advices are given and consultations are made so that the budget of the project is secured and the project is implemented by the Tunisian side in future.

2) Study about the protection of farmlands from erosion and hydromorphy at Fernana

- Present situation of soil erosion and hydromorphy are confirmed through the field survey about farmlands affected by soil erosion and hydromorphy coming from the inflow of rain water at Fernana. Then, necessary protection measures for these farmlands are recommended to the CRDA, following a drainage study including a runoff analysis.

- After this survey, advices are given and consultations are made so that the budget of the project is secured and the project is implemented by the Tunisian side in future.

(2) Results of the studies

Table 2-45 Result of the study of drainage, and protection from runoff waters in the irrigated perimeter of Sedjnane

Description	Study components	Cost
Inundation problems in Sedjnane irrigated perimeter were noted at the level of sectors 1, 2, 3 et 4, and mainly in low areas. Water stagnation results from the overflow of small water courses (chaâba), called Khlij. The physic conditions of water course in the irrigated perimeter is a major constraints for the exit of runoff waters. The low slope, the slitting up, and the wild vegetation in the flow axes represent major obstacles to water outlet of the Sedjnane river.	· Rectification of the existing water course: 29 255 m · Setting new buried canals: 1984 m · Cleaning of water courses: 1500 m · Setting buried ditches: 1544 m · Replacing the crossing devices: 14 devices · Setting crossing devices: 2 devices · Maintenance of the river crossing devices: 2 outrages	Which is equivalent to a total of 1,956,690 DT including VAT , that is 1,087.050 DT/ha equipped (over 1800 ha)

Table 2-46 Result of the study of drainage and protection from runoff waters in the irrigated perimeter of Fernana

Description	Study components	Cost
Fernana perimeter is located in an area where rain waters are drained through small water courses, crossing the perimeter to reach the two main rivers: Ghrib and Ghezala. Heavy rains on low areas and which are not properly drained stagnate several days and cause the decrease of the agricultural production and even the loss of some plantations.	· Rectification of the dimensions of the existing water courses: 4945 m · Setting new underground canals: 1890 m · Setting buried ditches :992 ml · Replacing the crossing devices : 5 devices · Setting crossing devices :5 devices · Maintenance of crossing devices : 2 devices	Which is equivalent to a total of 1,261,500 DT including VAT (5,867.440 DT/ha equipped (over 215 ha)

2.8 Holding JCC

JCC (Joint Coordination Committee) had been held five times including a terminal evaluation during this project for three years. Main contents of JCC were explanation, discussion, confirmation of the results of the project activities. Furthermore, the numerical indicators of the project goals in the PDM (4th JCC in Feb 2014) were discussed and the status of achievements of the indicators for the project goals were confirmed (5th JCC in 2015 Feb).

Table 2-47 Record of holding JCC

Name of conference	Date	Place	The number of participants	Main Content
2nd JCC	2012.12.05	Conference room in the hotel at Tunis.	35	Explanation, discussion and confirmation of the results of the project activities in 1st year
JCC for Terminal evaluation	2013.06.20	Conference room in Ministry of Agriculture	20	Terminal evaluation of the Project
3rd JCC	2013.11.04	Conference room in Ministry of Agriculture	29	Explanation, discussion and confirmation of the results of the project activities in 2nd year
4th JCC	2014.02.28	Conference room in Ministry of Agriculture	22	Explanation of the plan of the project activities in final year Discussion of the indicators (Irrigation efficiency) in the PDM
5th JCC	2015.02.16	Conference room in Ministry of Agruculture	27	Explanation and Discussion of the status of achievements in the PDM. Explanation and confirmation of the achievements of the project goals,

Conference minutes and slides for presentation in JCC were attached in Annex A-6 ~ A-10.

2.9 Equipments provided and transferred

In relation to provided equipments, DPINT team took over from long term expert for the plan and made an arrangement in order of priority.

Table 2-48 List of equipments provided and procured

Year	Equipments	Spec	Units
Equipments provided			
2012	Motorbike	PEUGEOT (103 VTTNB)	9
	Maintenance Equipment (Generator)	CTH-8	3
	Electro fusion unit	+GF (MSA 230 Standard)	3
	Engine pump set	HONDA (Type WBK30)	3
	Electric jackhammer	-	3
	Portable PC without printer	Toshiba (Satellite Intel Core i3)	3
2013	Projector	EPSON（EB-1900）	3
	Screen	ORAY（TRE03B1175175）	3
	Tool box	ACEM	9
	Working clothes	-	18
	Desktop PC with printer	DELL （VOSTRO 260MT：desktop） SAMSUNG （ML 2160：printer）	13
	FAX	Brother（FAX-236S）	3
	Back hoe	VOLVO（BL61B）	3
Equipments transferred			
2014	Vehicle	MITSUBISHI（4WD）	2
	Vehicle	CITROEN（Sedan）	1
	GPS	Magellan（eXplorist 210）	1
	Desktop PC	HP（Pro 3120 MT）	2
	Printer / Photocopy Machine	SHARP（AR5520n）	1
	Printer / Photocopy Machine	HP（LaserJet Pro CM1415fnw color MFP）	1
	Projector	EPSON（EB-1900）	1
	Moisture meter	Daiki（DIK-311E）	1
	PH/EC meter	TOA DKK（WM-32EP）	3
	Leaser Distance Meter	Leica（DISTO D5）	3
	LAN Storage	3.5” HDD 1TB	1

3. Constraints, solutions and lessons learned of the project operation

(1) Delay Demonstration Activities at the first year

＜Constraints＞

- The implementation structure of the Project was modified from the direct management experts into dispatch of consultants. At the last, the team got to start consultation with the Tunisian counterparts regarding the demonstration farms and pilot site selection in March in 2012. Therefore, the period up to the planting preparation of crops was very limited and the schedule for the demonstration farms became extremely tight.

＜Solutions＞

- With provision of a shortlist of local consultants (on irrigation, agriculture, soil, and sociology) from DGGREE, a Tunisian counterpart of the Project, early commencement of the activities were made possible. Moreover, timely and necessary instructions by CRDA representatives to those who are concerned with pilot activities minimized delay of commencement of the activities. These allowed for planting in June at 20 demonstration farms that had been planned in the first year.

(2) The Number and Management of Demonstration Farms

＜Constraints＞

- Selection of demonstration farms in the first year ended up with unsatisfied results because selection processes of farms and candidates led by DPINT team, CRDA, and CTV did not necessarily involved GDA into the selection processes, which led to insufficient ownership of GDA on demonstration activities and low participation.

- The first phase of the second assignment period of the Project added 21 farms to 20 demonstration farms chosen in the first year. The reason why the number of demonstration farms increased is that the demonstration activities must be performed by Tunisian counterparts including GDA, therefore, the demonstration farms selected by them should be added.

- Tunisia side, however, failed to secure the number of necessary staffs, which made local engineers (especially field engineers) on irrigation and farming and Japanese consultants manage demonstration farms and spend much time in monitoring activities.

＜Solutions/ Lessons learned＞

- As mentioned above, management of demonstration farms led to insufficient participation of Tunisia side due to limitation in terms of time. Learning from this lesson, selection of demonstration farms in the first phase of the second assignment period held in November 2012 carefully followed selection criteria while securing GDA representatives' opportunities for participation and their ownership since the phase of making of a shortlist of candidates. As a result, monitoring and extension activities such as demonstration activities in the second phase of the second assignment period and ahead were implemented, while securing concerned counterparts' voluntary participation.
- Even though it was a request from Tunisia side, the number of demonstration farms was too much. Activities should have been planned after consideration on implementing structure and minimum standard necessary for achievement of objectives.

(3) Delay in Selection of Pilot Sites

＜Constraints＞

- Regarding selection of pilot sites in the first year, there were not only limits in terms of time but also a strong request from Tunisia side to secure "tangible achievements" as soon as possible because relationships between farmers and Tunisian administration worsened after the revolution. Due to this, establishment of demonstration farms and demonstration activities came to be prior to selection of pilot sites that are targets of extension of irrigation farming. As mentioned, the fact that the number of demonstration farms was too much delayed selection of pilot sites until May 2013.
- Collection of data such as irrigated rate and yields in pilot sites, which will be criteria for degree of achievement of project objectives, did not begin until the first phase of the second assignment period as pilot sites were not selected.

＜Solutions/ Lessons learned＞

- Demonstration farms should have been selected in the first assignment period, following processes while involving Tunisia side so that the Project could expect demonstration effects in pilot sites. Although dispatch of experts began from preparation for planting, it should have begun earlier.

(4) Indebted Farmers for Water and Problems of a Lack in Time for and Delay of Water Supply

＜Constraints＞

- Debts for water in the target three irrigation areas were left as of June 2012 (20% debt payment ratios in the areas are; 53% in Nefza, 57% in Sedjnane, and 45% in Fernana). Nefza paid a certain amount of money and stop of water supply did not happen, but GDA's collection of debts in Sedjnane and Fernana did not proceed, which led to stop of pumping water supply and a decrease in water supply period throughout the Project. As a result, negative impacts were put on the Project's achievements. The following negative factors due to unpaid debt for water use caused worse incidents, which severely prevented implementation of the Project for demonstration and extension of irrigation farming.
    - Stop of water supply to demonstration farms damaged achievement of outputs in demonstration activities
    - Farmers' trust and interest in irrigation agriculture was deteriorated in pilot sites
    - Conflicts between CRDA and farmers hampered smooth implementation of workshops for farmers
    - Instruction on saving water irrigation through water management groups' rotation system that was originally planned by DPINT did not start

＜Solutions/ Lessons learned＞

- In Sedjnane area where farmers chronically did not pay for water use, the project team again implemented education and enlightenment activities about duties to pay for water use so that debt payment ratio will be improved in the early stage of the first phase of the second assignment period, too. These were implemented based on a strong request from CRDA and GDA.
- DPINT encouraged CRDA to hold meetings with SECADENORD about adjustment of water supplying periods, which led to a conclusion to double water supplying periods, delay the peak time, increase the amount of water supply (in July 2014 in Fernana), and restart water supply that used to be stopped (in June 2014 in Sedjnane). Capacity of irrigation system, however, is not sufficient, so problems are still to be solved.

(5) Sharing of Outcomes of Activities for Concerned Persons in Hammam Bourguiba Area

＜Constraints＞

- Whereas the Project encouraged concerned persons in Hammam Bourguiba to participate in JCC and seminars to share outcomes of achievements with those concerned, they did not. GDA is still dismantled in Hammam Bourguiba area.

＜Solutions/ Lessons learned＞

- Through CRDA Jendouba, DGGREE requested area to participate in JCC and important seminars. The Project requested DGGREE to provide relevant information to share achievements of the Project when concerned persons in Hammam Bourguiba did not attend the final seminar in December 2014. DGGREE conveyed this request to CRDA Jendouba on 19th of January 2015, and CRDA agreed to send relevant information to concerned persons in Hammam Bourguiba on 21st of January 2015. The provided information is the Progress Report and Work Plan in the first phase of the second assignment period and achievements in the final seminar.

4. Achievement of the project objectives

4.1 Activities and Achievements

Herein are described the activities implemented by DPINT from March 2012 to February 2015. DPINT analysed the extent of achievements of each outcome that was stated in the Project Design Matrix (PDM) of the Project.

- Output 1: Natural situation, agriculture condition, farming support and extension system supported by CRDA and GDA, etc. in the 3 irrigated areas (Nefza, Sedjnane and Fernana) are grasped.
- Output 2: The irrigation agriculture which serves as a model of irrigation agriculture at pilot sites is established.
- Output 3: The farming extension support system by CRDA and GDA is strengthened.
- Output 4: The results of activities of the Project are shared among the persons/organizations related in 4 irrigated areas (Nefza, Sedjnane, Fernana and Hammam Bourguiba).

4.1.1 Activities for Output 1

	Activities in PDM	Status of Activities as of June 2013[1]	Status of Activities as of February 2015	Achievement
1-1	To conduct survey about the natural situations (meteorology, hydrology, landscape, etc.) and all farmers' situations (farmland, crop, irrigation, market, farm matter, ownership of land, income, opinion of farmers to future, etc.) in 3 irrigated areas.	- Baseline survey covering farmers' situations in 3 irrigated areas had been conducted by February 2012.	ditto	Completed.
1-2	To conduct survey about the situation of management and maintenance concerning the facilities and organizational structures of CRDA and GDA.	- Baseline survey covering these issues in 3 irrigated areas had been conducted by February 2012. - Additional survey for grasping actual situations of GDA by interviewing with CRDA officers in charge of GDA, board members of GDA, and farmers was conducted in March and April 2012.	ditto	Completed.
1-3	To analyze the data of survey conducted on Activity 1-1 & 1-2.	- Results of the baseline survey were analyzed and compiled as baseline survey reports.	ditto	Completed.

4.1.2 Activities for Output 2

	Activities in PDM	Status of Activities as of June 2013[2]	Status of Activities as of February 2015	Achievement
2-1	To pick up possible pilot sites.	- It was agreed between Project (DPINT) Team and CRDA/CTV that pilot sites would be selected after deciding demonstration farms. Since setting of demonstration farms were done over two years (2012 and 2013) based on agreement of both parties,	ditto	Completed.

