

(6) Environment

Natural environment	Water quality	Salt density: meets irrigation requirements
		Bacillus : oui
	Soil salinity	No
	Desertification control	No
Social environment	Khettara water use as drinking water	Some
	Laundry water treatment	Yes
Environment evaluation results	Components having a strong impact on environment	No

J.5 Study Results

J.5.1 Khettara Rehabilitation

The validity of the Master plan is verified based on the compiled survey results on selected sites for khettaras rehabilitation section (length, cross-section), which is designed in the Master plan. Designs made in the Master plan and survey results of the study are summarized in the table below.

Comparison of Rehabilitation Section (length, cross-section)

Master plan	Design of Master plan study	Results of survey								
<p><u>Length</u></p> <p>Rehabilitation level is set as 30 % (targeting total 40 % including 10 % of completed portion).</p>	<p>(1) The target of rehabilitation is the section where discharge loss is observed (60 % of total length of the khattara).</p> <p>(2) Rehabilitation level (rehabilitated length/ total length) is basically set as the same for all khattaras in order to secure equitability.</p> <p>(3) Cost effective portions (30 % of total length of the khattaras) are planned for rehabilitation considering the balance between the annual budget of ORMVA/TF and rehabilitation cost.</p>	<p>(1) Discharge loss is shown in the table below. The survey revealed that there was severe leakage section and its average length is 30 % (10 - 50 %) of the total length.</p> <p>(2) Rehabilitation level is basically set as the same for all khattaras in order to secure equitability.</p> <p>(3) As for cost effectiveness, some methods were found such as culverts in possible portions for open excavation, concrete canal or PVC pipe at exuding portions.</p>								
<p><u>Cross-section</u></p> <p>Culvert type is applied basically.</p>	<p>(1) Culvert type is applied as cross-section considering easy O&M.</p> <p>(2) In terms of longitudinal section, a rehabilitation method of concreting from upstream exuding section to midstream should be avoided to secure the needs for further bottom lowering of khattara in the future.</p>	<p>(1) Culvert type is applied in open excavation section at downstream. Culvert or canal type is suitable in tunnel section from the economical view.</p> <p>(2) Concrete canal construction is suitable in the section where bottom lowering is not expected in the future.</p>								
<p><u>Loss prevention</u></p>	<p>Saved discharge by khattara rehabilitation per km</p> <table border="1"> <thead> <tr> <th>Present discharge Q (lit/sec)</th> <th>10□Q</th> <th>5□Q<10</th> <th>Q<5</th> </tr> </thead> <tbody> <tr> <td>Saved discharge (lit/sec/km)</td> <td>2.5</td> <td>2.0</td> <td>1.5</td> </tr> </tbody> </table>	Present discharge Q (lit/sec)	10□Q	5□Q<10	Q<5	Saved discharge (lit/sec/km)	2.5	2.0	1.5	<p>Saved discharge shown in the left table is deemed valid in 7 selected khattaras.</p>
Present discharge Q (lit/sec)	10□Q	5□Q<10	Q<5							
Saved discharge (lit/sec/km)	2.5	2.0	1.5							

Survey Results on Khettara Leakage of Selected 7 Sites

	Khettara	Total length (L, m)	Exuding length (m)	Leaking length (Ll, m)	Ll/ L (%)	Discharge loss (lit/sec)	Note
1	Ait Ben Omar	1,050	300	300	30 %	1 ~ 2	
2	Diba	1,700	600	500	30 %	1	
3	Lambarkia	6,200	600	1,000	15 %	4 ~ 5	
4	Oustania	7,700	300	500	10 %	3 ~ 4	Discharge loss is observed during winter, when there is lot of discharge.
5	Lagrinia	6,500	200	2,000	30 %	2 ~ 3	
6	Timarzite	2,100	50	400	20 %	1	Loss is observed uniformly in all along the khattara.
7	Taomart	600	300	300	50 %	1	

The survey results point out the followings.

- (1) Evaluation standard designed in the Master plan in the table below is deemed valid as the effect of loss prevention with rehabilitation.

Saved discharge by khettara rehabilitation per km

Present discharge Q (lit/sec)	10≤Q	5≤Q<10	Q<5
Saved discharge (lit/sec/km)	2.5	2.0	1.5

- (2) The appropriate khettara rehabilitation cost was estimated as the necessary cost for rehabilitation of 30 % of the whole stretch of khetaras, counted in the Master plan. This was because, the ceiling was set from the financial view point, and rehabilitation works were focused on leakage portions to increase rehabilitation effect more efficiently. Leakage was common at downstream of khetaras and bottom lowering was expected in the future at up-and mid-stream portions to increase discharge. Therefore it was confirmed that to implement rehabilitation works from the downstream is reasonable.

The survey also found that there were severe leakage sections at up-and mid-stream, so it was confirmed that it was still necessary to study the appropriate rehabilitation section through field interview and detailed discharge measurement.

- (3) O&M activities are carried out 3 to 4 times a year in each khettara. O&M cost per 1 km is calculated about DH 17,000, by the following formulation. It shows the appropriateness of the value used for the cost benefit calculation on the effect of O&M work load reduction in the Master plan.

$$(6 \text{ people/time}/100 \text{ m}) \times 1,000 \text{ m} \times 3 \text{ to } 4 \text{ times} = \text{DH } 17,000$$

O&M cost survey results

	Omar	Diba	Lambarkia	Oustania	Lagrinia	Timarzite	Taoumart	Average
O&M cost (DH/km)	15.680	11.530	23.610	12.970	11.820	23.040	21.600	17.180

Source : Socio-economic Survey (JICA)

J.5.2 Irrigation Canal Rehabilitation

The validity of the component and assumption in the Master plan was verified by the following fact-finding, which was obtained through the investigation on actual situation of irrigation canal and water management in the selected seven Khettaras

- Main canal plays a major role for improving water use efficiency because irrigation water flows in the main canals with high frequency. Based on the result of the investigation in seven Khettaras, around half of main canals in length are left as earthen canal. Therefore, the drastic reduction of infiltration loss with concrete lining was confirmed to contribute the improvement of water use efficiency over the whole benefited area
- It is common operation that farmers divert water flow at the inlet points with stacking the soil by manpower; therefore, leakage loss and operation loss are observed here and there. The improvement of the inlet structure aiming to restrain above water losses is also important so that it provides the multiplier effect for both of the existing concrete canal and the concrete lining of the earthen canal.
- Adaptability of the following assumption in the Master Plan was confirmed.
 - (1) Dimension of the main canals in the seven Khettaras was in the range of 0.35 to 0.60m width and 0.20 to 0.50m height, which are similar to the assumption of 0.40 to 0.50m width and 0.40 to 0.50m height in the Master Plan.
 - (2) Identification of the main canal including the classification of the structure type was conducted during this investigation. Total length of the earthen canal was estimated to be 3.05km in seven Khettaras, which is correspond to 2.76km estimated from the average length per Khettara irrigation area (50m/ha).
 - (3) Distance of the inlets depends on the irrigation canal in each Khettara. Standard interval of 30 m being assumed in Master Plan was endorsed with the fact-finding that the inlets are installed at the interval between 15 and 53 m according to the random samplings of the irrigation canals.
 - (4) According to the interview with water right holders in the seven Khettaras, 6 to 32 persons participate in the maintenance activities for irrigation canal at the rate of 2 to 6 times once a year. Number of 25 participants being assumed in Master Plan was endorsed with the average number 24 participants per year per km estimated from above data.

Investigation result on main irrigation canal in the seven Khattars

Khattara name	Investigation result (Main canal)				Remarks
	Canal dimension (m) (Width×Height)	Canal length (km)			
		Concrete canal	Earthen canal	Total	
Ait Ben Omar	0.40 x 0.40	0.68	0.83	1.51	
Diba	0.40 x 0.40	0.04	0.71	0.75	
Lambarkia	0.50 x 0.50	-	1.04	1.04	
Oustania	0.60 x 0.40	1.44	-	1.44	
Lagrinia	0.50 x 0.40	0.86	0.47	1.33	
Timarzite	0.40 x 0.20		-		
Jdid Taoumart	0.35 x 0.20		-		
Total			3.05		
Inventory survey		3.56	3.28	6.84	
Master Plan average		3.11 (52%)	2.76 (48%)	5.88	@50m/ha

J.5.3 Water Saving Irrigation

The most of farmers showed their interesting in water saving technique under severe situation that Khattara water discharge has been decreasing in recent years.

For the purpose of water saving, regulating reservoirs are installed at the exit of the Khattara with small water discharge such as Diba, Timarzite, and Jdida Taoumart in order to convey as much water as possible to the farmland through minimizing water loss during the distribution. After farmer stores the water into the regulating reservoir for some part of his water right hours, he distributes the stored water during his remaining water right hours.

Farmer's strong intension for water saving was observed in Khattara Lambarkia as well. Two PVC pipes with the diameter of 150 mm are installed under the ground from main canal to the farmlands in order to reduce water conveyance loss.

Traditional basin irrigation method is applied to all of Khattara irrigation area. Water saving techniques such as furrow irrigation and drip irrigation are already applied to the other region in Morocco; however, these techniques have not applied in Khattara irrigation area.

In accordance with the accomplishments during the verification study, demonstration farmers showed their understanding and interesting in furrow irrigation which leads to improve the productivity and quality of the crops as well as farming technique.

Drip irrigation is recognized to be the most water saving technique in the verification study, which can provide the control of the irrigation amount and timing. In addition, National Government formulates a supporting system with 40 % subsidy for the investment of drip irrigation facilities.

In Tafilalet region, the extension of drip irrigation technique with water resource of well is in initial stage. Drip irrigation with Khettara water does not require any water resource exploitation like digging well, so that this is more economic than the drip irrigation with well. It only requires the installation of on-farm reservoir in order to regulate irrigation hours because the distribution of Khettara water is managed by water right hours based on the rotation irrigation.

J.5.4 Agriculture Production

The cropping patterns of 7 zones of the feasibility were established regarding the results of land use. Among the points modified comparing to the Master Plan, we can mention the increase of areas cultivated by cumin and henna in the zone of Alnif and the cultivation of vegetables, which offer strong value added, or alfa-alfa for the livestock. The cycles of cultivation practically remain unchanged comparing to those established in the Master Plan.

Among the 7 zones, the water requirements were estimated for 0.4 lit/sec on average (see Figure J.5.1), which allows to increase the cultivated area by 36% on average within those 7 zones.

J.5.5 Organizations for Khettara Maintenance

As a result of field survey, following facts are confirmed on farmer's organization concerned to Khettara maintenance works, namely traditional Khettara water user's organization and association.

- Even though traditional Khettara water user's organization has not obtained legal status, it has been continuously carrying out Khettara maintenance works including dredging of canal, as well as simple rehabilitation works, for long time.
- Khettara water users have been contributed to the necessary maintenance works by providing work force according to their volume of water rights. In addition, the traditional organization has also been collecting necessary fund from water users to procured materials and additional workforce when required.
- The traditional organization will be able to continue these maintenance works even in the future.
- Under the situation of decreasing rain fall faced in the study area, above mentioned simple maintenance works are not sufficient to secure the water volume for irrigation. Khettara rehabilitation works, including lining and lowing of Khettara canal and extension of mother well, are considered necessary. However, these rehabilitation works requires a lot of money and work force which exceeds the capability of traditional Khettara water user's organization.

- Support from outside organization(s) on Khettara rehabilitation work is necessary in order to sustain people's life in Khettara *Ksars* with minimum agriculture production.
- Although many associations have been established since 2000, most of them have not acquired basic knowledge and skills on association management, including holding general assembly, election of bureau members, amendment of charters, preparation of operation plan, minutes of meetings and accounting records, and so on.
- Khettara farmers, represented by traditional Khettara water user's organization, are expecting newly established association only to prepare and send application to outside organizations and not regarding it as a partner for jointly implementing Khettara maintenance and rehabilitation works.
- Judging from present activities and experience in the past, organizational capacity of association appeared not sufficient for directly supporting Khettara maintenance and rehabilitation works, nor coordinating concerned farmer's organizations.

Based on these facts, objectives and roles of each farmer's organization proposed in the master plan, and presented on the table below, are confirmed feasible.

Objectives and roles of farmer's organization on Khettara maintenance and rehabilitation works

Organization	Objective	Roles
Traditional Khettara water user's organization	Maintenance and rehabilitation of Khettara	- Continuous implementation of Khettara maintenance and rehabilitation works
Khettara Association and Rural Development Association	Expansion of Khettara rehabilitation activity	- Preparation of application to outside organization - Support on Khettara maintenance and rehabilitation works - Coordination with other Khettara in the region

J.5.6 Project Evaluation

The economic evaluation result (value of EIRR) is calculated from; 1) khettara's discharge, 2) water requirement (cropping pattern) and 3) market prices. Since khettara's discharge is the only factor limiting the benefited area and it affects EIRR drastically, the economic evaluation for the Master plan should be conducted taking account of more accurate discharge measurement results.

Economic evaluation results of 7 selected sites

	Results	
	EIRR (%)	Discharge (lit/sec)
1. Ait Ben Omar	23.4	9.4
2. Diba	12.5	3.6
3. Lambarkia	21.8	20.6
4. Oustania	8.7	6.0
5. Lagrinia	9.1	4.9
6. Timarzite	9.0	3.1
7. Jdida Taoumart	18.3	2.3
Average (Total)	14.1	(49.5)

J.5.7 Environmental Impact Assessment

The Environmental Impact Assessment (EIA) for selected sites was conducted as before, based on “the Environmental Assessment Guideline for Agricultural Development Study (March, 1992, JICA)”, because the project components do not fall into the coverage of the Environmental Impact Assessment Act (enacted on May, 2003), and detailed evaluation criteria based on the act are not ready yet so far. The outline of the assessment results are as follows.

- Conflict creation among residents

The Master plan designates to apply the almost same length and cross-section for rehabilitation planning to all khattaras, focusing on equitability and equality, as one of the basic conditions. On the other hand, the whole rehabilitation work takes 10 years and the timing of implementation may vary, so it is possible for non-beneficiaries to have complaints for the order of implementation. Therefore, it is necessary to explain selection criteria of rehabilitation sites and the determination basis of the implementation order, to the people thoroughly, before implementation.

- Influence to water right

Although this project is carried out based on the traditional water right, change of water distribution management is necessary for introduction of water saving technologies. It is important to formulate a water management plan taking account of khattara’s water right.

- Contamination of water quality, soil, etc. caused by increase of chemical application

Present use of chemicals is limited in little amount and in limited areas, when just pests are found. As the agriculture progresses due to the project implementation, chemical use may become more. Therefore, careful monitoring in the future is essential and effective instructions for chemical use by ORMVA/TF

are expected.

- Progress of salt injury due to saline irrigation water (Lambarkia, Oustania, Lagrinia)

This project adopts the irrigation method resistive to saline, like water saving technology. But careful monitoring for salt injury is important in Lambarkia, Oustania and Lagrinia, because khattara water for irrigation in those areas include 2,000 $\mu\text{s}/\text{m}$ of saline.

J.6 Effectiveness and Relevance on Components of the Plan

(1) Rehabilitation of khattaras and canals

Since it is necessary to use khattara water efficiently for agricultural production, to achieve the project purpose, “Stabilization and improvement of agricultural income”, rehabilitation of khattaras and irrigation canals is the major component. The benefit of khattara rehabilitation consists of discharge increase and decrease of O&M work load. But the rehabilitation cost sometimes surpasses the benefit because rehabilitation works underground requires bigger cost. From the economical point of view, it is necessary to rehabilitate especially the sections, where leakage prevention is efficiently possible. In most khattaras, the downstream portions have more leakage and the smaller cross-section. That affects easy O&M, so rehabilitation of down stream portions is very effective.

As canal rehabilitation is cheaper and leakage prevention effect by rehabilitation appears for sure, the canal rehabilitation has usually higher const-benefit performance than khattara rehabilitation. Therefore, as it is proposed in the Master plan, the plan to complete the main canals rehabilitation in 5 years is quite valid. Other canals are excluded from rehabilitation plan, because they are small and they are at the field facility level.

(2) Agricultural technology and water saving irrigation

As for the water saving irrigation (drip irrigation), it is deemed that in order to decrease facility cost per unit area, it is necessary to use 3 to 4 ha of farmland intensively as a minimum block. But farmland use is divided into pieces in these days, so integration of farmland and water right is necessary through establishment of a drip irrigation cooperative. According to the survey results on farmers group strengthening, since to secure finance and labor force for discharge increase of khattara and irrigation canal is the urgent task, the necessity to support khattara associations on setup, operation and strengthening is confirmed.

As for vegetables as high value crops, it is necessary to shorten irrigation interval days for production increase and quality improvement, and agricultural technology extension by

ORMVA/TF is required strongly. It is also necessary to maintain cultivation plans based on the local farmers' experience and knowledge, like area increase of alfalfa (fodder crop for animals), and Alnif's henna and cumin.

(3) Organizations for operation and maintenance

Necessity of following organization strengthening components proposed in the master plan was confirmed in order that each farmer's organization becomes able to fulfill expected roles.

1. Strengthening of traditional Khettara water user's organization on its institutional aspect (registration as an association)
2. Acquiring basic knowledge and skills on association management
3. Enhancing project implementation capability through joint implementation of Khettara rehabilitation works in cooperation with the traditional organization and association.

Tables

Table J.4.1 Cost Estimates

(1) Khettara Ait Ben Omar						(unit:DH)
Designation	Unit	Q'ty	Unit cost	Amount	Remarks	
1. Rehabilitation of khettara						
1.1 Concrete culvert and masonry	m	300	1,182	354,600	Tunnel	
1.2 Shaft installation ctc 30m (Open)	m	0	57	0		
1.3 Concrete canal installation (Tunnel)	m	0	496	0	Weathered rock	
1.4 Mortar plastering	m	0	124	0		
1.5 Extension of gallery (Rock)	m	0	642	0		
1.6 Extension of gallery (Soft rock)	m	0	338	0		
Sub-Total 1				354,600		
2. Réhabilitation de Canal d'irrigation						
2.1 Concrete canal (without concrete cover)	m	576	272	156,672		
2.2 Concrete canal (with concrete cover)	m	250	345	86,250		
2.3 Distribution works	sites	50	186	9,300		
Sub-Total 2				252,222		
Total				606,822		

(Cost includes temporary work and site expense)

(2) Khettara Diba						(unite:DH)
Designation	Unit	Q'ty	Unit cost	Amount	Remarks	
1. Rehabilitation of khettara						
1.1 Concrete culvert and masonry	m	50	1,182	59,100	Tunnel	
1.2 Shaft installation ctc 30m (Open)	m	500	283	141,500	H=5.0m	
1.3 Concrete canal installation (Tunnel)	m	450	496	223,200	Weathered rock	
1.4 Mortar plastering	m		124	0		
1.5 Extension of gallery (Rock)	m		642	0		
1.6 Extension of gallery (Soft rock)	m		338	0		
Sub-Total 1				423,800		
2. Réhabilitation de Canal d'irrigation						
2.1 Concrete canal (without concrete cover)	m	709	272	192,848		
2.2 Concrete canal (with concrete cover)	m	0	0	0		
2.3 Distribution works	sites	24	222	5,328		
Sub-Total 2				198,176		
Total				621,976		

(Cost includes temporary work and site expense)

(3) Khettara Lambarkia						(unite:DH)
Designation	Unit	Q'ty	Unit cost	Amount	Remarks	
1. Rehabilitation of khettara						
1.1 Concrete culvert and masonry	m	500	1,244	622,000	D=5.0m	
1.2 Shaft installation ctc 30m (Open)	m	1500	283	424,500	H=5.0m	
1.3 Concrete canal installation (Tunnel)	m	1000	1,182	1,182,000	Roches altérées	
1.4 Mortar plastering	m		124	0		
1.5 Extension of gallery (Rock)	m		642	0		
1.6 Extension of gallery (Soft rock)	m		338	0		
Sub-Total 1				2,228,500		
2. Réhabilitation de Canal d'irrigation						
2.1 Concrete canal (without concrete cover)	m	586	325	190,450		
2.2 Concrete canal (with concrete cover)	m	450	409	184,050		
2.3 Distribution works	sites	35	219	7,665		
Sub-Total 2				382,165		
Total				2,610,665		

(Cost includes temporary work and site expense)

(4) Khettara Oustania

(unite:DH)

Designation	Unit	Q'ty	Unit cost	Amount	Remarks
1. Rehabilitation of khettara					
1.1 Concrete culvert and masonry	m	700	1,244	870,800	D=5.0m
1.2 Shaft installation ctc 30m (Open)	m	700	283	198,100	H=5.0m
1.3 Concrete canal installation (Tunnel)	m	500	496	248,000	Roches altérées
1.4 Mortar plastering	m	1000	1,182	1,182,000	
1.5 Extension of gallery (Rock)	m		642	0	
1.6 Extension of gallery (Soft rock)	m		338	0	
Sub-Total 1				2,498,900	
2. Réhabilitation de Canal d'irrigation					
2.1 Concrete canal (without concrete cover)	m	0	0	0	
2.2 Concrete canal (with concrete cover)	m			0	
2.3 Distribution works	sites	48	191	9,168	
Sub-Total 2				9,168	
Total				2,508,068	

(Cost includes temporary work and site expense)

(5) Khettara Lagrinia

(unite:DH)

Designation	Unit	Q'ty	Unit cost	Amount	Remarks
1. Rehabilitation of khettara					
1.1 Concrete culvert and masonry	m	1250	1,123	1,403,750	D=3.0m
1.2 Shaft installation ctc 30m (Open)	m	1250	57	71,250	H=1.0m
1.3 Concrete canal installation (Tunnel)	m	1100	496	545,600	Roches altérées
1.4 Mortar plastering	m	0	1,182	0	
1.5 Extension of gallery (Rock)	m	0	642	0	
1.6 Extension of gallery (Soft rock)	m	0	338	0	
Sub-Total 1				2,020,600	
2. Réhabilitation de Canal d'irrigation					
2.1 Concrete canal (without concrete cover)	m	473	282	133,386	
2.2 Concrete canal (with concrete cover)	m	0	0	0	
2.3 Distribution works	sites	45	188	8,460	
Sub-Total 2				141,846	
Total				2,162,446	

(Cost includes temporary work and site expense)

(6) Khettara Timarzite

(unite:DH)

Designation	Unit	Q'ty	Unit cost	Amount	Remarks
1. Rehabilitation of khettara					
1.1 Concrete culvert and masonry	m	580	1,123	651,340	D=3.0m
1.2 Shaft installation ctc 30m (Open)	m	580	57	33,060	H=3.0m
1.3 Concrete canal installation (Tunnel)	m		496	0	Roches altérées
1.4 Mortar plastering	m		124	0	
1.5 Extension of gallery (Rock)	m		642	0	
1.6 Extension of gallery (Soft rock)	m		338	0	
Sub-Total 1				684,400	
2. Réhabilitation de Canal d'irrigation					
2.1 Concrete canal (without concrete cover)	m	0	0	0	
2.2 Concrete canal (with concrete cover)	m	0	0	0	
2.3 Distribution works	sites	70	157	10,990	
Sub-Total 2				10,990	
Total				695,390	

(Cost includes temporary work and site expense)

(7) Khettara Jdida Taoumart

(unite:DH)

Designation	Unit	Q'ty	Unit cost	Amount	Remarks
1. Rehabilitation of khettara					
1.1 Concrete culvert and masonry	m		1,123	0	D=3.0m
1.2 Shaft installation ctc 30m (Open)	m		57	0	H=1.0m
1.3 Concrete canal installation (Tunnel)	m		496	0	Roches altérées
1.4 Mortar plastering	m		124	0	
1.5 Extension of gallery (Rock)	m3	550	535	294,250	
1.6 Extension of gallery (Soft rock)	m		338	0	
Sub-Total 1				294,250	
2. Réhabilitation de Canal d'irrigation					
2.1 Concrete canal (without concrete cover)	m	0	0	0	
2.2 Concrete canal (with concrete cover)	m	0	0	0	
2.3 Distribution works	sites	32	155	4,960	
Sub-Total 2				4,960	
Total				299,210	

(Cost includes temporary work and site expense)

Table J.4.2 (1.1): Net Income from Agricultural Production "Without Project" Condition; Ait Ben Omar (financial price)

Cultures		Benefit					Input	Net Value [DH]
		Area ha	%	Harvest Qty. [kg/ha]	Unit Price [DH/kg]	Value [DH/ha]	Unit Price [DH/ha]	
Cereal	Wheat	0.41	51%	1,800	3.00	6,600	3,160	1,415
Vegetables		0.02	2%			43,549	7,668	574
Vegetable 1	Carrot			12,600	1.50	18,900	6,510	
Vegetable 2	Onion			16,380	4.00	65,520	5,740	
Vegetable 3	Tomato			18,900	1.75	33,075	9,410	
Vegetable 4	Green pepper			12,600	4.50	56,700	9,013	
Vegetable 5	Bean	0.05	6%	3,150	8.00	25,200	3,635	1,104
Forage	Alfalfa	0.08	11%	28	350.00	9,828	6,924	244
Arboriculture		0.24	30%			15,916	2,954	3,080
Arb. 1	Date Palm	0.15	63%	1,573	15.50	24,385	4,547	
Arb. 2	Olive	0.09	37%	2,310	4.00	1,497	242	
Land out of cultivation			5%	0		0	0	0
		0.80	105%					6,400

Table J.4.2 (1.2): Net Income from Agricultural Production dan "With Project" Condition (1 - 6 years); Ait Ben Omar (financial price)