[1] Cited from Evaluation Report in June, 2013
[2] Cited from Evaluation Report in June, 2013

		selection of pilot sites was delayed and has just been completed (14 sites, 1,450ha) in June, 2013. -		
2-2	To survey farmers etc. in pilot sites picked up by Activity 2-1.	- List of farm plots (location and area) and their cultivator (owner) farmers in the selected pilot sites will be prepared.	- Each P/S's profile (location, area, and cultivators (or owners)) in the pilot sites in the three irrigated areas was developed from August to October 2013. The survey on farming area, irrigated area, and number of farmers using irrigation facilities was conducted in the P/Ss in September and October, 2014.	Completed
2-3	To select pilot sites and organize farmers' group in each water bulb unit.	- Short time of water supply pumping by SECADENORD (water supply public corporation) have led demand-supply gap of water in irrigation peak season. Due to shortage of absolute water quantity, trust relations between farmers and CRDA are in difficult situation. - Without solving this water supply issue, step for organizing farmers' group could not be proceeded.	- For season 2014/15, a problem on scarcity of water supply, which is similar to the last season, occurred in all Sedjnane P/Ss and Ain El Baya P/S of Fernana. The planned activity on organizing farmers group and introducing rotation irrigation about each hydrant was canceled due to fragile relationships between farmers and CRDA with consideration of opinions cancelling the planned activities from Tunisian side.	Incomplete (canceled)
2-4	To advices the farming plan and the water management plan in each pilot site.	- Guidance and trainings on soil analysis for staff of CTV, CRA, and GDA were provided with using demonstration farms. - Sustainable farming model such as introduction of rotation cropping and companion planting were shown with using demonstration farms. - Guidance related to appropriate on-farm water management is continued to be given to farmers in pilot sites.	<Advice on farming and water management plan> - Technical guidance on water management and farming (fertilization, crop protection, disease control, weeding, farming management, and so on) was provided to farmers in the pilot sites through training and Field Days. <Implementation of study based on Tunisia side's request> - In order to improve the farming condition, drainage study was requested by Tunisia side, which was conducted at Sedjnane and Fernana. The study was completed by January 2015 and study reports were prepared so that Tunisian side could tackle this issue following suggestions described in the study report. - In order to improve the problems of water distribution networks, hydraulic systems, and/or unsuitable locations of irrigation hydrants, hydraulic studies was requested by Tunisian side, which were conducted at Nefza and Sedjnane area. The study was completed by January 2015 and survey report was prepared, which enabled Tunisian side to tackle this issue.	Completed

2-5	To advise on improvement of market access. ▪ To advise CRDA to provide farmer groups with market report containing information such as trends of demands and prices of agricultural products	- As a part of preparation for establishing SMSA, social survey was conducted at 3 irrigated areas. - Results of the survey will be analyzed and submitted to the concerned organizations.	- Results of social survey at the three irrigated areas that would be a basis of establishment of SMSA (from April to June 2014) were analyzed and compiled. The report was delivered to concerned agencies (2012 and 2013). - Technical and economic survey for SMSA establishment at Nefza and Sedjnane (from April to June 2014) were conducted. In addition, Sensitization programs on type of SMSA, authority, management structure and legislative frameworks, role of SMSA's executives (e.g. responsibility of leading farmers groups for better production, sale, and procurement) were implemented in Nefza and Sedjnane between June and September 2014. - SMSA in Nefza was established and authorized through official procedures in the end of October. As a result, market information such as trends of demands/supply and prices of agricultural products are expected to be shared among farmers through SMSA. Concerning SMSA of Sedjnane, it is at the stage of collecting fund for establishment. CRDA, AFIOP, and CTV are the core agencies for supporting its establishment, following the results of surveys.	Completed
2-6	To develop appropriate water charge and collecting system of water charge. a) To give advice on spreading the high-accuracy water flow meter widely in the pilot sites b) To clarify the roles and responsibilities of the stakeholders involved in the installation, operation and maintenance of the high-accuracy water flow meter and	- Issues relating to existing water charge collecting system were clarified through hearing from concerned parties. Since water quantity used by farmers is not correctly measured, water charges accounted by current system are unfairly imposed on user farmers. - High-accuracy water meters were installed and operated at demonstration farms. It was shown to Tunisian C/Ps that using high-accuracy water meters would improve water charge collection system. Since ensuring funds for installation of such water meters are not expected, full-scale introduction of these meters has not yet decided, despite partially installed on trial base. - Other possible measures for improving water collecting system still based on size of irrigated areas will be examined and proposed to concerned parties.	- Necessity of budget allocation for procurement of high-accuracy flow meters and installation schedule were advised to CRDA. The procurement, exchange and installation started at a part of Nefza and Sedjnane irrigated areas from September 2013. - At a part of Nefza irrigated areas where existing billing system was relatively smoothly working, a model area for water billing system based on water consumption quantity measured by high-accuracy flow meters was defined in order to carry out the trial activities. Methods of installation of accessories that keep accuracy stable, i.e. stabilizers and filters, and method of accuracy test on the flow meters were instructed to CRDA Béja and GDAs at Nefza. - A billing system based on water consumption with highly accurate flow meter was introduced on a trial basis to the above mentioned model area. Roles and responsibilities for installation, operation, and maintenance of devices were notified to CRDAs and	Completed

	irrigation facilities c) To introduce a new water charge system based on water consumption		GDAs in the three irrigated areas in consideration of applicability to the three irrigated areas in future. - Besides introducing water billing system based on water consumption, the more precise and proper calculation method based on size of irrigated areas was recommended to C/Ps in the three irrigated areas, in which the species of crops and crop water requirements of each cultivation season, etc., were considered.	
2-7	To demonstrate irrigation agriculture as model.	- Through series of discussions with CRDA/CTV, 20 demonstration farms in 3 irrigated areas were decided for the 1st year (Feb. 2012 ~ Jan. 2013). Necessary equipment and materials were provided. Based on soil analysis, cultivated crops and cultivation methods were decided, and guidance was provided to concerned people (e.g. farmers and extension staff of CRDA/CTV). Tunisian irrigation expert and agronomy expert were assigned from the Project team to respective irrigated areas and they went around the demonstration farms to monitor water management, fertilization, pest management, and crop marketing. - For the 2nd year (Mar. 2013~), additional 21 demonstration farms were selected and irrigation cropping was already started for those farms. - In some demonstration farms, the activities related to the analysis of data necessary for comparison was insufficient, thus the Project could not obtain results such as the interest of neighboring farmers in the project. - Model demonstration activities at the 41 farms will be continued until July 2013.	- Model demonstration activities at the 41 farms were continued until November 2014 (a demonstration at one farm was cancelled due to a farmer's unwillingness). - In the third cropping year, 13 demonstration farms that were chosen from each pilot site were intensively guided and monitored by the project team and were regarded as crucial for extension works. Other demonstration farms were monitored mainly by C/Ps for the purpose of enhancing their capabilities and experiences on instruction activities, with assistance of the project team. - Yield of main crops such as Tomato, Melon, Watermelon, and Pepper at each demonstration farm exceeded the average standard yield at the end of the third cropping year, except the regular cases such as delay of water distribution in Sedjnane in 2014, etc. Furthermore, almost all of the farmers who own demonstration farms were satisfied with their profits (Detailed data are shown in Annex 12 ~14). - Regarding fodder cultivation at Sedjnane, improvement of profitability was remarkable. Its yield and profits per ha exceeded average standard of those in the same area at the third cropping year. - In 2013 and 2014, farmers around the P/Ss participated in Field Day activities many times. Through carrying out the Field Days, Demonstration farms and surrounding farming areas were compared in terms of profitability. As a consequence, irrigated farming demonstrated by the Project was verified to be appropriate as a model.	Completed
2-8	To disseminate the model of irrigation agriculture to the farmers in the pilot	- Grafted nursery plants of melon and water melon introduced at the demonstration farms were shown to neighboring farmers. - Target farmers will be selected and their advanced	<Visit on advanced irrigated areas> - Representing farmers in the pilot sites, GDA, and CTV visited the advanced case of irrigated farming and successful cases were introduced in September 2013.	Completed

	sites. a) To develop education materials that deal with issues such as profitability of the water saving irrigation system to convince the farmers in the pilot sites to invest in it and practice it b) To organize farmer-to-farmer technical extension activities on advanced agriculture by water saving irrigation systems c) To disseminate the output of demonstration farms of each pilot site, involving neighboring competent farmers who could work as "promoters" of irrigation agriculture	farming will be exhibited in the pilot sites.	<Field Day>. - Field Day, as training scheme for farmers, including farming by water saving irrigation were carried out from May to September 2013 at demonstration farms in pilot sites of Nefza and Sedjnane (9 times, 178 participants). - Field Days were conducted from April to September 2014 at demonstration plots in pilot sites of the three irrigated areas (23 times, 219 participants). Through these trainings, both of irrigation farmers and non-irrigation farmers actively exchanged and shared their opinions. In addition, materials with which farmers can understand merits of water saving irrigation were developed and provided to extension agencies. <Other trainings> - Training on introduction of drip / sprinkler irrigation, crop protection, and required water amount and cost for application of water saving irrigation was held at Testour training center on October 2013 (3 days, 50 farmers). - Training on protection for summer crops was conducted at three irrigated areas in June 2014 (87 participants). - At Nefza and Sedjnane, CTV spontaneously held invitation program for farmers outside of pilot sites and CTV / CRA personnel in Beja and Bizerte to demonstration farms. The Project provided advices pertaining to this program.	
2-9	To verify effects of irrigation, improvement of farming and activities of farmers groups, etc.	- Seminars will be held in July 2013 for CRDA, CTV, CRA, GDA and some farmers, where applicability of the irrigation agriculture model demonstrated by the Project as well as appropriateness of its approaches will be verified based on the results and process of the Project activities at pilot sites.	- Most C/Ps accepted the results of the following projects outcomes which were shared with Tunisia side at the final seminar in December 2014. 1) Assistance for GDA and sensitization program 2) Development of a calculation system for water billing system 3) Demonstration farms activities 4) Assistance for SMSA establishment 5) Result of irrigation ratio improvement, and so on	Completed

4.1.3 Activities for Output 3

<table>
<tr><th></th><th>Activities in PDM</th><th>Status of Activities as of June 2013[3]</th><th>Status of Activities as of February 2015</th><th>Achievement</th></tr>
<tr><td>3-1</td><td>To conduct technical guidance and trainings for staff of CRDA and GDA.

a) To give technical guidance on the operation and maintenance of the high-accuracy water-flow meters and irrigation facilities
b) To support CRDA's preparation of the work plan on the installation, operation and maintenance of the high-accuracy water flow meters and irrigation facilities</td><td>- Following draft manuals on irrigation and agronomy were prepared: i) manual for drip irrigation; ii) manual for maintenance of water supply equipment; iii) handbook for cultivation of melon and water melon; iv) handbook for cultivation of tomato; v) handbook for cultivation of pepper; vi) handbook for cultivation of sorghum; vii) handbook for cultivation of alfalfa; viii) handbook for sustainable soil treatment. They will be finalized with reflecting comments from Tunisian concerned officials.
- 3 kinds of posters for disseminating technical information to farmers were prepared and distributed to CTV offices.
- Technical trainings on soil management were conducted for staff of CTV and CRA of 3 irrigated areas (4-days classroom lecture and field practices, Sep.~ Nov. 2013). The number of participants for these trainings is 44 in total.
- Trainings on agronomy and irrigation were conducted in Nov. 2012 as follows:
<table>
<tr><th>Date</th><th>Place</th><th>Target</th><th>Participants</th></tr>
<tr><td>6th Nov.</td><td>Fernana</td><td>GDA, CTV</td><td>3</td></tr>
<tr><td>7th Nov.</td><td>Sedjnane</td><td>GDA, CTV, CRDA</td><td>9</td></tr>
<tr><td>8th Nov.</td><td>Nefza</td><td>GDA, CTV, CRA, CRDA</td><td>7</td></tr>
</table>
- Meetings with GDAs were held in Mar. and Apr. 2012 for discussing issues (e.g. organizational activation, promotion of payment of water charge, etc.) and countermeasures for strengthening GDA.
- Trainings for board members of all 9 GDAs were conducted in Jul.~Aug.2012 (2days) and Mar. 2013 (4</td><td><Technical instructions and workshops for CRDA and GDA staff>
- Training course on plant pathology, soil and water requirements was conducted for extension agents in charge of the three irrigation pilot areas for 3 days continuously in October, 2013.
- Visit for case study of advanced irrigation for staff of CTV and GDA, and farmers' representatives was conducted in September, 2013. (as already mentioned in 2-8)
- Concerning the water billing system (developed in 2014) based on water consumption, operation and management methods were instructed to CRDA and GDA. Furthermore, necessity of preparation for future project plan including budget allocation was suggested at the final seminar held in December 2014.