Cultures		Benefit					Input	Net Value [DH]
		Area ha	%	Harvest Qty. [kg/ha]	Unit Price [DH/kg]	Value [DH/ha]	Unit Price [DH/ha]	
Cereal	Wheat	0.41	40%	2,700	3.00	9,300	6,640	1,094
Vegetables		0.13	13%			50,698	9,788	5,359
Vegetable 1	Carrot			15,300	1.50	22,950	8,190	
Vegetable 2	Onion			18,720	4.00	74,880	7,890	
Vegetable 3	Tomato			22,950	1.75	40,163	11,890	
Vegetable 4	Green pepper			14,400	4.50	64,800	11,183	
Vegetable 5	Bean	0.05	5%	4,320	8.00	34,560	5,300	1,498
Forage	Alfalfa	0.20	19%	42	350.00	14,742	9,632	1,017
Arboriculture		0.24	23%			33,555	8,426	5,807
Arb. 1	Date Palm	0.15	63%	2,736	15.50	42,408	10,258	
Arb. 2	Olive	0.09	37%	4,620	4.00	18,480	5,306	
Land out of cultivation			5%			0		0
		1.03	105%			0		14,800

Table J.4.2 (1.3): Net Income from Agricultural Production dan "With Project" Condition (7-30 years); Ait Ben Omar (financial price)

Cultures		Benefit					Input	Net Value [DH]
		Area ha	%	Harvest Qty. [kg/ha]	Unit Price [DH/kg]	Value [DH/ha]	Unit Price [DH/ha]	
Cereal	Wheat	0.41	40%	2,700	3.00	9,300	6,640	1,094
Vegetables		0.13	13%			50,698	9,788	5,359
Vegetable 1	Carrot			15,300	1.50	22,950	8,190	
Vegetable 2	Onion			18,720	4.00	74,880	7,890	
Vegetable 3	Tomato			22,950	1.75	40,163	11,890	
Vegetable 4	Green pepper			14,400	4.50	64,800	11,183	
Vegetable 5	Bean	0.05	5%	4,320	8.00	34,560	5,300	1,498
Forage	Alfalfa	0.08	8%	42	350.00	14,742	9,632	429
Arboriculture		0.35	34%			41,145	10,145	10,630
Arb. 1	Date Palm	0.26	87%	2,736	15.50	42,408	10,258	
Arb. 2	Olive	0.09	23%	4,620	4.00	18,480	5,306	
Land out of cultivation			5%			0		0
		1.03	105%			0		19,000

Table J.4.2 (2.1): Net Income from Agricultural Production dan "Without Project" Condition; Diba (financial price)

Cultures		Benefit					Input	Net Value [DH]	
		Area		Harvest		Unit Price	Value		Unit Price
		ha	%	Qty.	[kg/ha]	[DH/kg]	[DH/ha]	[DH/ha]	
Cereal	Wheat	0.46	58%	1,800		3.00	6,600	3,160	1,582
Vegetables		0.01	1%				43,549	7,668	316
Vegetable 1	Carrot			12,600		1.50	18,900	6,510	
Vegetable 2	Onion			16,380		4.00	65,520	5,740	
Vegetable 3	Tomato			18,900		1.75	33,075	9,410	
Vegetable 4	Green pepper			12,600		4.50	56,700	9,013	
Vegetable 5	Bean	0.02	2%	3,150		8.00	25,200	3,635	380
Forage	Alfalfa	0.04	5%	28		350.00	9,828	6,924	125
Arboriculture		0.27	34%				20,872	3,882	4,580
Arb. 1	Date Palm	0.23	84%	1,573		15.50	24,385	4,547	
Arb. 2	Olive	0.07	26%	2,310		4.00	1,497	242	
Land out of cultivation			5%	0			0	0	0
		0.80	105%						7,000

Table J.4.2 (2.2): Net Income from Agricultural Production dan "With Project" Condition (1 - 6 years); Diba (financial price)

Cultures		Benefit					Input	Net Value [DH]	
		Area		Harvest		Unit Price	Value		Unit Price
		ha	%	Qty.	[kg/ha]	[DH/kg]	[DH/ha]	[DH/ha]	
Cereal	Wheat	0.46	45%	2,700		3.00	9,300	6,640	1,224
Vegetables		0.12	12%				50,698	9,788	5,065
Vegetable 1	Carrot			15,300		1.50	22,950	8,190	
Vegetable 2	Onion			18,720		4.00	74,880	7,890	
Vegetable 3	Tomato			22,950		1.75	40,163	11,890	
Vegetable 4	Green pepper			14,400		4.50	64,800	11,183	
Vegetable 5	Bean	0.02	2%	4,320		8.00	34,560	5,300	515
Forage	Alfalfa	0.16	15%	42		350.00	14,742	9,632	808
Arboriculture		0.27	26%				40,428	9,996	7,979
Arb. 1	Date Palm	0.23	84%	2,736		15.50	42,408	10,258	
Arb. 2	Olive	0.07	26%	4,620		4.00	18,480	5,306	
Land out of cultivation			5%				0	0	0
		1.03	105%				0		15,600

Table J.4.2 (3.3): Net Income from Agricultural Production dan "With Project" Condition (7-30 years); Diba (financial price)

Cultures		Benefit					Input	Net Value [DH]	
		Area		Harvest		Unit Price	Value		Unit Price
		ha	%	Qty.	[kg/ha]	[DH/kg]	[DH/ha]	[DH/ha]	
Cereal	Wheat	0.46	45%	2,700		3.00	9,300	6,640	1,224
Vegetables		0.12	12%				50,698	9,788	5,065
Vegetable 1	Carrot			15,300		1.50	22,950	8,190	
Vegetable 2	Onion			18,720		4.00	74,880	7,890	
Vegetable 3	Tomato			22,950		1.75	40,163	11,890	
Vegetable 4	Green pepper			14,400		4.50	64,800	11,183	
Vegetable 5	Bean	0.02	2%	4,320		8.00	34,560	5,300	515
Forage	Alfalfa	0.04	4%	42		350.00	14,742	9,632	221
Arboriculture		0.38	37%				40,175	9,943	11,307
Arb. 1	Date Palm	0.34	83%	2,736		15.50	42,408	10,258	
Arb. 2	Olive	0.07	27%	4,620		4.00	18,480	5,306	
Land out of cultivation			5%				0	0	0
		1.03	105%				0		18,300

Table J.4.2 (3.1): Net Income from Agricultural Production dan "Without Project" Condition; Lambarkia (financial price)

Cultures		Benefit					Input	Net Value [DH]	
		Area		Harvest		Unit Price	Value		Unit Price
		ha	%	Qty.	[kg/ha]	[DH/kg]	[DH/ha]	[DH/ha]	
Cereal	Wheat	0.30	38%	1,800		3.00	6,600	3,160	1,032
Vegetables		0.04	5%				43,549	7,668	1,550
Vegetable 1	Carrot			12,600		1.50	18,900	6,510	
Vegetable 2	Onion			16,380		4.00	65,520	5,740	
Vegetable 3	Tomato			18,900		1.75	33,075	9,410	
Vegetable 4	Green pepper			12,600		4.50	56,700	9,013	
Vegetable 5	Bean	0.02	2%	3,150		8.00	25,200	3,635	362
Forage	Alfalfa	0.13	17%	28		350.00	9,828	6,924	388
Arboriculture		0.31	38%				22,325	4,159	5,566
Arb. 1	Date Palm	0.28	91%	1,573		15.50	24,385	4,547	
Arb. 2	Olive	0.03	9%	2,310		4.00	1,497	242	
Land out of cultivation			5%	0			0	0	0
		0.80	105%						8,900

Table J.4.2 (3.2): Net Income from Agricultural Production dan "With Project" Condition (1 - 6 years); Lambarkia (financial price)

Cultures		Benefit					Input	Net Value [DH]	
		Area		Harvest		Unit Price	Value		Unit Price
		ha	%	Qty.	[kg/ha]	[DH/kg]	[DH/ha]	[DH/ha]	
Cereal	Wheat	0.30	29%	2,700		3.00	9,300	6,640	798
Vegetables		0.16	15%				50,698	9,788	6,472
Vegetable 1	Carrot			15,300		1.50	22,950	8,190	
Vegetable 2	Onion			18,720		4.00	74,880	7,890	
Vegetable 3	Tomato			22,950		1.75	40,163	11,890	
Vegetable 4	Green pepper			14,400		4.50	64,800	11,183	
Vegetable 5	Bean	0.02	2%	4,320		8.00	34,560	5,300	492
Forage	Alfalfa	0.25	24%	42		350.00	14,742	9,632	1,270
Arboriculture		0.31	30%				40,254	9,812	9,071
Arb. 1	Date Palm	0.28	91%	2,736		15.50	42,408	10,258	
Arb. 2	Olive	0.03	9%	4,620		4.00	18,480	5,306	
Land out of cultivation			5%				0		0
		1.03	105%				0		18,100

Table J.4.2 (3.3): Net Income from Agricultural Production dan "With Project" Condition (7-30 years); Lambarkia (financial price)

Cultures		Benefit					Input	Net Value [DH]	
		Area		Harvest		Unit Price	Value		Unit Price
		ha	%	Qty.	[kg/ha]	[DH/kg]	[DH/ha]	[DH/ha]	
Cereal	Wheat	0.30	29%	2,700		3.00	9,300	6,640	798
Vegetables		0.16	15%				50,698	9,788	6,472
Vegetable 1	Carrot			15,300		1.50	22,950	8,190	
Vegetable 2	Onion			18,720		4.00	74,880	7,890	
Vegetable 3	Tomato			22,950		1.75	40,163	11,890	
Vegetable 4	Green pepper			14,400		4.50	64,800	11,183	
Vegetable 5	Bean	0.02	2%	4,320		8.00	34,560	5,300	492
Forage	Alfalfa	0.13	13%	42		350.00	14,742	9,632	683
Arboriculture		0.42	41%				41,451	10,060	12,865
Arb. 1	Date Palm	0.39	96%	2,736		15.50	42,408	10,258	
Arb. 2	Olive	0.03	4%	4,620		4.00	18,480	5,306	
Land out of cultivation			5%				0		0
		1.03	105%				0		21,300

Table J.4.2 (4.1): Net Income from Agricultural Production dan "Without Project" Condition; Oustania (financial price)

Cultures		Benefit					Input	Net Value [DH]	
		Area		Harvest		Unit Price	Value		Unit Price
		ha	%	Qty.	[kg/ha]	[DH/kg]	[DH/ha]	[DH/ha]	
Cereal	Wheat	0.40	50%	1,800		3.00	6,600	3,160	1,365
Vegetables		0.10	13%				43,549	7,668	3,732
Vegetable 1	Carrot			12,600		1.50	18,900	6,510	
Vegetable 2	Onion			16,380		4.00	65,520	5,740	
Vegetable 3	Tomato			18,900		1.75	33,075	9,410	
Vegetable 4	Green pepper			12,600		4.50	56,700	9,013	
Vegetable 5	Bean	0.03	4%	3,150		8.00	25,200	3,635	656
Forage	Alfalfa	0.15	19%	28		350.00	9,828	6,924	432
Arboriculture		0.12	15%				20,872	3,882	2,039
Arb. 1	Date Palm	0.10	84%	1,573		15.50	24,385	4,547	
Arb. 2	Olive	0.03	26%	2,310		4.00	1,497	242	
Land out of cultivation			5%	0			0	0	0
		0.80	105%						8,200

Table J.4.2 (4.2): Net Income from Agricultural Production dan "With Project" Condition (1 - 6 years); Oustania (financial price)

Cultures		Benefit					Input	Net Value [DH]	
		Area		Harvest		Unit Price	Value		Unit Price
		ha	%	Qty.	[kg/ha]	[DH/kg]	[DH/ha]	[DH/ha]	
Cereal	Wheat	0.40	39%	2,700		3.00	9,300	6,640	1,055
Vegetables		0.22	21%				50,698	9,788	8,959
Vegetable 1	Carrot			15,300		1.50	22,950	8,190	
Vegetable 2	Onion			18,720		4.00	74,880	7,890	
Vegetable 3	Tomato			22,950		1.75	40,163	11,890	
Vegetable 4	Green pepper			14,400		4.50	64,800	11,183	
Vegetable 5	Bean	0.03	3%	4,320		8.00	34,560	5,300	890
Forage	Alfalfa	0.26	26%	42		350.00	14,742	9,632	1,348
Arboriculture		0.12	12%				40,428	9,996	3,551
Arb. 1	Date Palm	0.10	84%	2,736		15.50	42,408	10,258	
Arb. 2	Olive	0.03	26%	4,620		4.00	18,480	5,306	
Land out of cultivation			5%				0		0
		1.03	105%				0		15,800

Table J.4.2 (4.3): Net Income from Agricultural Production dan "With Project" Condition (7-30 years); Oustania (financial price)