< Technical instructions and workshops for GDA staff >
- Training for GDA staff in the three irrigated areas on administrative and financial matters was conducted in June, 2013. (Total 12 days, 69 participants)
- Training for GDA staff in the three irrigation irrigated areas on GPS and data processing were conducted for 3 days in July, 2013 (Total 34 staff participated).
- Training on proper installation and maintenance of irrigation equipments for GDA staff (Water guards) of the three pilot areas was conducted in September, 2013 (1 day, 17 persons participated)
- Training on formulation of GDA budget and balance sheet for GDA staff of Nefza and Sedjnane was conducted in February, 2014 (4 days, 18 persons participated)
- Trainings on proper installation and maintenance of flow meters and irrigation accessories for technical</td><td>Completed</td></tr>
</table>

[3] Cited from Evaluation Report in June, 2013

<table>
<tr>
<td></td>
<td></td>
<td>days) at each irrigated area.
- Trainings for GDA staff on administrative and financial matters are underway. Trainings on maintenance of irrigation equipment will be done before Ramadan.
- Technical trainings (e.g. fertilization, pest prevention, maintenance of irrigation equipment, how to use soil analysis kit, pH/EC meter, etc.) for extension staff of CTV, CRA and GDA will be conducted in collaboration with AVFA before Ramadan.
- Visit to advance irrigation district with staff of CRDA, CVT, CRA, GDA, and some farmers will be conducted before Ramadan in 2013.</td>
<td>directors and water guards in GDA were carried out on May and June 2014 in Nefza, utilizing a new model of water billing system with flow meter.</td>
<td></td>
</tr>
<tr>
<td>3-2</td>
<td>To conduct educational activities and technical trainings for members of GDA.

a) To enhance the capacity of GDA in terms of organizational management
b) To enhance the technical knowhow of GDA staff in terms of promoting irrigation agriculture</td>
<td>- Trainings for farmers for discussing issues related to GDA were conducted in Oct. ~ Dec. 2012.
- Trainings on soil management for farmers at pilot sites (tentative) were conducted from Oct. to Dec.2012 as follows:
<table>
<tr><th>Date</th><th>Place</th><th>Participants</th></tr>
<tr><td>10, 11, 12, 16 Oct.</td><td>Nefza</td><td>39</td></tr>
<tr><td>19 Oct</td><td>Fernana</td><td>12</td></tr>
<tr><td>4, 7 Dec</td><td>Sedjnane</td><td>27</td></tr>
</table>
- Trainings on agronomy and irrigation for farmers at pilot sites were conducted in Nov. 2012 as follows:
<table>
<tr><th>Date</th><th>Place</th><th>Participants</th></tr>
<tr><td>6th Nov.</td><td>Fernana</td><td>23</td></tr>
<tr><td>7th Nov.</td><td>Sedjnane</td><td>23</td></tr>
<tr><td>8th Nov.</td><td>Nefza</td><td>24</td></tr>
</table></td>
<td><Reinforcement of GDA's organizational management>
- Workshops on various issues for management of GDA and sensitization program were conducted between October and December 2012 (28 days, 641 participants).
- Trainings for capacity building of GDA board members inclusive of roles, responsibility and authority were held in March 2013 for new board members of 4GDA in Nefza (8 days, 24 participants).
- Trainings (mainly as a form of meetings) on duty of payment of water bill were conducted for 4GDA at Sedjnane from April to May 2013 (9 days, 245 participants)

<Enhancement of GDA staff's technical knowledge>
- Training for GDA staff in the three irrigated areas on administrative, budgetary, and financial matters was conducted in June 2013 and February 2014.
- Trainings on GPS and data utilization for GDA staff at the three irrigated areas were held in July 2013.(as already mentioned in 3-1)
- Trainings on proper installation and maintenance of irrigation equipment for GDA staff (water guards) at the three irrigated areas were conducted in September 2013.
Trainings on proper installation and maintenance of water flow meters and its accessories for technical</td>
<td>Completed</td>
</tr>
</table>

			directors and water guards of GDA at Nefza were conducted from May to June 2014.	
3-3	To conduct educational activities for non-participated farmers to GDA.	- Trainings on payment obligation of water charge for GDA member/non-member farmers are underway. - Seminar with field visit and lecture for GDA member /non-member farmers will be conducted at each irrigated area, utilizing the demonstration farms.	- Non-GDA members also participated in the sensitization program "strengthening of GDA's organizational management" as already mentioned in the section 3-2. - Non- GDA members were also invited to the Field Days organized at Pilot Sites and merits of irrigation agriculture were appealed in 2014.	Completed

4.1.4 Activities for Output 4

	Activities in PDM	Status of Activities as of June 2013[4]	Status of Activities as of February 2015	Achievement
4-1	To carry out seminars concerning results of the Project activities to the organizations and persons in all irrigated areas.	- Workshop with participation of DGGREE, CRDA and CTV of 3 irrigated areas was held on 18th Oct. 2012 at Tunis to share progress of activities in respective areas and exchange their opinions. - 2nd JCC was held on 5th Dec. 2012 at Tunis. - Seminars for confirming and disseminating the results of the Project activities will be held at each irrigated area with participation of CRDA, CTV, CRA, and GDA in July 2013. - JCC will be held in Sep. 2013 to confirm the results of Project activities and propose for continuation of the activities by the initiative of Tunisian side. Concerned parties from Hammam Bourguiba will be invited.	<Holding seminars> - Workshops / Seminars were held for DGGREE CRDA, CTV and GDA in Nefza in September 2013 (15 attendees). - Also, seminar was held with CRDA Jendouba in November 2013 for sharing the result of discussion of third JCC (12 attendees). - Seminars were held on December 2014 (27 attendees) in order to share the following results of DPINT on-site activities in 2014 with Tunisia side and to secure the sustainability of the Project. 1) Assistance and sensitization for GDA 2) Development of a calculation system for hydraulic billing system 3) Follow-up of demonstration farms 4) Assistance for SMSA establishment 5) Survey on irrigation ratio, and so on <Holding workshops> - Workshops were held in the three irrigated areas in September and October, 2014, which was organized by CTV to share issues and achievements of irrigation farming. Around 30 persons concerned participated in	Completed

[4] Cited from Evaluation Report in June, 2013

			each workshop. <Holding JCC> - The third JCC was held in November 2013 in Tunis (29 attendees). - The fourth JCC was held in February 2014 to confirm the future's implementation plan in consideration of the achievements in the past two years and to set numerical target of PDM indicators (22 attendees). - The fifth JCC was held in February 2015. Achievements of project activities and the Project Purposes were shared. - Nobody from Hammam Bourguiba where GDA is still dismantled attended at the main seminars and JCCs. Therefore, CRDA Jendouba requested DGGREE to share information on the achievements of the project to Hammam Bourguiba. DGGREE provided information on main achievements of the Project.	
4-2	To confirm effects of the Project to participants on Activity 4-1.	- The effects of the Project will be confirmed at the above seminars and JCC to be held in Jul. and Sep. 2013.	- As described in 4-1, outputs of the Project were confirmed through workshops, seminars, and JCCs held in autumn/winter season from 2012 and 2014, for sharing the results of series of activities and discussions among attendants. - The outcome of the Project, especially the applicability of water saving irrigation technology and high cost performance was recognized and confirmed among participants through series of discussion.	Almost completed

4.2 Achievement of Outputs

Narrative Summary	Verification Indicators	Achievements as of June 2013[5]	Achievements as of February 2015
Output1: Natural situation, agriculture condition, farming support and extension system supported by CRDA and GDA, etc. in the 3 irrigated areas (Nefza, Sejnane and Fernana) are grasped.	1-1. Analysis reports are made.	- Baseline survey report including analyses and action plans were prepared; thus, this indicator was achieved.	- ditto
Output 2: The irrigation agriculture which serves as a model of irrigation agriculture at pilot sites is established.	2-1. Yield per ha of major crops in demonstration farms are improved.	- Higher yields of pepper and tomato were recorded in some of the first year demonstration farms which were cultivated by farmers with experiences of irrigated farming. They were 42t/ha for pepper and 80t/ha for tomato while average figures for northern part of Tunisia were 16t/ha and 50t/ha respectively. Based on the data of the first year, this indicator was achieved. However, one should refer to the results of the second assignment period.	- For the first assignment period, comparisons between the average yields of crops at demonstration farms and those of overall area show that about half of the demonstration farms in Nefza and Fernana surpassed the average figures in the area. While in Sedjnane, almost all of demonstration farms surpassed the average figures. - Most of the demonstration farms in Nefza, 70% of demonstration farms in Sedjnane, and 50% of demonstration farms in Fernana surpassed average yield figures of the area in second cropping season. - Due to the shortage of delivered water amount, the result of yield on demonstration farms in Sedjnane was almost same as average. On the other hand, almost all of the demonstration farms in Nefza and Fernana surpassed the average figure in the third cropping season f. - The detail of the above mentioned results are shown in Annex 12~14. - From these data, indicator 2-1 on output 2 could be considered as achieved.

[5] Cited from Evaluation Report in June, 2013

	2-2. Rate of utilization of common hydrants is increased in pilot sites.	- Actions for organizing farmers per water bulb unit is suspended due to absolute shortage of water supply, as mentioned. It is not expected that this indicators will be achieved by the Project completion.	- Although activities on organizing farmers per hydrant had been planned under the premises that it would raise the ratio of hydrant use, this activity was not carried out because the problem on scarcity of water was not solved and it was difficult to promote further usage of common hydrants during the project period. However, according to the result of monitoring the number of irrigation farmers during the Project (See Table 2-27), it has been increased; hence, ratio of hydrant use are also expected to increase in proportion to the increase of irrigation farmers. - In addition, some CRDA revealed their intention to coordinate with SECADENORD and GDA to solve water issues before irrigation season in 2015. It can be expected that rate of hydrant use is further increased through group forming actions and introduction of rotation under the initiative of Tunisian side.
	2-3. Group activities of farmers concerning marketing are initiated in the 3 irrigated areas.	- As a part of planned activities (*to advice on improvement of market access*), social survey for establishing SMSA was conducted. In order to achieve this indicator for Output2, further activities are required. - Further necessary procedures (technical & economic F/S, sensitization of farmers, establishment/registration, etc.) are required for starting activities of SMSA which usually takes 1~2 years. Thus, this indicator will not be achieved by the Project completion.	- SMSA at Fernana was established through the assistance of CRDA Jendouba in December 2013. - At Sedjnane and Nefza, technical and economical feasibility study was conducted from April to June 2014 and, followed by sensitization programs to farmers. - Concerning Nefza, funds for establishment of SMSA were collected from farmers and official procedure followed. As a result, SMSA of Nefza was established in October 2014. - Concerning Sedjnane, collected funds for establishment of SMSA were not enough and consequently SMSA was not established during the project period. However, CRDA is following this issue to realize the establishment of SMSA in future. - In Nefza, CRDA assists for provision of SMSA office. In addition, farmers group are, with the support of Tunisian agencies, now taking actions of preparing for developing marketing strategies

			such as; target market to sell a lot of agricultural products, solution for maximizing the sales profit in consideration of the past trend of seasonal fluctuation, and so on. - From the above, the indicator 2-2 on output 2 could be considered as achieved.
Output 3: The farming extension support system by CRDA and GDA is strengthened.	3-1. Educational tools and materials are elaborated.	- Manuals (draft), handbooks (draft), and posters on irrigation and agronomy were prepared. Since they will be finalized with reflecting comments from concerned parties, this indicator is expected to be achieved by the Project completion.	- Drafts of technical manuals were finalized with comments from Tunisian side. - New technical manuals for farmers such as farming/cultivation and irrigation equipments were elaborated and distributed to CTV in 2014. Handbooks for board members of GDA to strengthen their capacity on management of GDA were elaborated and distributed to each GDA. The handbooks deal with issues on organization, finance and management of GDA. - From the above results, the indicator 3-1 on output 3 could be considered as achieved.
	3-2. All extension staff of CRDA and GDA in the 3 irrigated areas participate in the technical guidance and trainings conducted by the Project.	- Although trainings for only some staff of CTV and CRA were conducted in the first year, additional trainings covering all extension staff of CRDA, CTV, and GDA will be conducted in the first phase of the second assignment period. Thus, it is expected that this indicator will be achieved by the Project completion.	- Training was intensively conducted to extension agents including all concerned persons of CRDA and GDA at the three irrigated areas by the second cropping season, thus, the indicator 3-2 on output 3 could be considered as achieved
	3-3. The level of understanding of CRDA and GDA staff is improved at the end of seminar.	- It was heard from concerned parties that understanding of CRDA and GDA on irrigation agriculture and its dissemination had been improved through DPINT activities but had not reached sufficient level. Thus, this indicator has been partially achieved. - It will be verified at seminars to be held in Jul. 2013.	- It was confirmed that CRDA and CTV staff could deepen their understandings sufficiently on merits like techniques and profitability of water saving irrigation agriculture and important matters when it would be spread through discussion at the final seminar held in December 2014 and interviews to participants in it. - At the third cropping season, extension activities were implemented by extension staff themselves in Nefza and Sedjnane. Farmers outside of pilot sites and extension staff of other irrigated areas were invited to the activities held at demonstration farms. Thus, this exemplifies

<table>
<tr><td></td><td></td><td></td><td>that understanding for extension activities is improved by extension staff.
- From the above result, the output was achieved.</td></tr>
<tr><td rowspan="2">Output 4:
The results of activities of the Project are shared among the persons/organizations related in 4 irrigated areas (Nefza, Sejnane, Fernana and Hammam Bourguiba).</td><td>4-1. Seminars concerning results of the project activities are carried out with more than 100 participants.</td><td>- Technical seminars and JCC were held in 2012 (participants of Tunisian side are 33 in total) to share progress of the Project activities. Seminars and JCC (also inviting concerned parties of Hammam Bourguiba) will be held in coming Jul. and Sep. 2013 to confirm the results of Project activities. Thus, it is expected that this indicators will be achieved with a certain level.</td><td>- The total number of participants for seminars and JCCs to share the results of the project outcome was more than 100.
<table>
<tr><th>Seminar/ JCC</th><th>Date</th><th>No. of participated C/P</th></tr>
<tr><td>Seminar</td><td>18. Oct 2012</td><td>11</td></tr>
<tr><td>JCC</td><td>05. Dec 2012</td><td>33</td></tr>
<tr><td>Seminar</td><td>24. Sep 2013</td><td>15</td></tr>
<tr><td>JCC</td><td>04. Nov 2013</td><td>15</td></tr>
<tr><td>Seminar</td><td>12. Nov 2013</td><td>10</td></tr>
<tr><td>JCC</td><td>28. Feb 2014</td><td>12</td></tr>
<tr><td>Seminar</td><td>11. Dec 2014</td><td>17</td></tr>
<tr><td>JCC</td><td>16. Feb 2015</td><td>18</td></tr>
<tr><td>Total</td><td></td><td>131</td></tr>
</table>
- From the above result, indicator 4-1 on output 4 could be said as achieved.</td></tr>
<tr><td>4-2. More than two thirds (2/3) of participants in the seminars recognize its effectiveness.</td><td>- It will be verified at coming seminars and JCC. However, judging from that many of the C/Ps interviewed recognized the effects of the DPINT activities although the latter were not sufficient, it is expected that this indicator will be achieved with a certain level.</td><td>- At the seminars and JCC held during the project period, C/Ps gave out lots of questions and opinions on project progress and achievements. Through this interactive process, the achievements of the Project were recognized by most participants.
- Among all the achievements, the followings were specially remarked:
1) Achievement on dissemination of irrigation agriculture technology to farmers at Demonstration farms,
2) Extension of methodology of irrigation agriculture through Field Days for farmers in the pilot sites,
3) Improvement of market access through establishment of SMSA, and
4) Improvement of water billing system
- Tunisian side declared that it is necessary that</td></tr>
</table>

			DGGREE, CRDA, CTV, and GDA need to continue cooperation and take over the project activities to maximize project outputs at the final seminar in December 2014. - From the above results, indicator 4-2 on output 4 could be said as achieved.