Cultures		Benefit					Input	Net Value [DH]	
		Area		Harvest		Unit Price	Value		Unit Price
		ha	%	Qty.	[kg/ha]	[DH/kg]	[DH/ha]	[DH/ha]	
Cereal	Wheat	0.40	39%	2,700		3.00	9,300	6,640	1,055
Vegetables		0.22	21%				50,698	9,788	8,959
Vegetable 1	Carrot			15,300		1.50	22,950	8,190	
Vegetable 2	Onion			18,720		4.00	74,880	7,890	
Vegetable 3	Tomato			22,950		1.75	40,163	11,890	
Vegetable 4	Green pepper			14,400		4.50	64,800	11,183	
Vegetable 5	Bean	0.03	3%	4,320		8.00	34,560	5,300	890
Forage	Alfalfa	0.15	14%	42		350.00	14,742	9,632	760
Arboriculture		0.24	23%				42,041	10,395	7,232
Arb. 1	Date Palm	0.22	87%	2,736		15.50	42,408	10,258	
Arb. 2	Olive	0.03	27%	4,620		4.00	18,480	5,306	
Land out of cultivation			5%				0		0
		1.03	105%				0		18,900

Table J.4.2 (5.1): Net Income from Agricultural Production dan "Without Project" Condition; Lagrinia (financial price)

Cultures		Benefit					Input	Net Value [DH]	
		Area		Harvest		Unit Price	Value		Unit Price
		ha	%	Qty.	[kg/ha]	[DH/kg]	[DH/ha]	[DH/ha]	
Cereal	Wheat	0.47	59%	1,800		3.00	6,600	3,160	1,621
Vegetables		0.10	13%				43,549	7,668	3,732
Vegetable 1	Carrot			12,600		1.50	18,900	6,510	
Vegetable 2	Onion			16,380		4.00	65,520	5,740	
Vegetable 3	Tomato			18,900		1.75	33,075	9,410	
Vegetable 4	Green pepper			12,600		4.50	56,700	9,013	
Vegetable 5	Bean	0.03	3%	3,150		8.00	25,200	3,635	569
Forage	Alfalfa	0.09	11%	28		350.00	9,828	6,924	253
Arboriculture		0.11	14%				22,554	4,202	2,041
Arb. 1	Date Palm	0.10	92%	1,573		15.50	24,385	4,547	
Arb. 2	Olive	0.01	8%	2,310		4.00	1,497	242	
Land out of cultivation			5%	0			0	0	0
		0.80	105%						8,200

Table J.4.2 (5.2): Net Income from Agricultural Production dan "With Project" Condition (1 - 6 years); Lagrinia (financial price)

Cultures		Benefit					Input	Net Value [DH]	
		Area		Harvest		Unit Price	Value		Unit Price
		ha	%	Qty.	[kg/ha]	[DH/kg]	[DH/ha]	[DH/ha]	
Cereal	Wheat	0.47	46%	2,700		3.00	9,300	6,640	1,253
Vegetables		0.22	21%				50,698	9,788	8,959
Vegetable 1	Carrot			15,300		1.50	22,950	8,190	
Vegetable 2	Onion			18,720		4.00	74,880	7,890	
Vegetable 3	Tomato			22,950		1.75	40,163	11,890	
Vegetable 4	Green pepper			14,400		4.50	64,800	11,183	
Vegetable 5	Bean	0.03	3%	4,320		8.00	34,560	5,300	772
Forage	Alfalfa	0.20	20%	42		350.00	14,742	9,632	1,033
Arboriculture		0.11	11%				40,494	9,862	3,313
Arb. 1	Date Palm	0.10	92%	2,736		15.50	42,408	10,258	
Arb. 2	Olive	0.01	8%	4,620		4.00	18,480	5,306	
Land out of cultivation			5%				0		0
		1.03	105%				0		15,300

Table J.4.2 (5.3): Net Income from Agricultural Production dan "With Project" Condition (7-30 years); Lagrinia (financial price)

Cultures		Benefit					Input	Net Value [DH]	
		Area		Harvest		Unit Price	Value		Unit Price
		ha	%	Qty.	[kg/ha]	[DH/kg]	[DH/ha]	[DH/ha]	
Cereal	Wheat	0.47	46%	2,700		3.00	9,300	6,640	1,253
Vegetables		0.22	21%				50,698	9,788	8,959
Vegetable 1	Carrot			15,300		1.50	22,950	8,190	
Vegetable 2	Onion			18,720		4.00	74,880	7,890	
Vegetable 3	Tomato			22,950		1.75	40,163	11,890	
Vegetable 4	Green pepper			14,400		4.50	64,800	11,183	
Vegetable 5	Bean	0.03	3%	4,320		8.00	34,560	5,300	772
Forage	Alfalfa	0.09	8%	42		350.00	14,742	9,632	446
Arboriculture		0.23	22%				41,479	10,067	6,910
Arb. 1	Date Palm	0.22	96%	2,736		15.50	42,408	10,258	
Arb. 2	Olive	0.01	4%	4,620		4.00	18,480	5,306	
Land out of cultivation			5%				0		0
		1.03	105%				0		18,300

Table J.4.2 (6.1): Net Income from Agricultural Production dan "Without Project" Condition; Timarzit (financial price)

Cultures		Benefit					Input	Net Value [DH]	
		Area		Harvest		Unit Price	Value		Unit Price
		ha	%	Qty.	[kg/ha]	[DH/kg]	[DH/ha]	[DH/ha]	
Cereal	Wheat	0.52	66%	1,800		3.00	6,600	3,160	1,803
Vegetables		0.09	12%				43,549	7,668	3,301
Vegetable 1	Carrot			12,600		1.50	18,900	6,510	
Vegetable 2	Onion			16,380		4.00	65,520	5,740	
Vegetable 3	Tomato			18,900		1.75	33,075	9,410	
Vegetable 4	Green pepper			12,600		4.50	56,700	9,013	
Vegetable 5	Bean	0.02	2%	3,150		8.00	25,200	3,635	414
Forage	Alfalfa	0.05	6%	28		350.00	9,828	6,924	137
Arboriculture		0.12	15%				21,788	4,055	2,085
Arb. 1	Date Palm	0.10	88%	1,573		15.50	24,385	4,547	
Arb. 2	Olive	0.03	22%	2,310		4.00	1,497	242	
Land out of cultivation			5%	0			0	0	
		0.80	105%						7,700

Table J.4.2 (6.2): Net Income from Agricultural Production dan "With Project" Condition (1 - 6 years); Timarzit (financial price)

Cultures		Benefit					Input	Net Value [DH]	
		Area		Harvest		Unit Price	Value		Unit Price
		ha	%	Qty.	[kg/ha]	[DH/kg]	[DH/ha]	[DH/ha]	
Cereal	Wheat	0.52	51%	2,700		3.00	9,300	6,640	1,394
Vegetables		0.21	20%				50,698	9,788	8,468
Vegetable 1	Carrot			15,300		1.50	22,950	8,190	
Vegetable 2	Onion			18,720		4.00	74,880	7,890	
Vegetable 3	Tomato			22,950		1.75	40,163	11,890	
Vegetable 4	Green pepper			14,400		4.50	64,800	11,183	
Vegetable 5	Bean	0.02	2%	4,320		8.00	34,560	5,300	562
Forage	Alfalfa	0.16	16%	42		350.00	14,742	9,632	829
Arboriculture		0.12	11%				41,385	10,194	3,567
Arb. 1	Date Palm	0.10	88%	2,736		15.50	42,408	10,258	
Arb. 2	Olive	0.03	22%	4,620		4.00	18,480	5,306	
Land out of cultivation			5%				0	0	
		1.03	105%				0		14,800

Table J.4.2 (6.3): Net Income from Agricultural Production dan "With Project" Condition (7-30 years); Timarzit (financial price)

Cultures		Benefit					Input	Net Value [DH]	
		Area		Harvest		Unit Price	Value		Unit Price
		ha	%	Qty.	[kg/ha]	[DH/kg]	[DH/ha]	[DH/ha]	
Cereal	Wheat	0.52	51%	2,700		3.00	9,300	6,640	1,394
Vegetables		0.21	20%				50,698	9,788	8,468
Vegetable 1	Carrot			15,300		1.50	22,950	8,190	
Vegetable 2	Onion			18,720		4.00	74,880	7,890	
Vegetable 3	Tomato			22,950		1.75	40,163	11,890	
Vegetable 4	Green pepper			14,400		4.50	64,800	11,183	
Vegetable 5	Bean	0.02	2%	4,320		8.00	34,560	5,300	562
Forage	Alfalfa	0.05	5%	42		350.00	14,742	9,632	241
Arboriculture		0.23	23%				41,451	10,060	7,101
Arb. 1	Date Palm	0.22	96%	2,736		15.50	42,408	10,258	
Arb. 2	Olive	0.03	4%	4,620		4.00	18,480	5,306	
Land out of cultivation			5%				0	0	
		1.03	105%				0		17,800

Table J.4.2 (7.1): Net Income from Agricultural Production dan "Without Project" Condition; Jdida Taoumart (financial price)

Cultures		Benefit					Input	Net Value [DH]	
		Area		Harvest		Unit Price	Value		Unit Price
		ha	%	Qty.	[kg/ha]	[DH/kg]	[DH/ha]	[DH/ha]	
Cereal	Wheat	0.61	77%	1,800		3.00	6,600	3,160	2,108
Vegetables		0.03	4%				43,549	7,668	1,005
Vegetable 1	Carrot			12,600		1.50	18,900	6,510	
Vegetable 2	Onion			16,380		4.00	65,520	5,740	
Vegetable 3	Tomato			18,900		1.75	33,075	9,410	
Vegetable 4	Green pepper			12,600		4.50	56,700	9,013	
Vegetable 5	Bean	0.04	5%	3,150		8.00	25,200	3,635	932
Forage	Alfalfa	0.01	2%	28		350.00	9,828	6,924	37
Arboriculture		0.10	13%				22,096	4,116	1,855
Arb. 1	Date Palm	0.09	90%	1,573		15.50	24,385	4,547	
Arb. 2	Olive	0.01	10%	2,310		4.00	1,497	242	
Land out of cultivation			5%	0			0	0	0
		0.80	105%						5,900

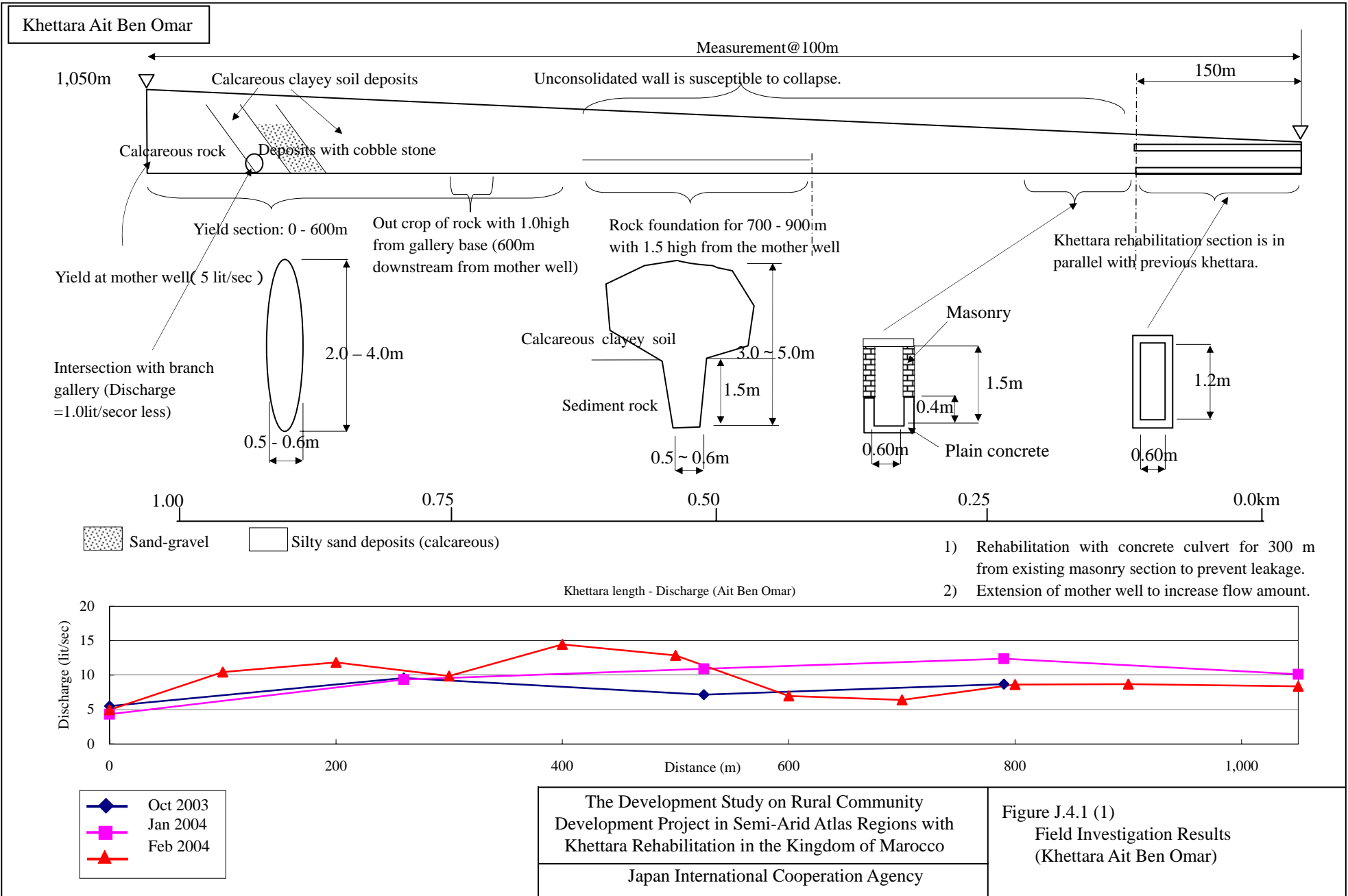
Table J.4.2 (7.2): Net Income from Agricultural Production dan "With Project" Condition (1 - 6 years); Jdida Taoumart (financial price)

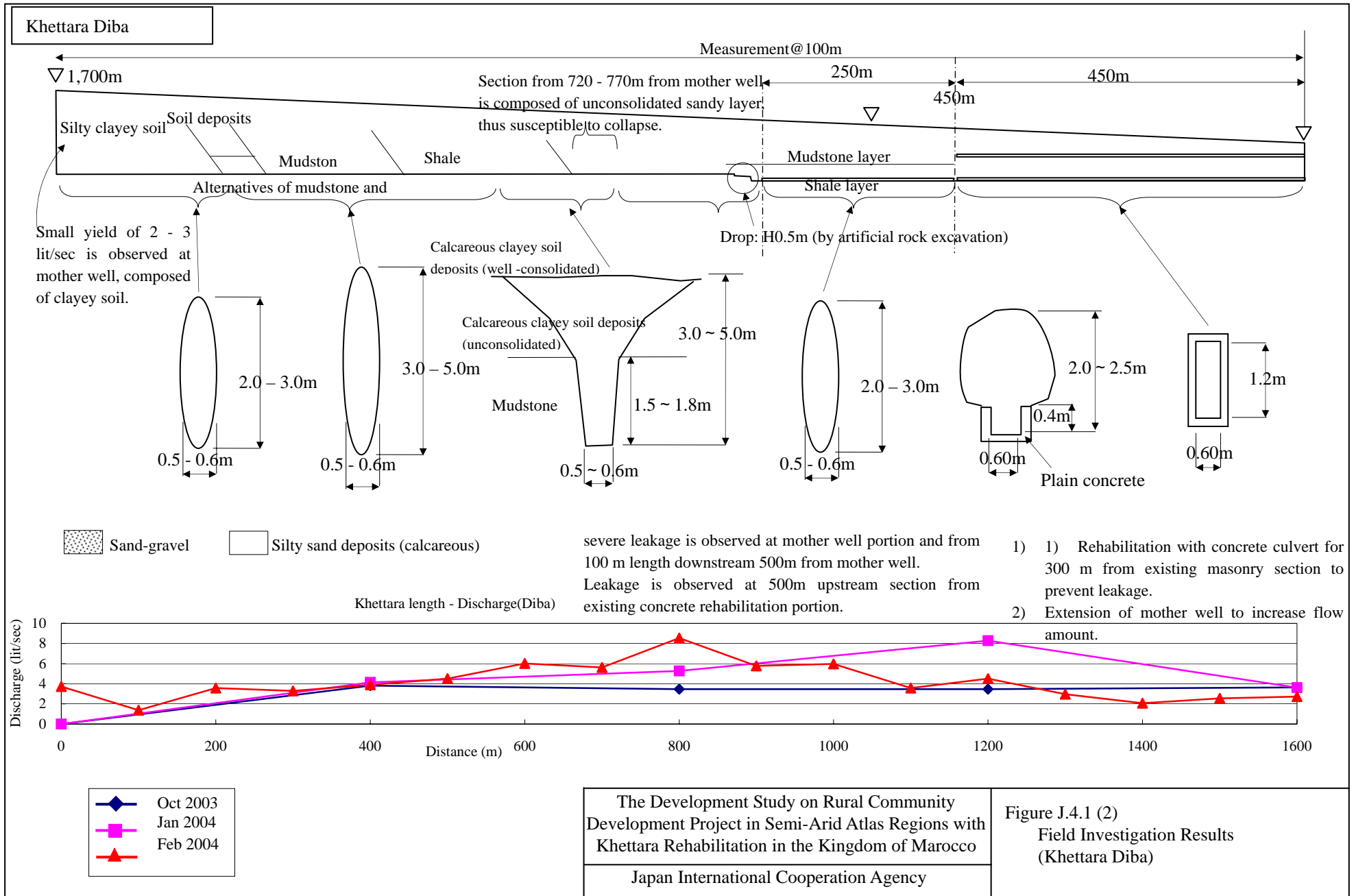
Cultures		Benefit					Input	Net Value [DH]	
		Area		Harvest		Unit Price	Value		Unit Price
		ha	%	Qty.	[kg/ha]	[DH/kg]	[DH/ha]	[DH/ha]	
Cereal	Wheat	0.61	60%	2,700		3.00	9,300	6,640	1,630
Vegetables		0.14	14%				50,698	9,788	5,850
Vegetable 1	Carrot			15,300		1.50	22,950	8,190	
Vegetable 2	Onion			18,720		4.00	74,880	7,890	
Vegetable 3	Tomato			22,950		1.75	40,163	11,890	
Vegetable 4	Green pepper			14,400		4.50	64,800	11,183	
Vegetable 5	Bean	0.04	4%	4,320		8.00	34,560	5,300	1,264
Forage	Alfalfa	0.13	12%	42		350.00	14,742	9,632	653
Arboriculture		0.10	10%				40,015	9,763	3,036
Arb. 1	Date Palm	0.09	90%	2,736		15.50	42,408	10,258	
Arb. 2	Olive	0.01	10%	4,620		4.00	18,480	5,306	
Land out of cultivation			5%				0		0
		1.03	105%				0		12,400

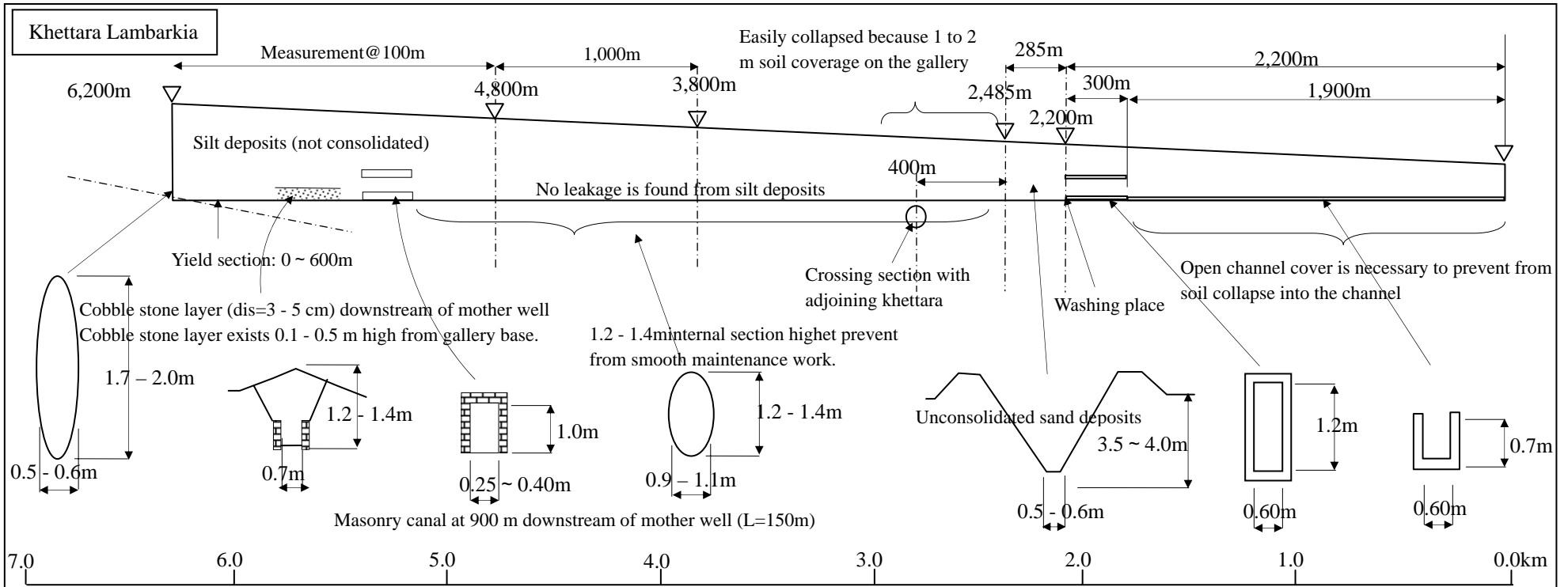
Table J.4.2 (7.3): Net Income from Agricultural Production dan "With Project" Condition (7-30 years); Jdida Taoumart (financial price)

Cultures		Benefit					Input	Net Value [DH]	
		Area		Harvest		Unit Price	Value		Unit Price
		ha	%	Qty.	[kg/ha]	[DH/kg]	[DH/ha]	[DH/ha]	
Cereal	Wheat	0.61	60%	2,700		3.00	9,300	6,640	1,630
Vegetables		0.14	14%				50,698	9,788	5,850
Vegetable 1	Carrot			15,300		1.50	22,950	8,190	
Vegetable 2	Onion			18,720		4.00	74,880	7,890	
Vegetable 3	Tomato			22,950		1.75	40,163	11,890	
Vegetable 4	Green pepper			14,400		4.50	64,800	11,183	
Vegetable 5	Bean	0.04	4%	4,320		8.00	34,560	5,300	1,264
Forage	Alfalfa	0.01	1%	42		350.00	14,742	9,632	65
Arboriculture		0.22	21%				41,929	10,159	6,742
Arb. 1	Date Palm	0.21	98%	2,736		15.50	42,408	10,258	
Arb. 2	Olive	0.01	2%	4,620		4.00	18,480	5,306	
Land out of cultivation			5%				0		0
		1.03	105%				0		15,600

Figures



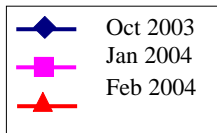
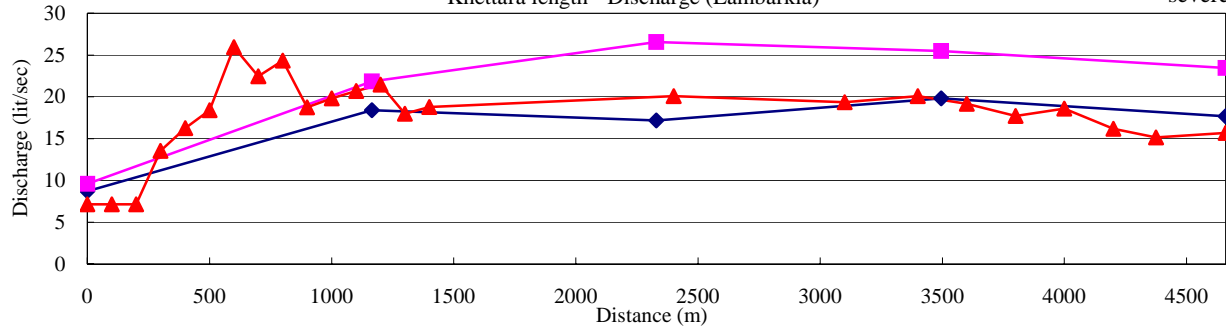




Sand-gravel
 Silty sand deposits (calcareous)