Regarding the activities in the PDM, DPINT project team's activities to achieve Outputs 1 to 4 are as described in the previous Tables (4.1.1~4.1.4), and it is considered that necessary activities are completed.

The current situation of each output is explained in Table 4.2. The following is complementary descriptions.

- Regarding Output 1:

Output 1 was achieved because the Baseline Report including analyses and action plan had been made.

- Regarding Output 2:

Vegetable cultivation with drip irrigation and summer pasture cultivation with sprinkler irrigation in the final year yielded sufficient outcomes because a larger amount of products and higher profitability than the area average were confirmed at most demonstration farms in the three irrigated areas, although three years may be too short to reach a conclusion in terms of model establishment.

As to the usage rate of hydrants, it was inferred that the rate rose since the number of irrigation farmers increased year by year, although it was difficult to directly confirm the increase.

Regarding the establishment of SMSA that is aiming at cooperative transport to improve market access, procedures of establishment and registration were completed in Nefza and group activities relevant to marketing have also begun.

From the above points, Output 2 was likely to be completed.

- Regarding Output 3

Regarding extension, necessary instructions and trainings including provision of textbooks were given to staffs of CRDA, CTV, and GDA, and new techniques and knowledge are being transferred. The fact that extension workers themselves planned and implemented trainings reveals the improvement of their understanding about the extension of irrigation farming. It is considered that Output 3 was almost achieved since CRDA and GDA's extension system was reinforced.

- Regarding Output 4

The outputs of project activities were shared in seminars and JCCs whose purpose was to share them with those concerned in the four irrigation areas every year, who also had to share these with many relevant parties concerned. Therefore, Output 4 is considered to be almost completed. Although Hammam Bourguiba, where the GDA has not been established, could not participate in seminars, the achievements of the Project were shared through Jendouba CRDA.

4.3 Achievement of the objectives of the project

The following table shows probability of achievement of project objectives based on PDM. As the table above shows, probability of achievement of the project objectives is thought to be high.

Project Objective in PDM	Index	Current Situation
Irrigation agriculture model shall be independently implemented in pilot sites of Nefza, Sedjnane, and Fernana areas, and extension structure applicable to the target irrigation areas shall be established.	1. The proportion of irrigated cultivation areas increases to 45% in Nefza, 55% in Sedjnane, and 35% in Fernana, by the time of the completion of the Project.	- Transition of ratio of irrigated areas of pilot sites (P/S) during the project period shows that irrigated areas either increased every year or maintained, on the condition that the irregular external factors hampering irrigation agriculture are not taken into considerations. The latest average irrigation ratio in each irrigated area is 42% in Nefza (2014), 52% in Sedjnane (2013), and 33% in Fernana (2014). - According to interviews on farmers' willingness toward irrigation farming in the next season, expected ratio of irrigation was proved to be 63% in a P/S in Nefza. In a P/S in Fernana, the ratio was 25% excluding out-season potatoes cultivation which is not counted at this point of time (February 2015). Given that the contribution of out-season potatoes on irrigation ratio is same as those monitored in the previous two years (over 20%), the ratio shall be raised to 45%. - In a P/S in Sedjnane, only 44% of areas are planned to conduct irrigation farming due to anxiety for serious delay of water supply as happened in spring 2014 which had made farmers to give up cropping. - With the above facts, the irrigation ratio of each pilot site is expected to reach the numerical target unless the water scarcity problem occurs as observed in Sedjnane area in 2014.
	2. The yield of major products per ha increases in pilot sites.	- Comparing of result of 2013 and 2014 on average yield of major four crops (tomato, melon, watermelon, and pepper) at pilot site, it shows the increase in 2014.In Sedjnane area, the yield of two crops has increased, despite the fact of water scarcity in the area and consequently the improvement is not so outstanding. - As a result of extension activities (Field Days) the irrigation farming model introduced by the Project were considerably recognized by farmers in the P/Ss and transfer of techniques and knowledge within P/S are in progress.

		- With the above facts, it is highly expected that the yield of the major crops will keep raising unless external hampering factors are not found.

5. Suggestion for Achievement of Overall Goal

It was concluded that probability of achievement of the objectives of the Project is high as discussed in the previous chapter. The Project needs completely taking over by Tunisian counterparts while stable irrigation agriculture should be maintained in the target areas to achieve the overall goal.

The overall goal and indexes described in Project PDM are as follows.

Overall Goal:

The suitable irrigation is performed and the efficient agriculture in 4 irrigated areas (Nefza, Sedjnane, Fernana and Hammam Bourguib) is achieved with desirable irrigation farming.

Objectively Verifiable Indicators:

(a) The rate of irrigation practicing areas is increased to 50%.

(b) Yield per ha of agricultural field practicing the irrigation agriculture is increased.

Experts of the Project shall suggest several points below for achievement of the overall goal of the Project.

(1) Irrigation Water Supply

During the farming season in 2014, the delay of irrigation water supply in Sedjnane irrigation area and a part of Fernana irrigation area (Ain El Baya) brought out the decline of the irrigated farming areas and represented a considerable constraint to the increase of irrigated farming rate.Besides, as mentioned above, the activity 2-3 was not completed not only because of the constraint of delay of irrigation water supply in Sedjnane irrigation area, but also because of the shortness of SECADENORD pumping hours in both Sedjnane and Fernana areas.

The Tunisian counterparts are requested to take necessary actions with SECADENORD and GDA so that farmers in respective irrigation area recognize the irrigation services as credible.

(2) Improvement of poor drainage area

It was proved that among three irrigated areas, targeted by the Project, some farmers could not conduct irrigated farming due to water drainage constraints.

The Tunisian counterparts are requested to improve unsuitable drainage conditions by planning

and allocating the necessary budget, based on the results of the drainage improvement study conducted by the Project.

(3) Collection of information for irrigation plan

To promote planned irrigation scheme, it is important to grasp actual condition of beneficial farmers. Therefore, it is suggested to Tunisian counterpart that a series of monitoring, including farming plan in next cropping season by farmers, is conducted continuously and acquired information is reflected to elaborate plan of operation every year.

(4) Distribution Network and Hydraulic System

Due to the problems of water distribution networks, hydraulic systems, and/or unsuitable locations of irrigation hydrants, some farmers are still not able to use the irrigation hydrants effectively, also a constraint to irrigated farming.

The Tunisian counterparts are requested to take necessary actions for effective use of irrigation facilities inclusive of hydrants, based on the results of the hydraulic study of irrigation networks and the irrigation hydrants study conducted by the Project.

(5) Promotion of Water Saving Irrigation

Some farmers are still relying on surface irrigation method; which causes the decrease of water pressure at the level of hydrants in water distribution network. In fact, a part of hydrants have condition of irrigation of being difficult due to the decrease of water pressure. Therefore, the Tunisian counterparts need further efforts to promote water saving irrigation methods by using drip and sprinkler irrigation equipment. Two measures are thought to be essential;

(a) Installation of credible flow meters as a basis of introducing water billing system based on water quantity

(b) Financial support (loan and subsidy) by Tunisian authority for the farmers in the targeted area to invest the initial cost for procuring on-plot irrigation equipments

With regard to A), the water billing system developed by the project contributes to makes farmers satisfy and utilize irrigation facilities. Therefore, it is worth of introducing to three irrigated areas. However, the Tunisian counterparts need to make efforts on scheduling plan of operation and

allocating budget to install proper measurable flow meters including necessary accessories as prerequisite.

(6) Establishment of SMSA

SMSA as farmer's cooperative was established in Nefza irrigation area with the assistance of the Project so that the farmers are expected to increase their income and invest to water-saving irrigation methods. It is necessary that the Tunisian counterparts continue to monitor and follow up the established SMSA in order to ensure a sustainable operation. Furthermore, the Tunisian counterparts are requested to assist farmers in Sedjnane continuously so that they can establish SMSA and start activities.

It is expected that Tunisian counterparts formulate projects and budget with priorities based on what was mentioned above, and actually implement these projects. The overall goal is likely to be realized by implementing the necessary projects.

6. Lessons Learned

(1) The necessity of arranging a system in advance to supply water reliably (external conditions)

This technical assistance project was intended to better farmers' standard of living, improve their means to earn a living, and boost agricultural productivity by promoting irrigated agriculture through effective utilization of water. In this case, the external conditions required to achieve the project's objectives and outcomes are considered to be that the needed irrigation water be supplied as planned to the target irrigation area. However, in this case, problems including defects in the irrigation system, equipment failure, and water restrictions due to inconsistent collection of water fees were encountered. Thus, the project was implemented in an environment where, in some areas, the external condition of a reliable water supply was not firmly established.

In regard to the water supply problems, the consultant in this project attempted to coordinate between the GDA, which is the farmer's organization, the CRDA, which is the governmental agency, and SECADENORD, which is the public corporation controlling water supply. Despite such efforts a resolution was not fully reached, and it would be a stretch to say that water supply solutions were wholly sufficient.

The consultant considers that, in such cases, the appropriate approach would be to engage in introducing full-scale irrigated agriculture projects only after first having a stable water supply fully ensured by the Tunisian component, or by establishing a system that makes it possible to collect water fees by prioritizing efforts toward strengthening the operation of groups such as Water User Associations.

(2) Deployment policy for pilot activities that address the issue of restoring trust between farmers and government

Amid a post-democratic revolution environment, where the general public is able to express dissatisfaction and make demands of government and politics publicly, the relationship between farmers and government in the target area was volatile in comparison with pre-revolution times. Under such conditions, it was important for specialists from Japan to act while striking a careful balance between the government and farmers. They were placed in a position of undertaking activities in a rather dilemmatic position: If balance was not maintained there was the potential of backlash from farmers, and if the government was not included, technology transfer would not be made possible.

Clearly discernible results were sought under these conditions, but selecting the pilot site to be

the target for promoting irrigated agriculture in this project was complicated due to the vast amount of equipment needed to be set up at the demonstration farm in response to requests by the beneficiary target area.

Despite the circumstances, the Japanese specialists progressively gained the trust of farmers by continuing to show, in a clearly discernible manner, how their presence was of great benefit to them, while also helping to bridge the gap between farmers and the government by relieving farmers' distrust of the government through a gradual increase of the counterpart's participation in the field.

It is necessary under such circumstances of mistrust between the farmers and government, to give priority to first earning the trust and understanding of farmers at project sites. Further, while remaining conscious of local needs that are based upon a trusting relationship, it is also considered necessary to have a strategy to narrow down target areas to those that appear easier to build trust in, start the pilot project on a small scale, and continue to show results to stakeholders on the Tunisia side while gradually increasing the involvement of counterparts.

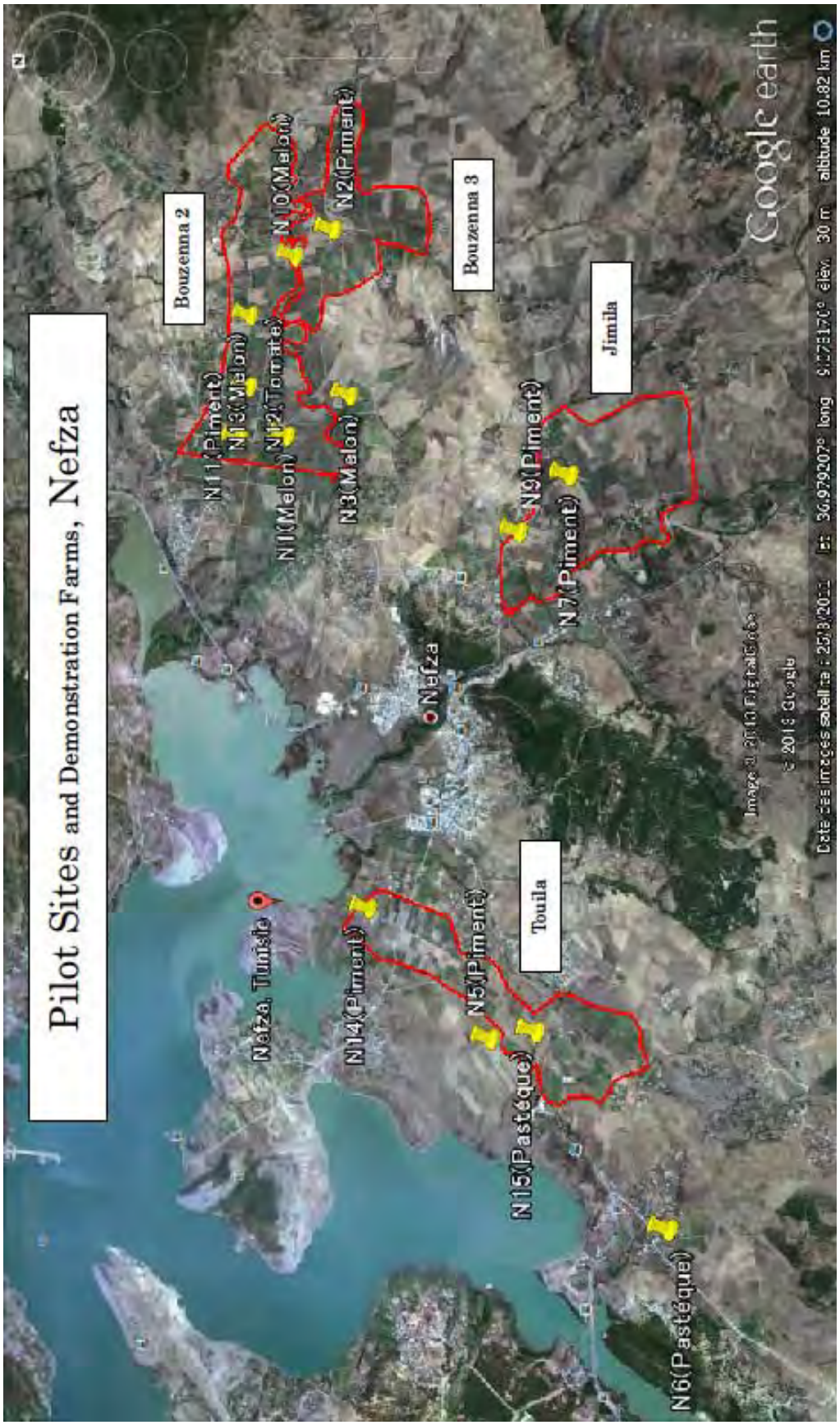
(3) The effectiveness of using local consultants in an unstable security situation

In the period from January 2011, when the state of emergency was declared after civil revolt, to March 2014, when the order was lifted, all of Tunisia was gripped by a state of security instability both politically and socially. Most of the activity of this project took place during the declared state of emergency, putting restrictions on the Japanese specialists' activity in terms of movement and lodging for safety and security reasons. For this reason, a system was formulated to allow consistent information flow between the three project sites, relevant parties at the CRDA, and the office in Tunisia by having the local consultant make the visits locally during times when the Japanese specialists were unable to travel freely. This system permitted stable execution of the project even during times of an instable security situation, and greatly contributed to the project reaching its objectives and outcomes.