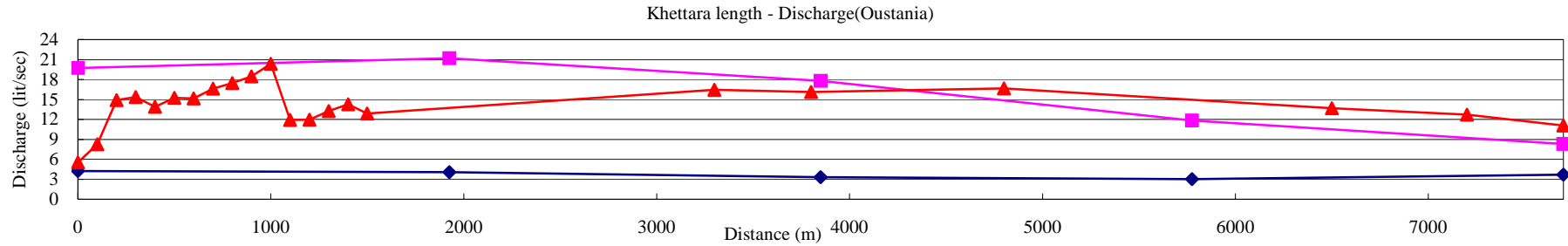
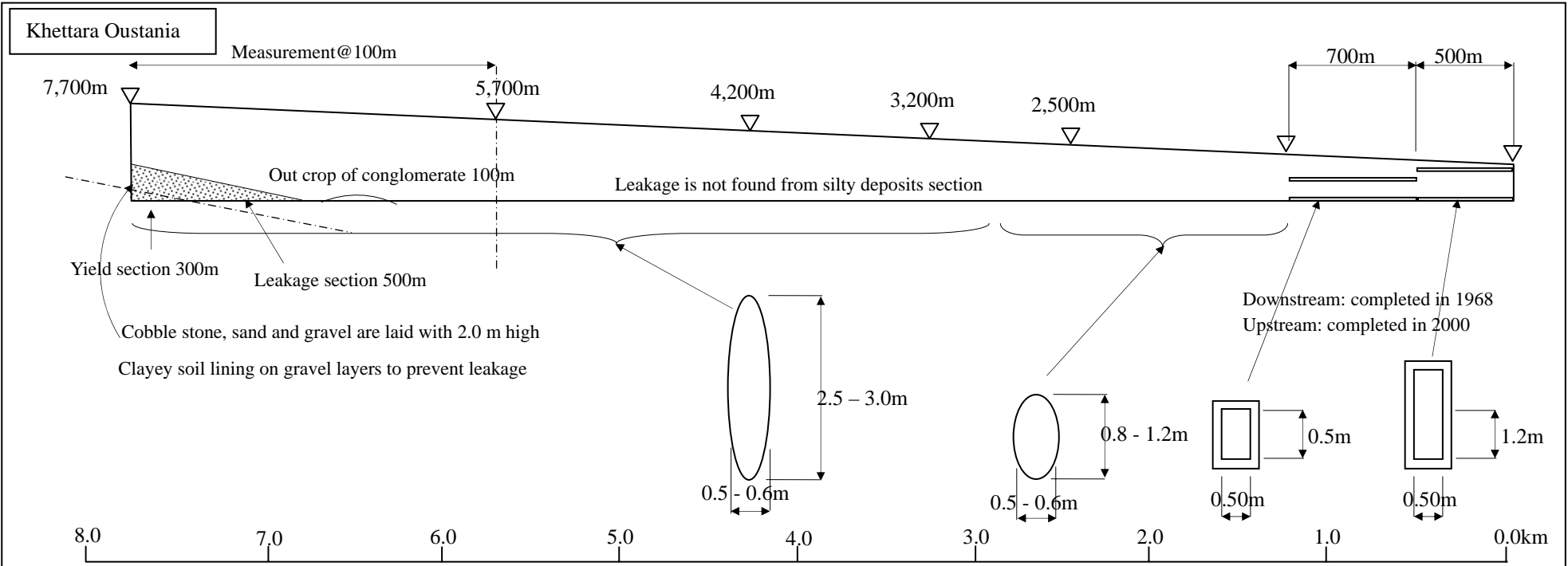
Khattara length - Discharge (Lambarkia)

Sediment is removed 2 times a year, but limited to severely accumulated portion.



The Development Study on Rural Community
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Figure J.4.1 (3)
 Field Investigation Results
 (Khattara Lambarkia)

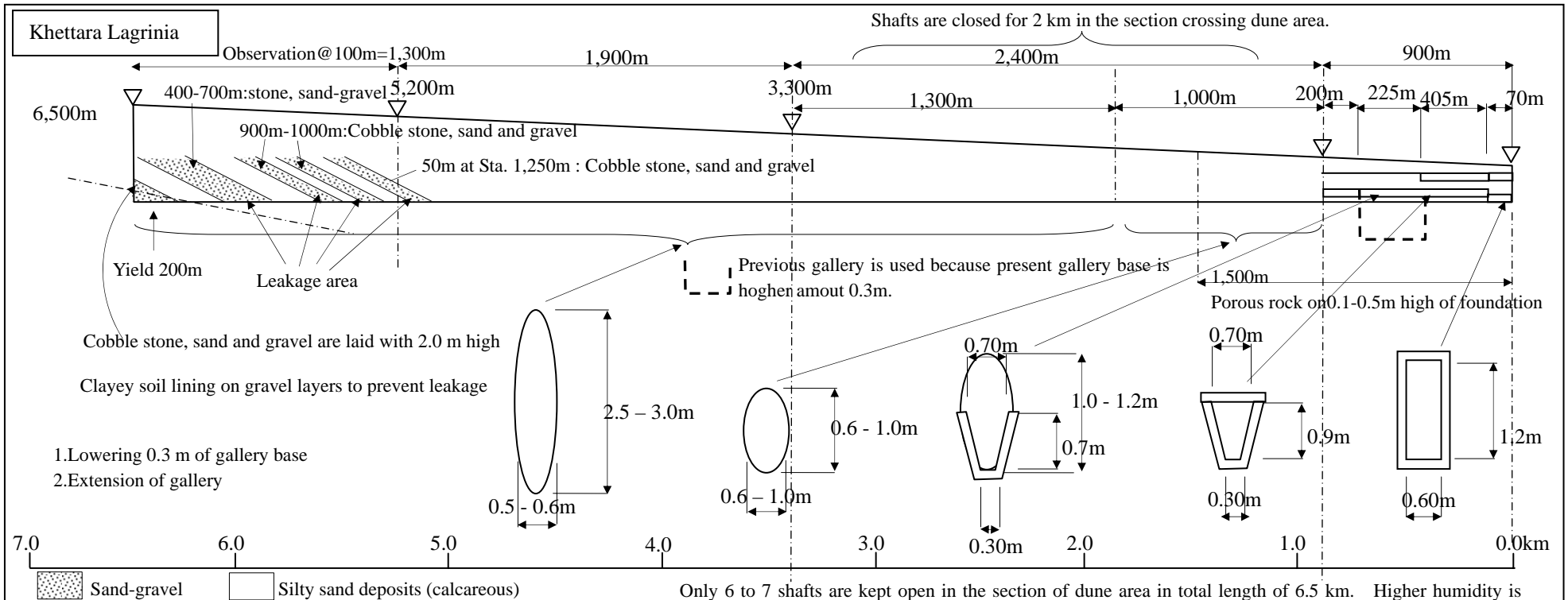


◆ Oct 2003
■ Jan 2004
▲ Feb 2004

The Development Study on Rural Community Development Project in Semi-Arid Atlas Regions with Khettara Rehabilitation in the Kingdom of Morocco

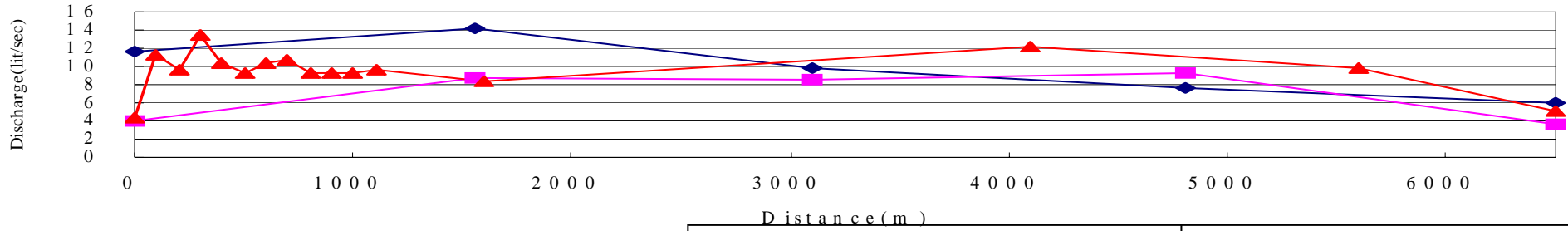
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Figure J.4.1 (4)
Field Investigation Results (Khettara Oustania)



Only 6 to 7 shafts are kept open in the section of dune area in total length of 6.5 km. Higher humidity is observed in the gallery, however wall collapse is not found. Gallery protection with concrete or masonry is necessary from collapse.

K h e t t a r a l e n g t h - D i s c h a r g e (L a g r i n i a)



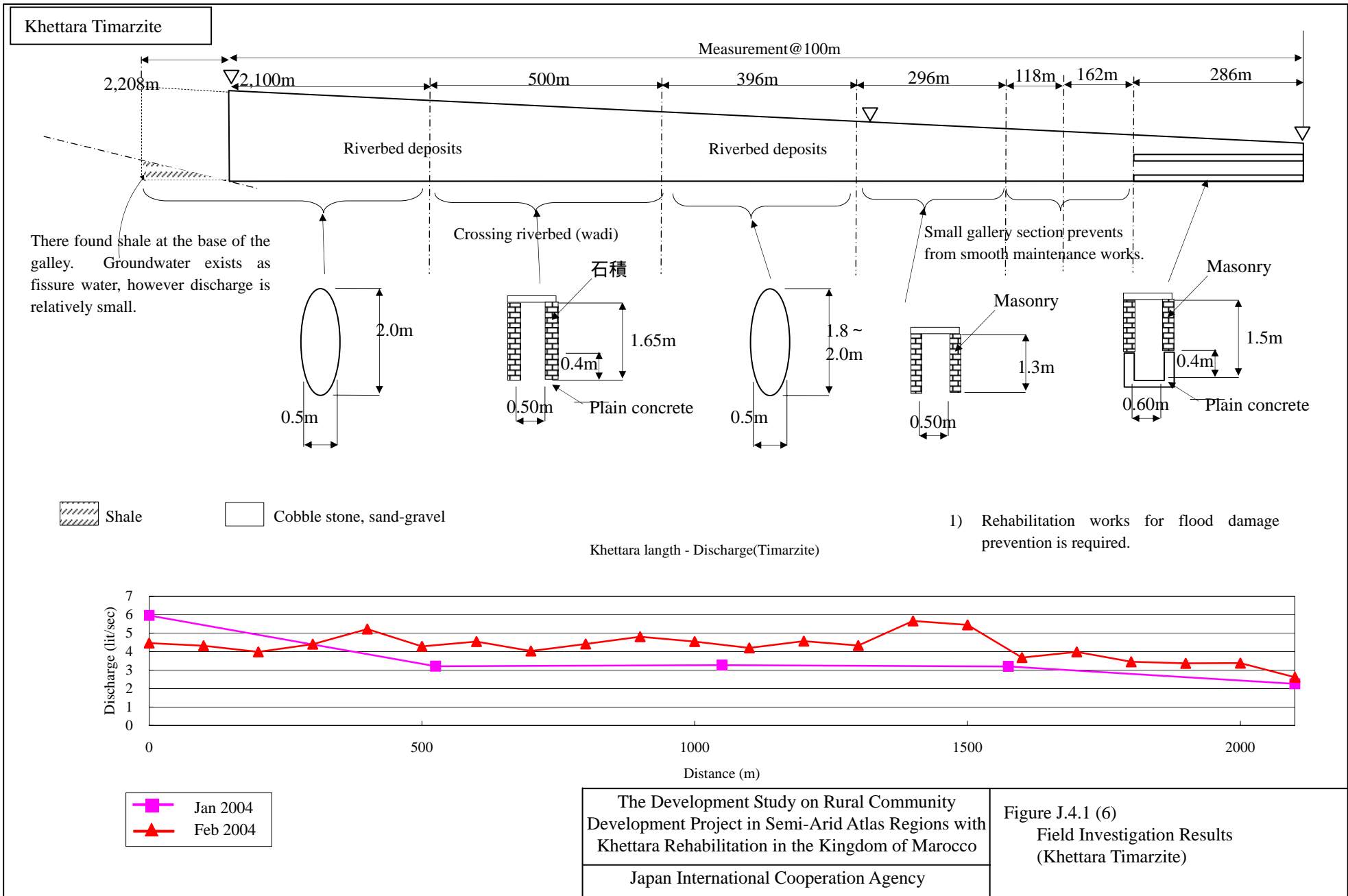
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 ■ Jan 2004
 ▲ Feb 2004