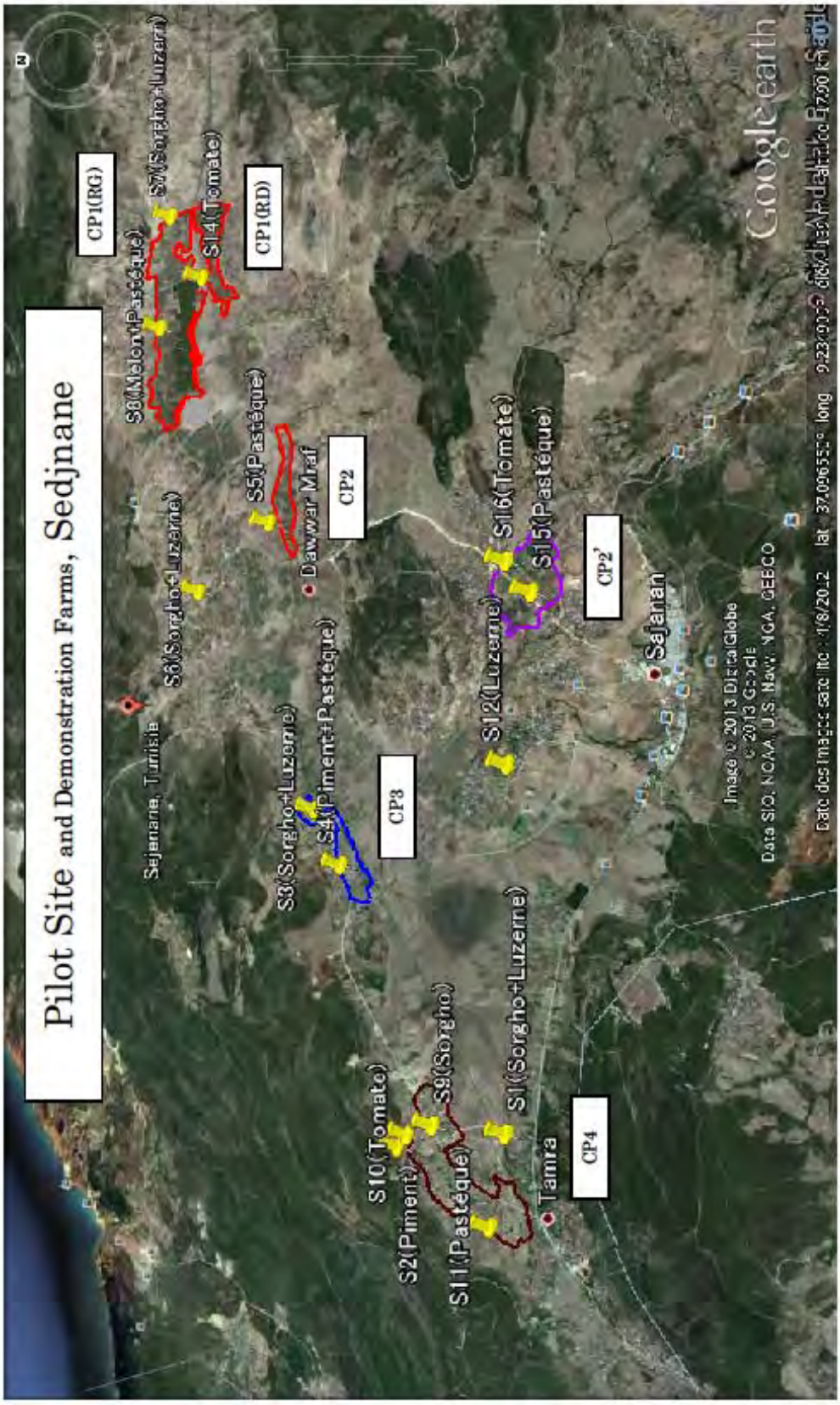
It is believed that this method of improving project outcomes, even in times of civil unrest, by utilizing local personnel can serve as reference for operating projects in the Middle East where security problems have persisted since the Arab Spring.

Appendix

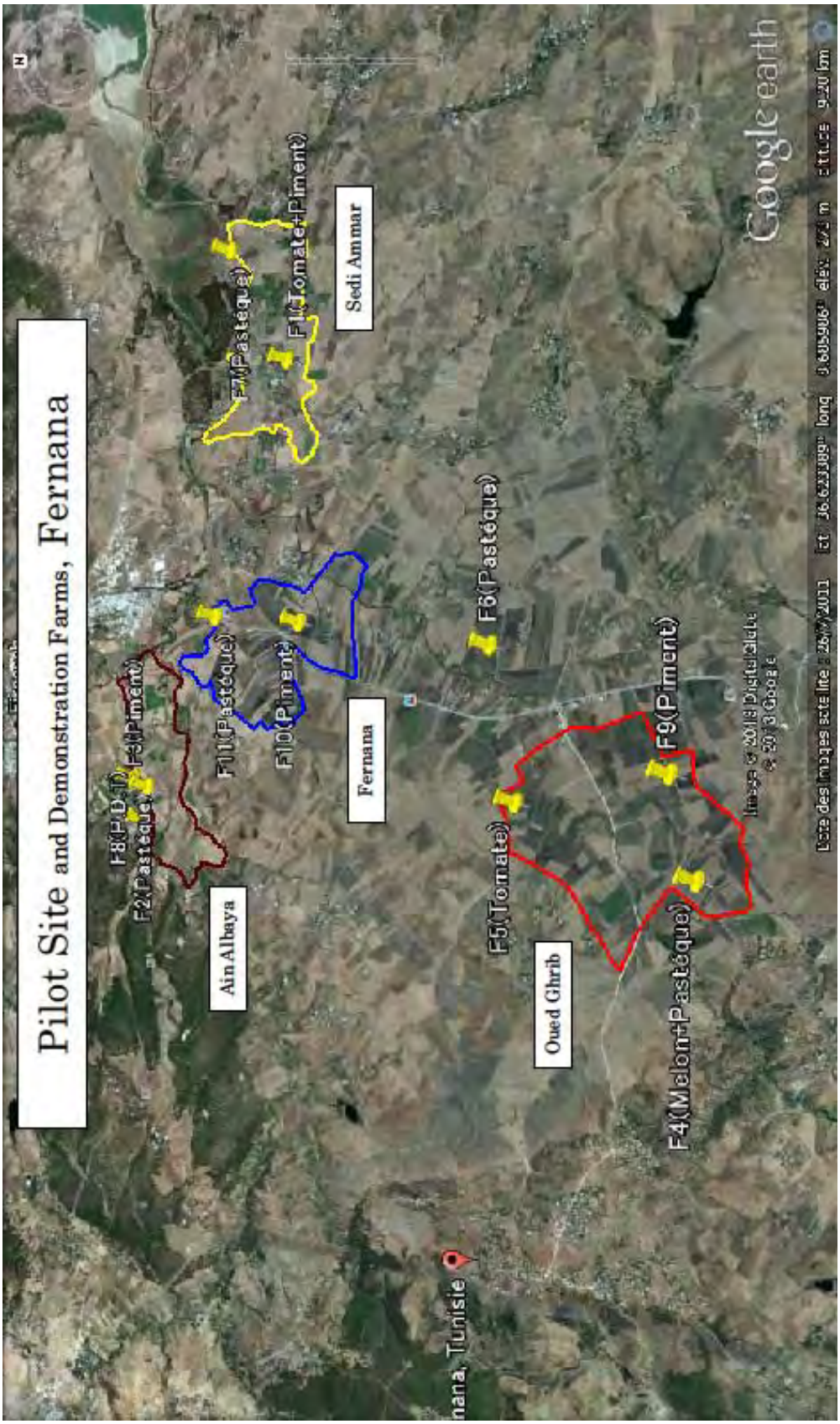
Appendix 1 Location Map of Pilot Sites and Demonstration Farms (Nefza)



Appendix 2 Location Map of Pilot Sites and Demonstration Farms (Sedjnane)



Appendix 3 Location Map of Pilot Sites and Demonstration Farms (Fernana)



Appendix 4 Results of monitoring on yield (ton/ha) and sales (DT/ha) of demonstration farms (2012)

Irrigated Perimeter	Plot No.	Farmers'name	Name of Crop	Area (ha)	Cropping Period	Yield (ton/plot)	Yield (ton/ha)	Average selling	Total sales	
									(DT/plot)	(DT/ha)
Nefza	N 1	Hsan Zammali	Pepper	1.00	July -Nov.	23.8	23.8	488.9	11,650	11,650
	N 2	Mouldi Mastouri	Melon	0.93	July-0ct.	37.4	40.2	357.0	13,354	14,359
	N 3	Hamadi Zammali	Pepper	1.04	Aug-Nov.	44.0	44.0	585.6	25,764	24,773
	N 4	Nouredine Khouildi	Pepper	0.50	Aug-Nov.	7.7	15.4	619.3	4,759	9,518
	N 5	Tawfik Zammali	Pepper	0.89	Aug-Nov.	8.2	9.2	888.4	7,285	8,185
	N 6	Farhat Atouani	Melon	0.43	Aug-Sept.	13.7	31.8	346.2	4,733	11,007
	N 7	Mohsen Brahmi	Melon	0.90	Aug-Oct.	17.4	19.3	289.8	5,042	5,602
Sedjnane	S 1	Hakim Sahbani	Alfalfa	0.30	July-0ct.	25.3	84.4	40.0	1,013	3,377
			Sorghom	0.30	July-0ct.	25.8	85.9	30.0	773	2,577
	S 2	Abdalla Sahbani	Watermelon	0.73	Aug-Sept.	44.7	61.2	112.7	5,038	6,901
	S 3	Tawfik Mechrgui	Sorghom	0.76	July-Sept.	44.2	58.1	30.0	1,325	1,743
	S 4	Jalel Sahbani	Watermelon	0.50	Aug-Sept.	18.5	37.0	133.5	2,470	4,940
			Tomato	0.57	Aug-Sept.	39.3	68.9	186.5	7,324	12,850
	S 5	Mounir Ayari	Tomato	0.70	Agust	51.3	73.3	100.8	5,174	7,392
	S 6	Boujomaa Saidani	Alfalfa	0.30	July-Aug.	19.7	65.7	40.0	788	2,628
			Sorghom	0.35	July-Aug.	20.5	58.6	30.0	615	1,758
	S 7	Amor Mechrgui	Sorghom	0.93	Aug- Sept.	69.3	74.5	30.0	2,079	2,235
	S 8	Massoud Saidani	Tomato	0.64	Aug-Oct.	38.1	59.5	195.6	7,451	11,642
			Pepper	0.21	Aug- Nov.	5.1	24.2	543.2	2,756	13,125
Fernana	F 1	Slah Aridhi	Melon	2.00	Aug- Sept.	31.9	16.0	321.7	10,269	5,134
	F 2	Mounir Ochi	Watermelon	0.93	July	24.3	26.1	231.9	5,623	6,046
	F 3	Mourad Boussaidi	Watermelon	0.77	July-0ct.	8.3	10.8	200.0	1,656	2,151
	F 4	Ahmed Ghazouani	Tomato	0.84	Aug- Sept.	67.7	80.6	166.1	11,248	13,390
			Pepper	0.99	Aug- Nov.	41.4	41.8	593.7	24,577	24,825

Appendix 5 Results of monitoring on yield (ton/ha) and sales (DT/ha) of demonstration farms (2013)

Irrigated Perimeter	Plot No.	Farmers'name	Name of Crop	Area (ha)	Cropping Period	Yield (ton/plot)	Yield (ton/ha)	Average selling price (DT/ton)	Total sales (DT/plot)	Total sales (DT/ha)
Nefza	N 1	Hsan Zammali	Melon	1.00	Aug-Oct.	34.2	34.2	395.3	13,520	13,520
	N 2	Mouldi Mastouri	Pepper	0.93	July-0ct.	26.8	28.8	487.9	13,056	14,039
	N 3	Hamadi Zammali	Melon	1.00	Aug-Sept.	38.9	38.9	435.1	16,905	16,905
	N 4	Nouredine Khouildi	Pepper	0.53	Aug-Oct.	19.1	36.0	366.5	7,002	13,212
	N 5	Tawfik Zammali	Pepper	0.66	July-0ct.	16.1	24.4	465.3	7,496	11,357
	N 6	Farhat Atouani	Watermelon	0.89	July	13.0	14.6	361.5	4,700	5,281
	N 7	Mohsen Brahmi	Pepper	0.90	Aug-Oct.	31.5	35.0	378.4	11,913	13,236
	N 9	Meriem Ayadi	Pepper	1.00	July-0ct.	21.5	21.5	491.9	10,586	10,586
	N 10	Nizar Mastouri	Melon	1.00	Aug-Sept.	35.5	35.5	405.1	14,380	14,380
	N 11	Bilel Rguii	Pepper	1.01	July-0ct.	22.0	22.0	423.1	9,309	9,309
	N 12	Mohsen Garrouri	Tomato	1.00	Aug-Sept.	48.6	48.6	204.7	9,944	9,944
	N 13	Ridha Garrouri	Melon	1.00	Aug-Sept.	29.5	29.5	520.0	15,319	15,319
	N 14	Mustapha Hmissi	Pepper	0.59	July-0ct.	12.3	20.8	486.1	5,967	10,113
	N 15	Jalila Atouani	Watermelon	1.13	August	21.2	18.7	448.6	9,488	8,396
Sedjnane	S 1	Hakim Sahbani	Alfalfa	0.30	July-0ct.	27.7	92.2	35.0	968	3,226
			Sorghom	0.30	July-0ct.	24.2	80.6	50.0	1,209	4,029
	S 2	Abdalla Sahbani	Pepper	0.73	Aug-Oct.	30.8	42.2	377.8	11,637	15,941
	S 3	Tawfik Mechrgui	Alfalfa	0.25	July-Sept.	13.0	52.1	70.0	912	3,647
			Sorghom	0.55	July-Sept.	31.3	56.9	50.0	1,565	2,845
	S 4	Jalel Sahbani	Watermelon	0.57	July	22.1	38.7	310.1	6,840	12,000
			Pepper	0.50	Aug- Nov.	19.0	38.0	381.4	7,238	14,476
	S 5	Mounir Ayari	Watermelon	0.70	July	24.2	34.6	309.7	7,500	10,714
	S 6	Boujomaa Saidani	Sorghom	0.55	July-Sept.	48.2	87.6	50.0	2,408	4,378
	S 7	Amor Mechrgui	Alfalfa	0.25	July-Sept.	8.3	33.0	70.0	578	2,310
			Sorghom	0.75	July-Sept.	44.3	59.1	50.0	2,216	2,955
	S 8	Massoud Saidani	Melon	0.42	Aug- Sept.	13.7	32.7	419.1	5,753	13,697
			Watermelon	0.43	Aug- Sept.	17.8	41.4	350.7	6,250	14,535
	S 9	Youssef Sahbani	Sorghom	0.53	July-0ct.	41.0	77.4	50.0	6,250	11,792
	S 10	Naceur Sahbani	Tomato	1.00	Aug-Oct.	36.3	36.3	166.6	6,053	6,053
	S 11	Abdelkarim Sahbani	Watermelon	1.00	July- August	16.4	16.4	332.2	5,432	5,432
	S 12	Mehrz Maalaoui	Alfalfa	0.55	July-0ct.	26.6	48.4	70.0	5,432	9,876
	S 14	Mongi Abassi	Tomato	1.00	Aug-Oct.	47.9	47.9	185.8	8,899	8,899
	S 15	Abdeaziz Maalaoui	Watermelon	1.00	July- August	27.0	27.0	387.4	10,459	10,459
	S 16	Sadok Maalaoui	Tomato	0.47	Aug-Oct.	24.9	53.0	217.3	5,410	11,511
Fernana	F 1	Slah Aridhi	Pepper	1.00	July- Nov.	42.2	42.2	487.4	20,568	20,568
			Tomato	1.00	July-0ct.	54.9	54.9	280.8	15,418	15,418
	F 2	Mounir Ochi	Watermelon	0.93	July	21.7	23.3	300.0	6,500	6,989
	F 3	Mourad Boussaidi	Pepper	0.77	July-0ct.	6.3	8.1	430.5	2,699	3,505
	F 4	Ahmed Ghazouani	Melon	0.43	July-Sept.	7.4	17.2	432.4	3,200	7,442
			Watermelon	1.40	July- August	59.5	42.5	329.3	19,595	13,996
	F 5	Hmida Ghazouani	Tomato	0.92	August	34.3	37.3	349.7	12,000	13,043
	F 6	Ouael Ghazouani	Watermelon	0.65	July	17.0	26.2	299.5	5,100	7,846
	F 7	Abdelbasset Jawadi	Watermelon	1.14	July	38.1	33.6	301.6	11,500	10,088
	F 8	Kais Boussaidi	Potato	1.03	August	8.5	8.3	489.7	4,163	4,041
	F 9	Hamadi Ghazouanli	Pepper	0.92	July-0ct.	21.6	23.5	470.8	10,192	11,078
	F 10	Belgacem Khemiri	Pepper	0.81	July-0ct.	29.3	36.2	550.8	16,141	19,927
	F 11	Abdelkarim Mejri	Watermelon	0.82	July	26.6	32.5	300.5	8,000	9,756

Appendix 6 Yield and benefit at demonstration farms (2012)

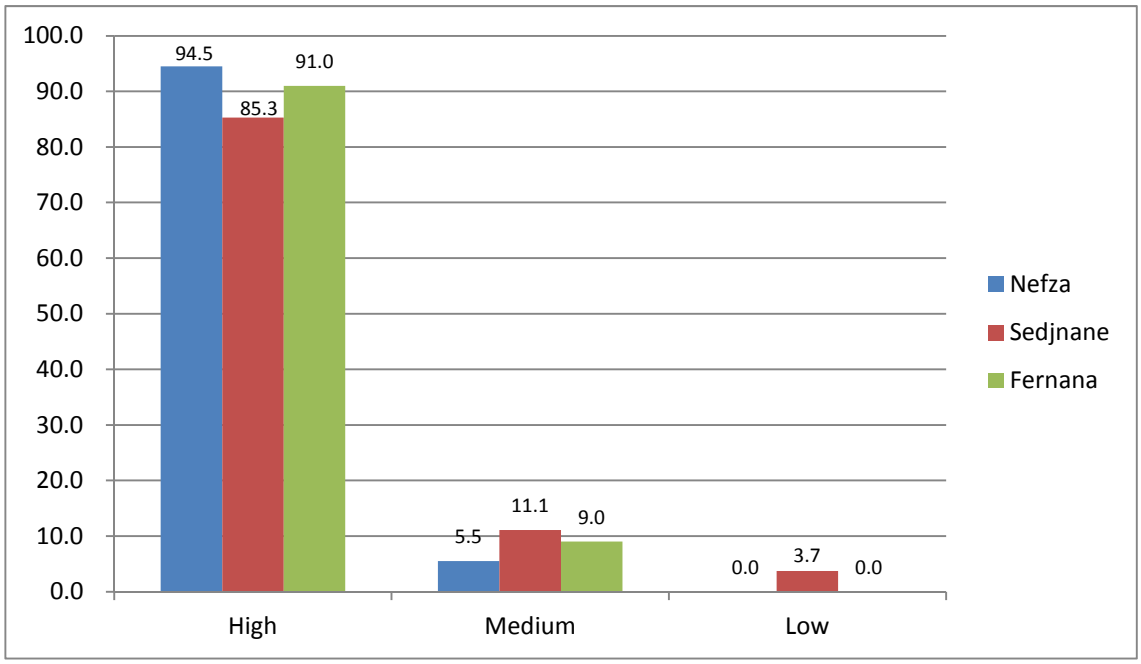
Irrigated Perimeter	Plot numbers	Farmers'name	Vegetable Plants	Area (ha)	Harvesting Period	Yield (ton/ha)	Sales (TD/ha)	Input (TD/ha)	Machines (TD/ha)	Labor (TD/ha)	Water charges (TD/ha)	Total cost (TD/ha)	Benefit (TD/ha)
Nefza	N 1	Hsan Zammali	Pepper	1.00	July -Nov.	23.8	11,650	4,690	835	1,230	304	7,059	4,591
	N 2	Mouldi Mastouri	Melon	0.93	July-0ct.	40.2	14,359	4,780	720	731	223	6,454	7,905
	N 3	Hamadi Zammali	Pepper	1.04	Aug-Nov.	44.0	24,773	4,726	1,077	2,141	284	8,228	16,545
	N 4	Nouredine Khouildi	Pepper	0.50	Aug-Nov.	15.4	9,518	5,180	220	896	346	6,642	2,876
	N 5	Tawfik Zammali	Pepper	0.89	Aug-Nov.	9.2	8,185	5,137	326	1,507	285	7,255	930
	N 6	Farhat Atouani	Melon	0.43	Aug-Sept.	31.8	11,007	6,140	570	651	223	7,584	3,423
	N 7	Mohsen Brahmi	Melon	0.90	Aug-Oct.	19.3	5,602	5,044	528	711	268	6,551	-949
Sedjnane	S 1	Hakim Sahbani	Alfalfa	0.30	July-0ct.	84.4	3,377	1,003	183	517	353	2,057	1,320
			Sorghom	0.30	July-0ct.	85.9	2,577	1,003	203	350	333	1,890	687
	S 2	Abdalla Sahbani	Watermelon	0.73	Aug-Sept.	61.2	6,901	4,711	329	489	344	5,873	1,028
	S 3	Tawfik Mechrgui	Sorghom	0.76	July-Sept.	58.1	1,743	684	184	237	384	1,489	254
	S 4	Jalel Sahbani	Watermelon	0.50	Aug-Sept.	37.0	4,940	3,344	140	488	530	4,502	438
			Tomato	0.57	Aug-Sept.	68.9	12,850	3,096	351	1,323	609	5,379	7,471
	S 5	Mounir Ayari	Tomato	0.70	Agust	73.3	7,392	3,201	286	611	699	4,797	2,595
	S 6	Boujomaa Saidani	Alfalfa	0.30	July-Aug.	65.7	2,628	1,003	227	317	383	1,930	698
			Sorghom	0.35	July-Aug.	58.6	1,758	951	257	171	331	1,711	47
	S 7	Amor Mechrgui	Sorghom	0.93	Aug- Sept.	74.5	2,235	572	280	204	280	1,335	900
	S 8	Massoud Saidani	Tomato	0.64	Aug-Oct.	59.5	11,642	3,038	617	1,328	720	5,703	5,939
			Pepper	0.21	Aug- Nov.	24.2	13,125	5,681	143	1,190	548	7,562	5,563
Fernana	F 1	Slah Aridhi	Melon	2.00	Aug- Sept.	16.0	5,134	3,950	155	350	213	4,668	466
	F 2	Mounir Ochi	Watermelon	0.93	July	26.1	6,046	4,095	280	527	352	5,253	793
	F 3	Mourad Boussaidi	Watermelon	0.77	July-0ct.	10.8	2,151	4,945	338	545	313	6,142	-3,991
	F 4	Ahmed Ghazouani	Tomato	0.84	Aug- Sept.	80.6	13,390	4,344	214	1,764	506	6,829	6,561
			Pepper	0.99	Aug- Nov.	41.8	24,825	5,494	788	2,418	387	9,087	15,738

Appendix 7 Yield and benefit at demonstration farms (2013)