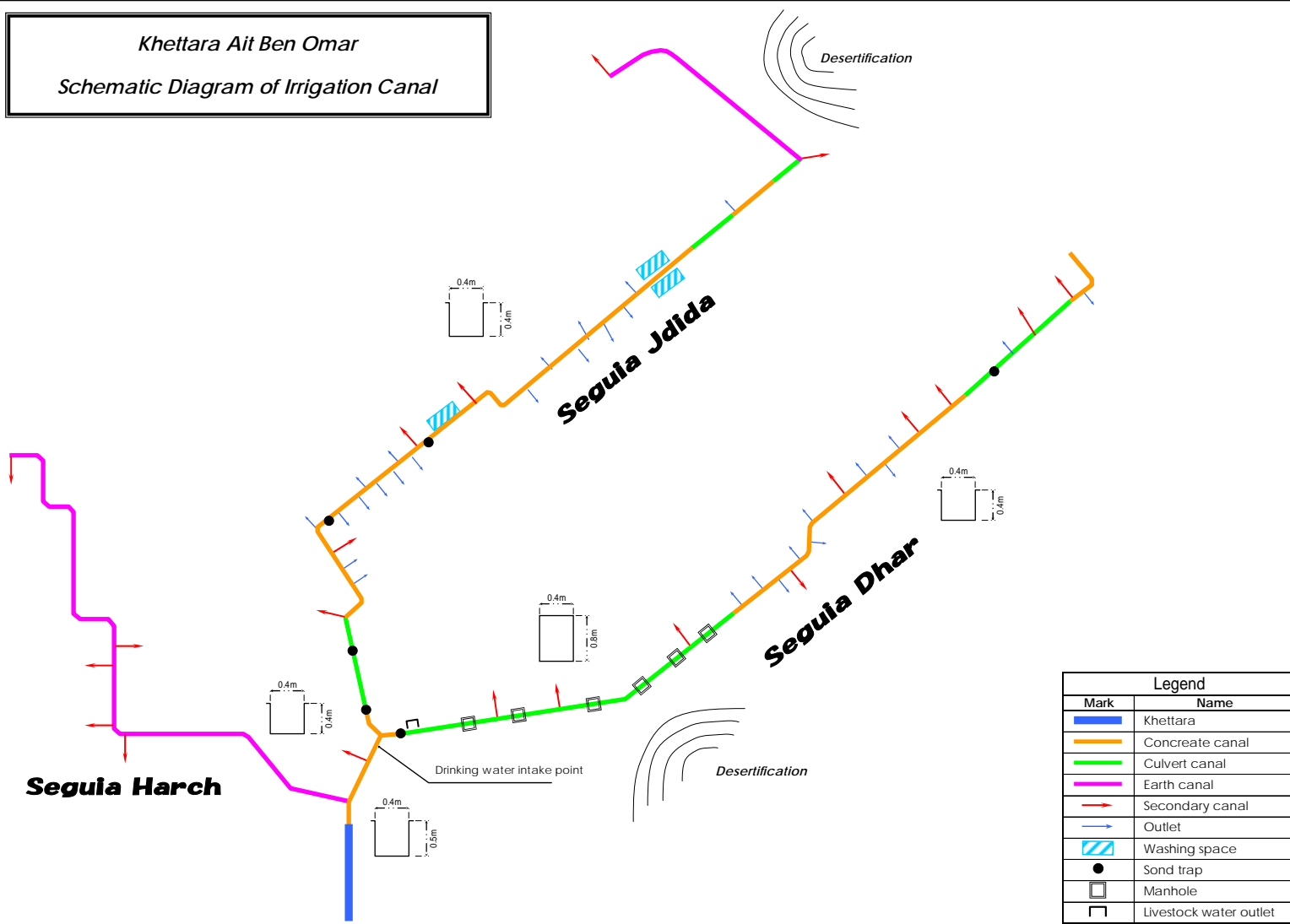
Sediment is removed 3 times a year, but limited to severely accumulated portion.

The Development Study on Rural Community Development Project in Semi-Arid Atlas Regions with Khetara Rehabilitation in the Kingdom of Marocco

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Figure J.4.1 (5)
Field Investigation Results
(Khetara Lagrinia)



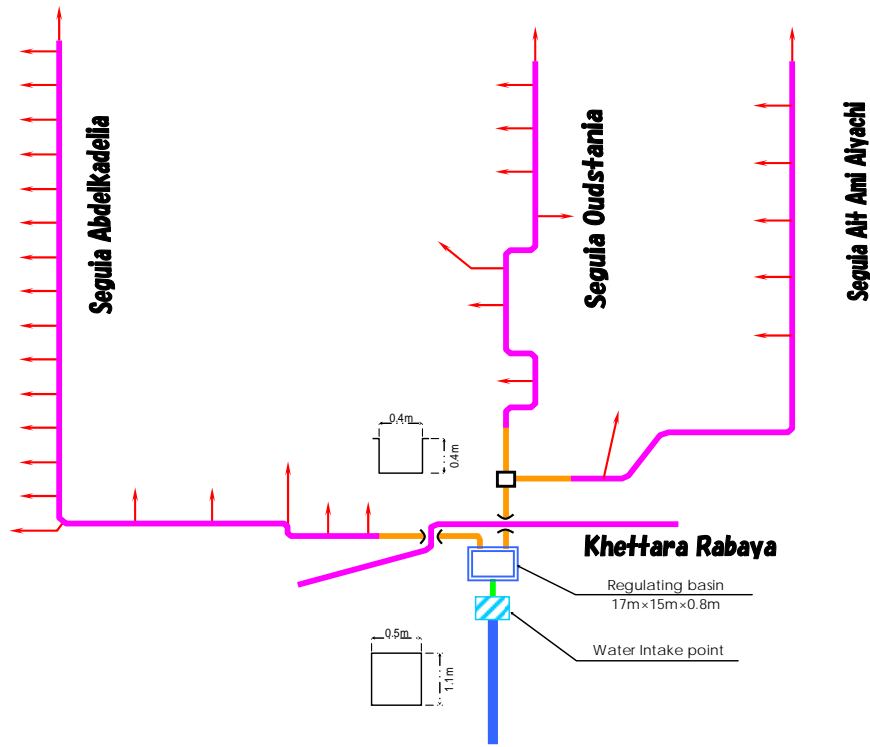


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Figure J.4.2 (1)
Khetara Ait Ben Omar

*Khattara Diba
Schematic Diagram of Irrigation Canal*



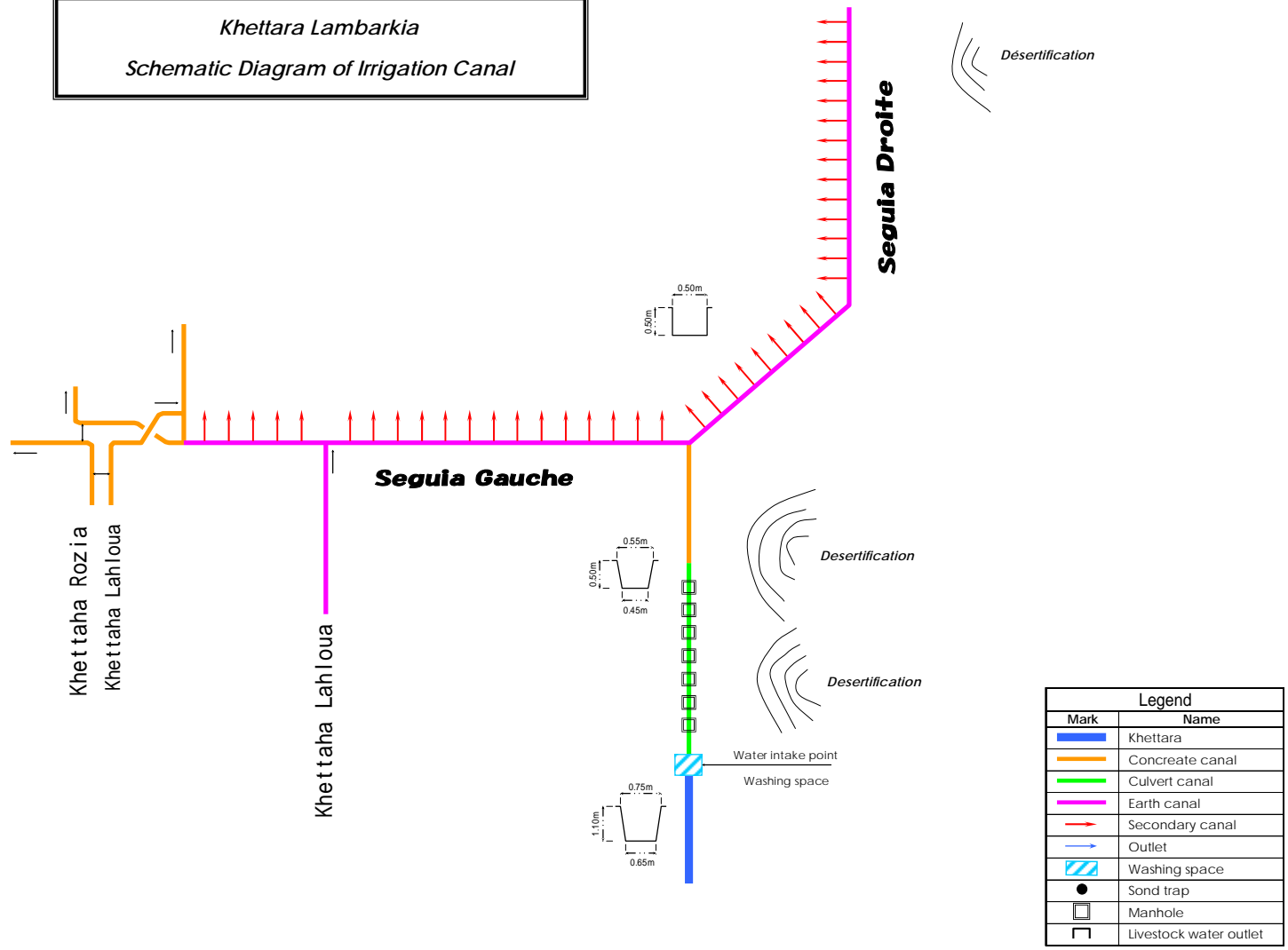
Legend	
Mark	Name
	Khattara
	Concrete canal
	Culvert canal
	Earth canal
	Secondary canal
	Outlet
	Washing space
	Sond trap
	Manhole
	Livestock water outlet

The Development Study on Rural Community Development Project
in Semi-Arid East Atlas Regions with Khattara Rehabilitation
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Figure J.4.2 (2)
Khattara Diba

Khettara Lambarkia
Schematic Diagram of Irrigation Canal

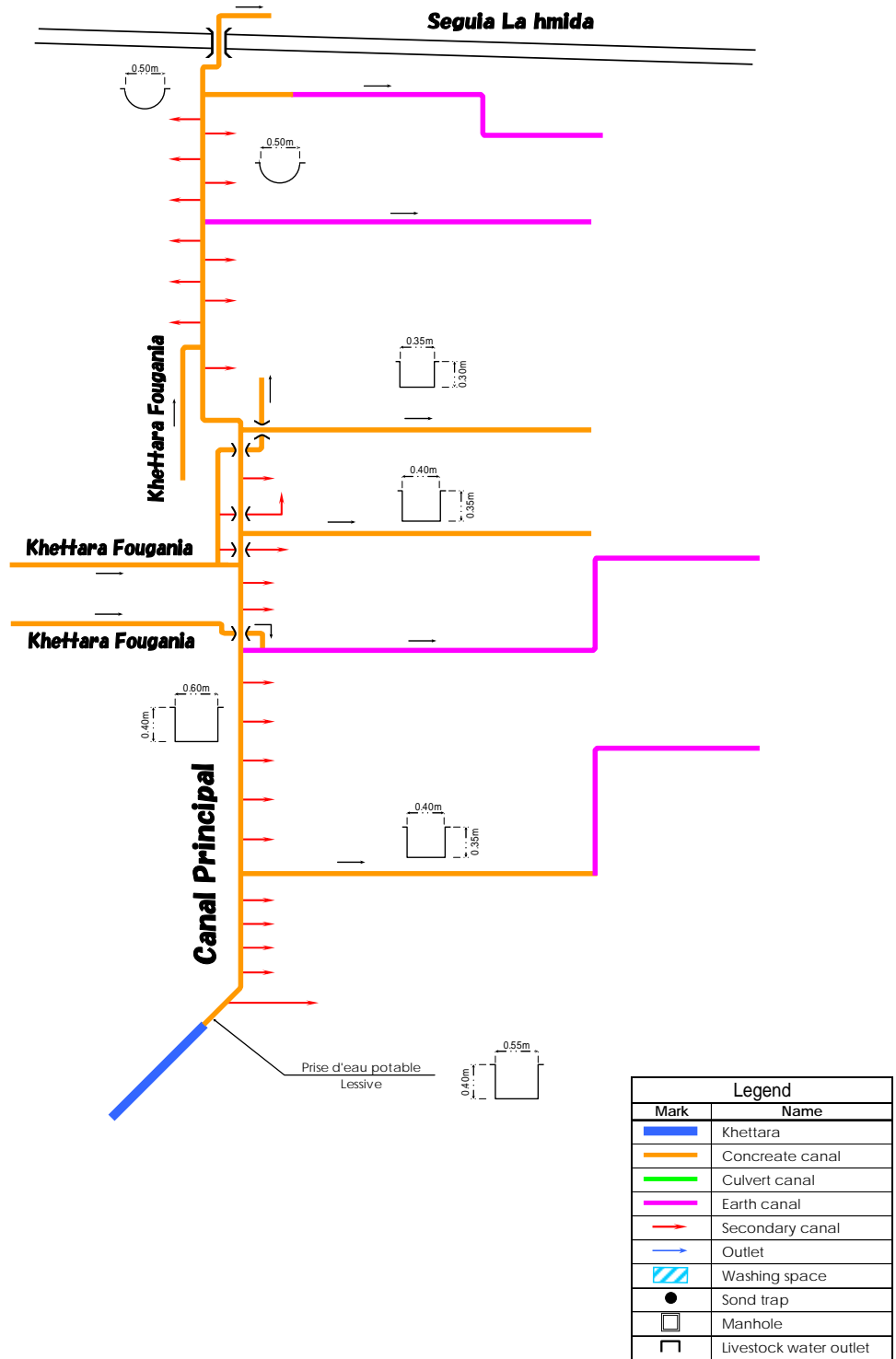


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Figure J.4.2 (3)
 Khettara Lambarkia