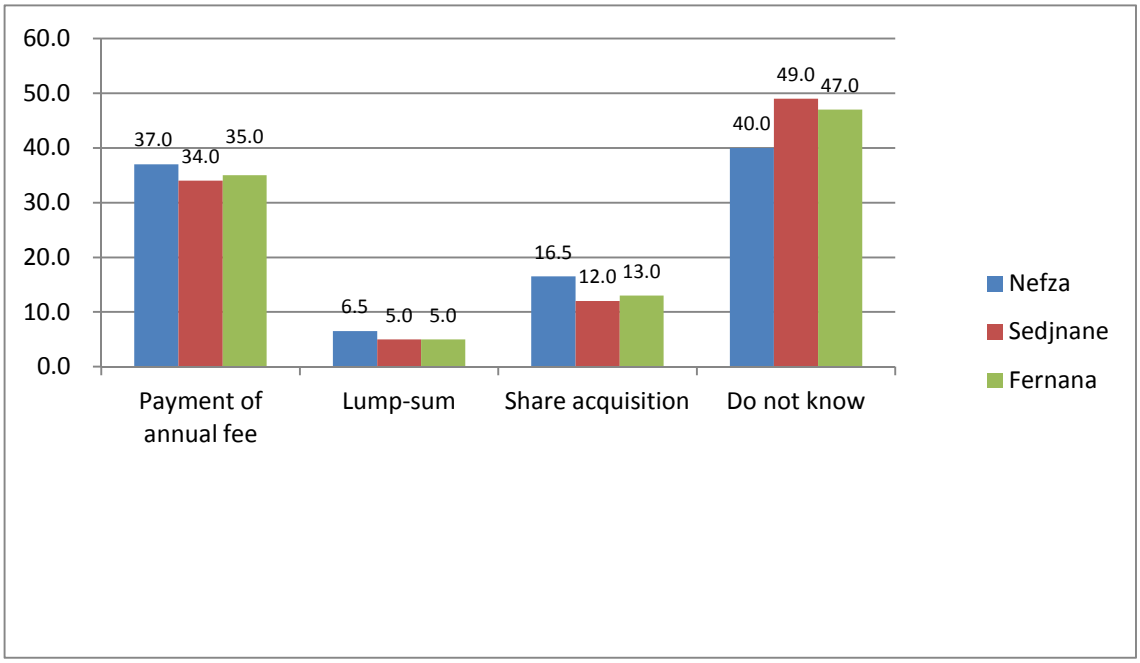
Irrigated Perimeter	Plot numbers	Farmers'name	Vegetable Plants	Area (ha)	Harvesting Period	Yield (ton/ha)	Sales (TD/ha)	Irrigation equipment (TD/ha)*	Input (TD/ha)	Machines (TD/ha)	Labor (TD/ha)	Water charges (TD/ha)	Total cost (TD/ha)	Benefit (TD/ha)
Nefza	N 1	Hsan Zammali	Melon	1.00	Aug-Oct.	34.2	13,520	996	4,514	200	612	272	6,593	6,927
	N 2	Mouldi Mastouri	Pepper	0.93	July-Oct.	28.8	14,039	996	5,467	194	1,606	306	8,569	5,470
	N 3	Hamadi Zammali	Melon	1.00	Aug-Sept.	38.9	16,905	996	4,574	210	648	272	6,699	10,206
	N 4	Nouredine Khouildi	Pepper	0.53	Aug-Oct.	36.0	13,212	996	5,605	226	2,292	306	9,426	3,786
	N 5	Tawfik Zammali	Pepper	0.66	July-Oct.	24.4	11,357	996	5,426	126	1,105	306	7,958	3,399
	N 6	Farhat Atouani	Watermelon	0.89	July	14.6	5,281	996	4,360	180	384	272	6,192	-911
	N 7	Mohsen Brahmi	Pepper	0.90	Aug-Oct.	35.0	13,236	996	5,473	200	1,950	306	8,925	4,312
	N 9	Meriem Ayadi	Pepper	1.00	July-Oct.	21.5	10,586	996	5,360	192	1,260	306	8,114	2,472
	N 10	Nizar Mastouri	Melon	1.00	Aug-Sept.	35.5	14,380	996	4,584	180	504	272	6,535	7,845
	N 11	Bilel Rguii	Pepper	1.01	July-Oct.	22.0	9,309	996	5,307	188	1,515	306	8,311	998
	N 12	Mohsen Garrouri	Tomato	1.00	Aug-Sept.	48.6	9,944	996	3,695	205	1,683	340	6,919	3,025
	N 13	Ridha Garrouri	Melon	1.00	Aug-Sept.	29.5	15,319	996	4,514	210	594	272	6,585	8,734
	N 14	Mustapha Hmissi	Pepper	0.59	July-Oct.	20.8	10,113	996	5,361	186	1,495	306	8,345	1,768
	N 15	Jalila Atouani	Watermelon	1.13	August	18.7	8,396	996	4,463	177	558	272	6,465	1,931
Sedjnane	S 1	Hakim Sahbani	Alfalfa	0.30	July-Oct.	92.2	3,226	778	506	282	293	133	1,992	1,234
			Sorghom	0.30	July-Oct.	80.6	4,029	778	679	282	293	340	2,372	1,657
	S 2	Abdalla Sahbani	Pepper	0.73	Aug-Oct.	42.2	15,941	996	5,465	202	1,633	457	8,753	7,188
	S 3	Tawfik Mechrgui	Alfalfa	0.25	July-Sept.	52.1	3,647	778	846	338	488	448	2,898	749
			Sorghom	0.55	July-Sept.	56.9	2,845	778	452	154	189	291	1,864	981
	S 4	Jalel Sahbani	Watermelon	0.57	July	38.7	12,000	996	4,652	186	147	350	6,332	5,668
			Pepper	0.50	Aug- Nov.	38.0	14,476	996	5,727	156	1,470	400	8,749	5,727
	S 5	Mounir Ayari	Watermelon	0.70	July	34.6	10,714	996	3,940	250	186	268	5,640	5,074
	S 6	Boujomaa Saidani	Sorghom	0.55	July-Sept.	87.6	4,378	778	604	154	189	211	1,936	2,442
	S 7	Amor Mechrgui	Alfalfa	0.25	July-Sept.	33.0	2,310	778	882	222	160	236	2,278	32
			Sorghom	0.75	July-Sept.	59.1	2,955	778	385	113	96	254	1,626	1,329
	S 8	Massoud Saidani	Melon	0.42	Aug- Sept.	32.7	13,697	996	6,576	171	833	363	8,939	4,758
			Watermelon	0.43	Aug- Sept.	41.4	14,535	996	5,503	167	823	349	7,839	6,696
	S 9	Youssef Sahbani	Sorghom	0.53	July-Oct.	77.4	11,792	778	412	159	272	331	1,952	9,840
	S 10	Naceur Sahbani	Tomato	1.00	Aug-Oct.	36.3	6,053	996	3,470	144	1,105	503	6,218	-165
	S 11	Abdelkarim Sahbani	Watermelon	1.00	July- Augus	16.4	5,432	996	4,415	120	262	257	6,050	-618
	S 12	Mehrz Maalaoui	Alfalfa	0.55	July-Oct.	48.4	9,876	778	745	154	204	261	2,142	7,734
	S 14	Mongi Abassi	Tomato	1.00	Aug-Oct.	47.9	8,899	996	2,435	225	1,232	378	5,265	3,634
	S 15	Abdeaziz	Watermelon	1.00	July- Augus	27.0	10,459	996	4,782	143	513	278	6,711	3,748
	S 16	Sadok Maalaoui	Tomato	0.47	Aug-Oct.	53.0	11,511	996	3,977	153	2,106	725	7,958	3,553
Fernana	F 1	Slah Aridhi	Pepper	1.00	July- Nov.	42.2	20,568	996	5,444	225	3,990	395	11,050	9,518
			Tomato	1.00	July-Oct.	54.9	15,418	996	3,696	225	2,510	463	7,890	7,528
	F 2	Mounir Ochi	Watermelon	0.93	July	23.3	6,989	996	4,613	237	310	400	6,554	435
	F 3	Mourad Boussaidi	Pepper	0.77	July-Oct.	8.1	3,505	996	5,655	208	1,636	395	8,890	-5,385
	F 4	Ahmed Ghazouani	Melon	0.43	July-Sept.	17.2	7,442	996	4,783	186	1,235	357	7,556	-114
			Watermelon	1.40	July- Augus	42.5	13,996	996	4,311	186	1,106	400	6,998	6,998
	F 5	Hmida Ghazouani	Tomato	0.92	August	37.3	13,043	996	3,904	245	783	400	6,327	6,716
	F 6	Ouael Ghazouani	Watermelon	0.65	July	26.2	7,846	996	4,629	203	277	400	6,505	1,341
	F 7	Abdelbasset Jawadi	Watermelon	1.14	July	33.6	10,088	996	4,622	295	518	399	6,830	3,258
	F 8	Kais Boussaidi	Potato	1.03	August	8.3	4,041	996	6,857	155	1,223	153	9,384	-5,343
	F 9	Hamadi	Pepper	0.92	July-Oct.	23.5	11,078	996	5,649	217	2,065	395	9,322	1,756
	F 10	Belgacem Khemiri	Pepper	0.81	July-Oct.	36.2	19,927	996	5,730	278	2,654	395	10,053	9,874
	F 11	Abdelkarim Mejri	Watermelon	0.82	July	32.5	9,756	996	4,569	188	357	400	6,509	3,247

* Irrigation equipment: 6 years amortization. Average per hectare on cost of drip and sprinkler irrigation equipments at the whole of demonstration farms is adapted.

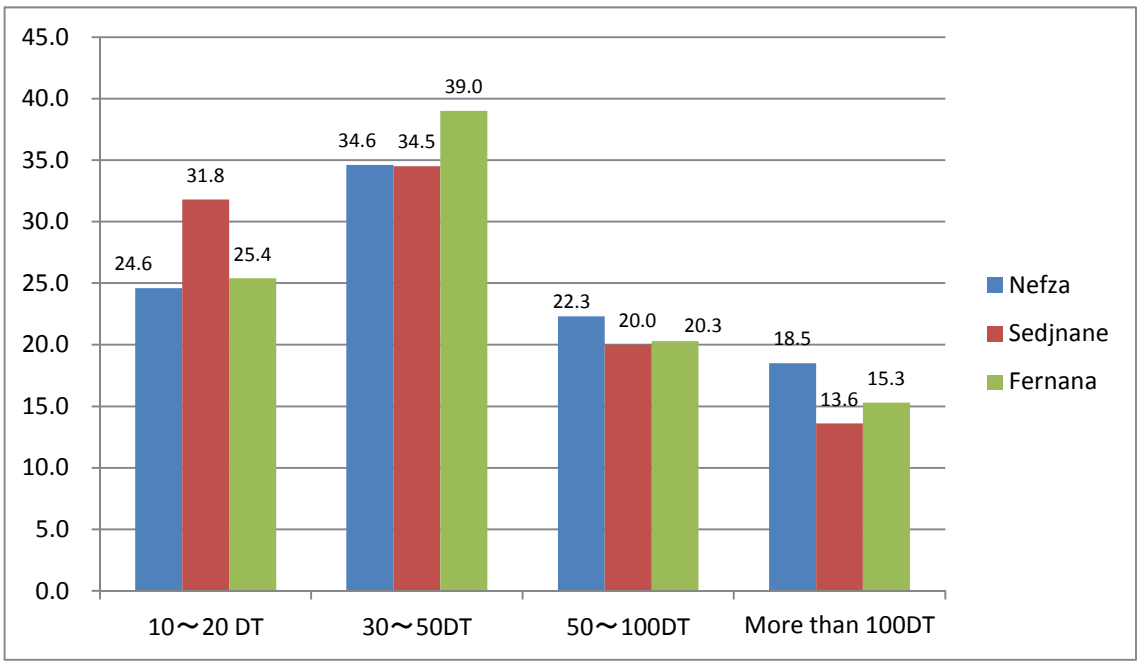
Appendix 8 Possibility on success of SMSA (%)



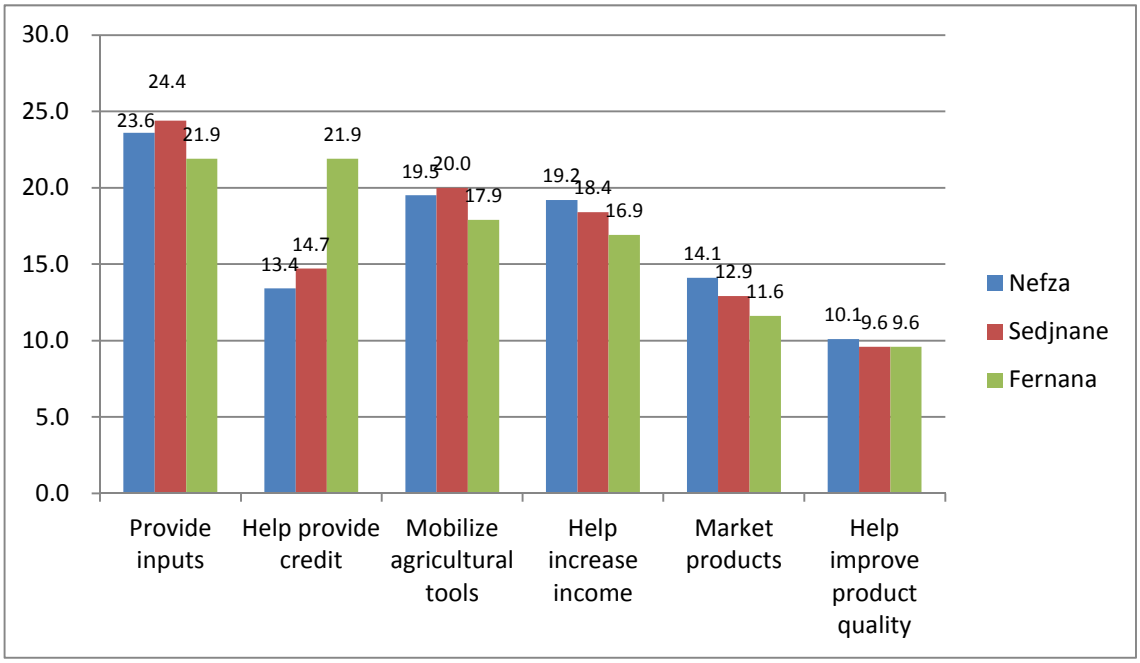
Appendix 9 Recognition of duty of SMSA member (%)



Appendix 10 Possible investment to SMSA (%)



Appendix 11 Expected role of SMSA (%)



Appendix 12 Yield, Sales and Benefit at demonstration farms (2012)

Irrigated Perimeter	Plot No.	Name of Crop	Area (ha)	Cropping Period	Yield (ton/plot)	Yield (ton/ha)	Average selling	Total sales (DT/plot)	Total sales (DT/ha)	Total Cost (DT/ha)	Benefit (TD/ha)
Nefza	N 1	Pepper	1.00	July -Nov.	23.8	23.8	488.9	11,650	11,650	7,059	4,591
	N 2	Melon	0.93	July-0ct.	37.4	40.2	357.0	13,354	14,359	6,454	7,905
	N 3	Pepper	1.04	Aug-Nov.	44.0	44.0	585.6	25,764	24,773	8,228	16,546
	N 4	Pepper	0.50	Aug-Nov.	7.7	15.4	619.3	4,759	9,518	6,642	2,876
	N 5	Pepper	0.89	Aug-Nov.	8.2	9.2	888.4	7,285	8,185	7,255	930
	N 6	Melon	0.43	Aug-Sept.	13.7	31.8	346.2	4,733	11,007	7,584	3,423
	N 7	Melon	0.90	Aug-Oct.	17.4	19.3	289.8	5,042	5,602	6,551	-949
Sedjnane	S 1	Alfalfa	0.30	July-0ct.	25.3	84.4	40.0	1,013	3,377	2,057	1,320
		Sorghom	0.30	July-0ct.	25.8	85.9	30.0	773	2,577	1,890	687
	S 2	Watermelon	0.73	Aug-Sept.	44.7	61.2	112.7	5,038	6,901	5,873	1,028
	S 3	Sorghom	0.76	July-Sept.	44.2	58.1	30.0	1,325	1,743	1,489	254
	S 4	Watermelon	0.50	Aug-Sept.	18.5	37.0	133.5	2,470	4,940	4,502	438
		Tomato	0.57	Aug-Sept.	39.3	68.9	186.5	7,324	12,850	5,379	7,471
	S 5	Tomato	0.70	Agust	51.3	73.3	100.8	5,174	7,392	4,797	2,595
	S 6	Alfalfa	0.30	July-Aug.	19.7	65.7	40.0	788	2,628	1,930	698
		Sorghom	0.35	July-Aug.	20.5	58.6	30.0	615	1,758	1,711	47
	S 7	Sorghom	0.93	Aug- Sept.	69.3	74.5	30.0	2,079	2,235	1,335	900
	S 8	Tomato	0.64	Aug-Oct.	38.1	59.5	195.6	7,451	11,642	5,703	5,939
		Pepper	0.21	Aug- Nov.	5.1	24.2	543.2	2,756	13,125	7,562	5,563
Fernana	F 1	Melon	2.00	Aug- Sept.	31.9	16.0	321.7	10,269	5,134	4,668	466
	F 2	Watermelon	0.93	July	24.3	26.1	231.9	5,623	6,046	5,253	793
	F 3	Watermelon	0.77	July-0ct.	8.3	10.8	200.0	1,656	2,151	6,142	-3,991
	F 4	Tomato	0.84	Aug- Sept.	67.7	80.6	166.1	11,248	13,390	6,829	6,561
		Pepper	0.99	Aug- Nov.	41.4	41.8	593.7	24,577	24,825	9,087	15,738

Average Standard Yield
Cropping Year 2012

	Nefza	Sedjnane	Fernana
Tomato	50.0	45.0	70.0
Pepper	17.0	20.0	16.0
Melon	27.0	28.0	27.0
Watermelon	-	30.0	32.0
Fodder	-	45.0	-

Source : CTV

: Yield of demonstration farms that exceeds average yield of each irrigated area

Appendix 13 Yield, Sales and Benefit at demonstration farms (2013)

Irrigated Perimeter	Plot No.	Name of Crop	Area (ha)	Cropping Period	Yield (ton/plot)	Yield (ton/ha)	Average selling price (DT/ton)	Total sales (DT/plot)	Total sales (DT/ha)	Total Cost (DT/ha)	Benefit (TD/ha)
Nefza	N 1	Melon	1.00	Aug-Oct.	34.2	34.2	395.3	13,520	13,520	6,593	6,927
	N 2	Pepper	0.93	July-0ct.	26.8	28.8	487.9	13,056	14,039	8,569	5,470
	N 3	Melon	1.00	Aug-Sept.	38.9	38.9	435.1	16,905	16,905	6,699	10,206
	N 4	Pepper	0.53	Aug-Oct.	19.1	36.0	366.5	7,002	13,212	9,426	3,786
	N 5	Pepper	0.66	July-0ct.	16.1	24.4	465.3	7,496	11,357	7,958	3,399
	N 6	Watermelon	0.89	July	13.0	14.6	361.5	4,700	5,281	6,192	-911
	N 7	Pepper	0.90	Aug-Oct.	31.5	35.0	378.4	11,913	13,236	8,925	4,311
	N 9	Pepper	1.00	July-0ct.	21.5	21.5	491.9	10,586	10,586	8,114	2,472
	N 10	Melon	1.00	Aug-Sept.	35.5	35.5	405.1	14,380	14,380	6,535	7,845
	N 11	Pepper	1.01	July-0ct.	22.0	22.0	423.1	9,309	9,309	8,311	998
	N 12	Tomato	1.00	Aug-Sept.	48.6	48.6	204.7	9,944	9,944	6,919	3,025
	N 13	Melon	1.00	Aug-Sept.	29.5	29.5	520.0	15,319	15,319	6,585	8,734
	N 14	Pepper	0.59	July-0ct.	12.3	20.8	486.1	5,967	10,113	8,345	1,768
	N 15	Watermelon	1.13	August	21.2	18.7	448.6	9,488	8,396	6,465	1,931
Sedjnane	S 1	Alfalfa	0.30	July-0ct.	27.7	92.2	35.0	968	3,226	1,992	1,234
		Sorghom	0.30	July-0ct.	24.2	80.6	50.0	1,209	4,029	2,372	1,657
	S 2	Pepper	0.73	Aug-Oct.	30.8	42.2	377.8	11,637	15,941	8,753	7,188
	S 3	Alfalfa	0.25	July-Sept.	13.0	52.1	70.0	912	3,647	2,898	749
		Sorghom	0.55	July-Sept.	31.3	56.9	50.0	1,565	2,845	1,864	981
	S 4	Watermelon	0.57	July	22.1	38.7	310.1	6,840	12,000	6,332	5,668
		Pepper	0.50	Aug- Nov.	19.0	38.0	381.4	7,238	14,476	8,749	5,727
	S 5	Watermelon	0.70	July	24.2	34.6	309.7	7,500	10,714	5,640	5,074
	S 6	Sorghom	0.55	July-Sept.	48.2	87.6	50.0	2,408	4,378	1,936	2,442
	S 7	Alfalfa	0.25	July-Sept.	8.3	33.0	70.0	578	2,310	2,278	32
		Sorghom	0.75	July-Sept.	44.3	59.1	50.0	2,216	2,955	1,626	1,329
	S 8	Melon	0.42	Aug- Sept.	13.7	32.7	419.1	5,753	13,697	8,939	4,758
		Watermelon	0.43	Aug- Sept.	17.8	41.4	350.7	6,250	14,535	7,839	6,696
	S 9	Sorghom	0.53	July-0ct.	41.0	77.4	50.0	6,250	11,792	1,952	9,840
	S 10	Tomato	1.00	Aug-Oct.	36.3	36.3	166.6	6,053	6,053	6,218	-165
	S 11	Watermelon	1.00	July- August	16.4	16.4	332.2	5,432	5,432	6,050	-618
	S 12	Alfalfa	0.55	July-0ct.	26.6	48.4	70.0	5,432	9,876	2,142	7,734
	S 14	Tomato	1.00	Aug-Oct.	47.9	47.9	185.8	8,899	8,899	5,265	3,634
	S 15	Watermelon	1.00	July- August	27.0	27.0	387.4	10,459	10,459	6,711	3,748
	S 16	Tomato	0.47	Aug-Oct.	24.9	53.0	217.3	5,410	11,511	7,958	3,553
Fernana	F 1	Pepper	1.00	July- Nov.	42.2	42.2	487.4	20,568	20,568	11,050	9,518
		Tomato	1.00	July-0ct.	54.9	54.9	280.8	15,418	15,418	7,890	7,528
	F 2	Watermelon	0.93	July	21.7	23.3	300.0	6,500	6,989	6,554	435
	F 3	Pepper	0.77	July-0ct.	6.3	8.1	430.5	2,699	3,505	8,890	-5,385
	F 4	Melon	0.43	July-Sept.	7.4	17.2	432.4	3,200	7,442	7,556	-114
		Watermelon	1.40	July- August	59.5	42.5	329.3	19,595	13,996	6,998	6,998
	F 5	Tomato	0.92	August	34.3	37.3	349.7	12,000	13,043	6,327	6,716
	F 6	Watermelon	0.65	July	17.0	26.2	299.5	5,100	7,846	6,505	1,341
	F 7	Watermelon	1.14	July	38.1	33.6	301.6	11,500	10,088	6,830	3,258
	F 8	Potato	1.03	August	8.5	8.3	489.7	4,163	4,041	9,384	-5,343
	F 9	Pepper	0.92	July-0ct.	21.6	23.5	470.8	10,192	11,078	9,322	1,756
	F 10	Pepper	0.81	July-0ct.	29.3	36.2	550.8	16,141	19,927	10,053	9,874
	F 11	Watermelon	0.82	July	26.6	32.5	300.5	8,000	9,756	6,509	3,247

Average Standard Yield
Cropping Year 2013

	Nefza	Sedjnane	Fernana
Tomato	40.0	50.0	60.0
Pepper	16.0	22.0	16.0
Melon	28.0	30.0	18.0
Watermelon	30.0	35.0	30.0
Fodder	-	50.0	-

Source : CTV

: Yield of demonstration farms that exceeds average yield of each irrigated area

Appendix 14 Yield, Sales and Benefit at demonstration farms (2014)

Irrigated Perimeter	Plot No.	Name of Crop	Area (ha)	Harvesting Period	Yield (ton/plot	Yield (ton/ha)	Average selling price (DT/ton)	Total sales (DT/plot)	Total sales (DT/ha)	Total Cost (DT/ha)	Benefit (TD/ha)
Nefza	N 1	Melon	1.00	Sept.	35.1	35.1	466.4	16,370	16,370	5,336	11,034
	N 2	Melon	0.93	July-Aug.	25.5	27.4	463.0	11,805	12,695	5,202	7,493
	N 3	Melon	1.00	Sept.	25.5	25.5	467.8	11,930	11,930	5,315	6,615
	N 4	Pepper	0.53	July-Nov.	19.8	37.3	606.4	11,993	22,629	8,639	13,990
	N 5	Tobacco	0.66	July-0ct.	No data						
	N 6	Melon	0.43	Aug.-Sept.	14.2	33.0	408.8	5,805	13,500	6,118	7,382
	N 7	Melon	0.90	Aug-Sept.	24.4	27.1	467.2	11,378	12,642	5,767	6,875
	N 9	Melon	1.00	Aug-Sep.	33.2	33.2	426.9	14,153	14,153	5,822	8,331
	N 10	Pepper	1.00	Aug-Nov.	38.4	38.4	501.6	19,251	19,251	8,383	10,868
	N 11	Melon	1.00	Aug.-Sept.	40.1	40.1	438.1	17,569	17,569	5,774	11,795
	N 12	Melon	1.00	July-Aug.	30.9	30.9	403.0	12,430	12,430	5,936	6,494
	N 13	Pepper	1.00	Aug-Nov.	34.8	34.8	480.4	16,701	16,701	8,041	8,660
	N 14	Watermelon	0.59	Aug.-Sept.	20.4	34.5	333.2	6,782	11,494	6,129	5,365
	N 15	Watermelon	1.14	Aug.-Sept.	68.2	59.8	360.8	24,604	21,582	5,980	15,602
Sedjnane	S 1	Sorghom	0.60	July-Oct.	67.7	112.8	50.0	3,384	5,640	1,947	3,693
	S 2	Watermelon	0.73	August	15.6	21.4	253.2	3,950	5,411	3,617	1,794
	S 3	Alfalfa	0.25	July-Sept.	16.2	64.8	70.0	1,134	4,536	1,306	3,230
		Sorghom	0.55	July-Sept.	37.3	67.8	50.0	1,865	3,391	1,384	2,007
	S 4	Tomato	0.57	Sept.-Oct.	24.4	48.8	243.7	5,943	10,427	3,757	6,670
		Pepper	0.50	Aug-Oct.	3.3	6.5	688.8	2,241	4,482	4,636	-154
	S 5	Tom/pep/waterm	0.70	July	No data : Out of the project						
	S 6	Sorghum	0.62	July-Oct.	31.0	49.8	50.0	1,542	2,488	1,029	1,459
	S 7	Alfalfa	0.37	JulyAug.	18.2	49.1	70.0	1,272	3,437	1,122	2,315
		Sorghom	0.56	Aug.-Sep.	18.4	32.9	50.0	920	1,643	1,348	295
	S 8	Tomato	0.42	Sept.-Oct.	11.0	31.5	310.5	3,424	9,782	3,840	5,942
		Pepper	0.43	Sept.-Oct.	2.7	10.6	461.3	1,223	4,890	5,005	-115
	S 9	Alfalfa	0.30	July-Aug.	10.0	33.4	70.0	702	2,339	1,526	813
		Sorghum	0.60	July-Aug.	42.3	70.5	50.0	2,114	3,523	1,377	2,146
	S 10	Watermelon	1.00	August	Est.40.000	Est.40.000	Flat sale	7,800	7,800	4,291	3,509
	S 11	Pepper	1.00	Aug.-Nov.	22.7	22.7	568.0	12,867	12,867	7,895	4,972
	S 12	Alfalfa	0.55	July-0ct.	Abundoned by water shortage						
	S 14	Melon	0.50	August	Est.14.000	Est..28.000	Flat sale	4,200	8,400	5,236	3,164
		Watermelon	0.50	August	Est.15.000	Est.30.000	Flat sale	2,700	5,400	4,638	762
	S 15	Tomato	0.51	Aug.-Oct.	25.1	50.2	222.0	5,574	10,930	5,148	5,782
		Pepper	0.50	Aug.-Oct.	9.8	19.6	451.4	4,420	8,839	7,278	1,561
	S 16	Melon	0.90	Aug-Sept.	23.6	26.2	404.2	9,520	10,577	5,015	5,562
Fernana	F 1	Watermelon	1.80	August	35.2	19.6	260.0	9,153	5,085	1,843	3,242
	F 2	Watermelon	0.93	July	No data : abundoned						
	F 3	Watermelon	0.77	July-0ct.	No data : abundoned						
	F 4	Tomato	1.85	August	135.0	73.0	145.9	19,700	10,649	5,931	4,718
	F 5	Watermelon	0.92	July-August	34.3	37.3	246.7	8,463	9,199	6,158	3,041
	F 6	Melon	0.65	July-August	16.1	24.7	379.3	6,088	9,366	6,747	2,619
	F 7	Tomato	1.14	Sept.	85.7	75.2	149.3	12,798	11,226	6,143	5,083
	F 8	Watermelon	1.03	July-August	33.3	32.3	273.3	9,100	8,835	5,829	3,006
	F 9	Melon	0.45	July-August	13.0	29.0	396.5	5,167	11,482	6,029	5,453
		Watermelon	0.45	July-August	21.9	48.7	263.2	5,765	12,811	6,682	6,129
	F 10	Melon	0.40	July-Sept.	17.3	43.1	434.4	7,494	18,735	6,319	12,416
		Watermelon	0.40	July-August	32.1	80.3	292.1	9,375	23,438	6,667	16,771
	F 11	Pepper	0.82	July-Nov.	37.5	45.7	582.2	21,828	26,620	9,596	17,024

Average Standard Yield
Cropping Year 2014

	Nefza	Sedjnane	Fernana
Tomato	50.0	48.0	64.0
Pepper	18.0	20.0	21.0
Melon	23.0	25.0	21.0
Watermelon	45.0	26.0	32.0
Fodder	-	56.0	-

Source : CTV

: Yield of demonstration farms that exceeds average yield of each irrigated area