Khettara Oustania
Schematic Diagram of Irrigation Canal

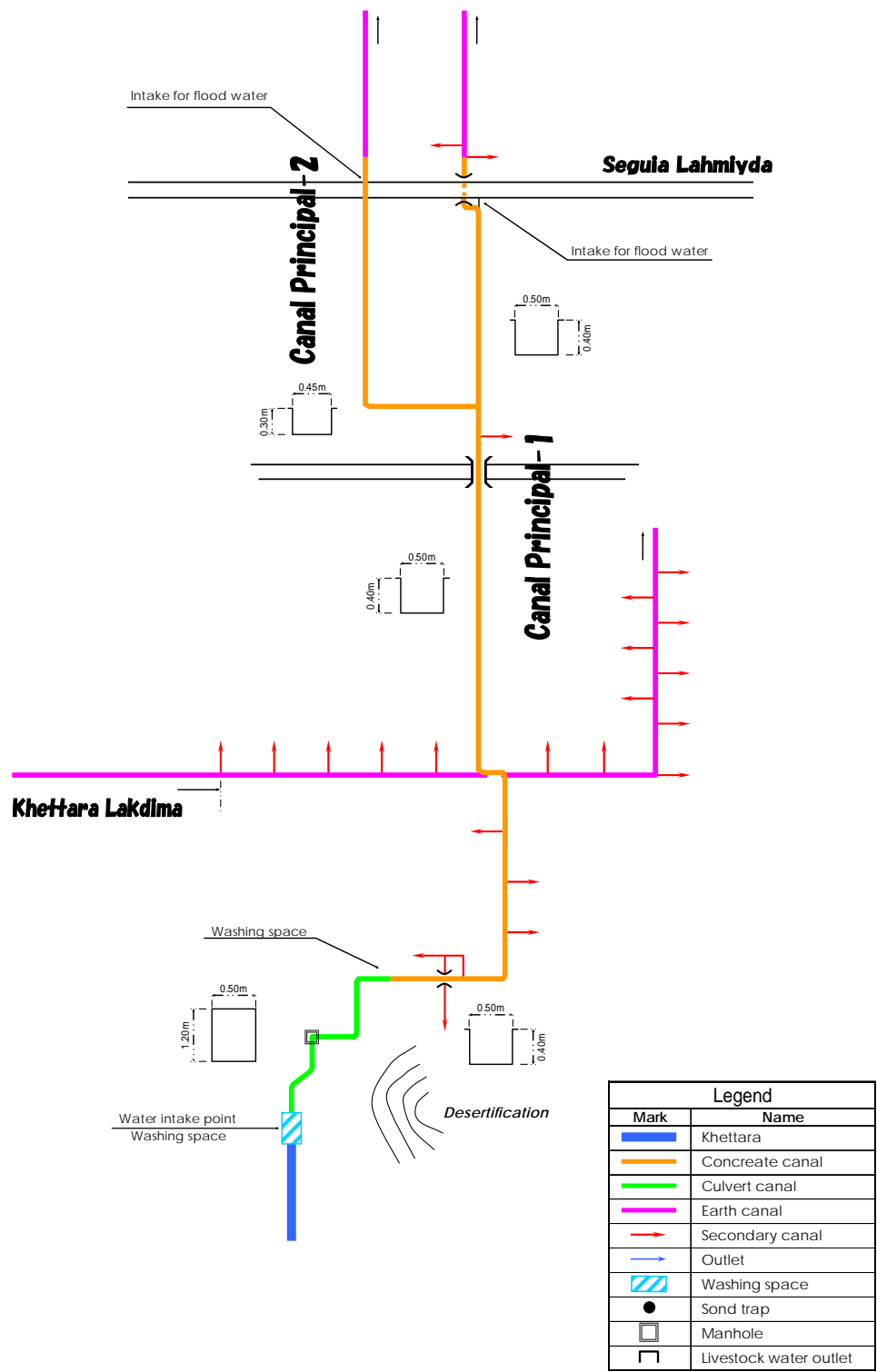


The Development Study on Rural Community Development Project
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in the Kingdom of Morocco

Figure J.4.2 (4)
Khettara Oustania

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Khettara Lagrinia
Schematic Diagram of Irrigation Canal



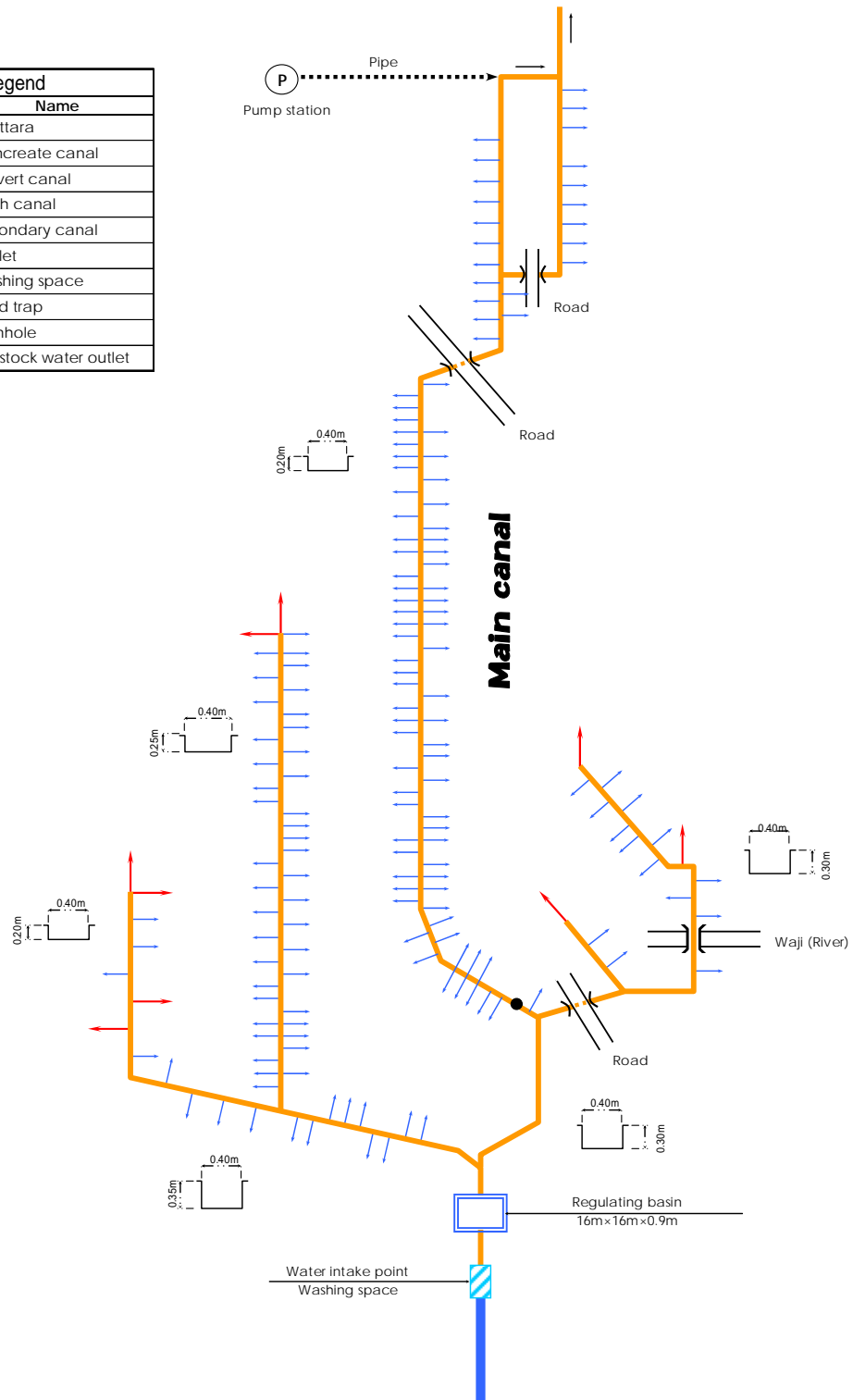
The Development Study on Rural Community Development Project
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in the Kingdom of Morocco

Figure J.4.2 (5)
Khettara Lagrinia

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Khettara Timarzite
Schematic Diagram of Irrigation Canal

Legend	
Mark	Name
	Khettara
	Concrete canal
	Culvert canal
	Earth canal
	Secondary canal
	Outlet
	Washing space
	Sand trap
	Manhole
	Livestock water outlet

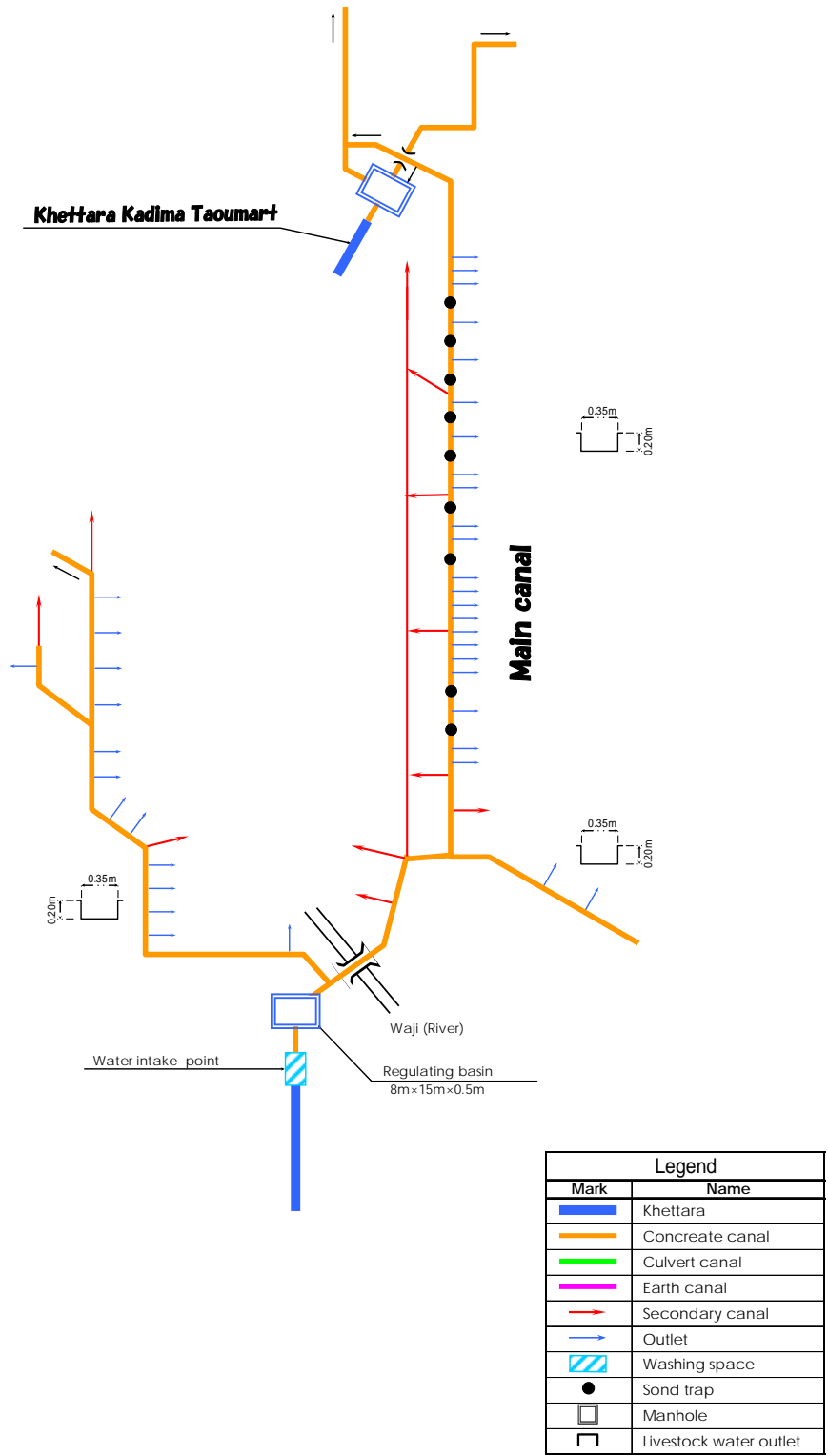


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in the Kingdom of Morocco

Japan International Cooperation Agency

Figure J.4.2 (6)
Khettara Timarzite

Khettara Jadid Taoumart
Schematic Diagram of Irrigation Canal

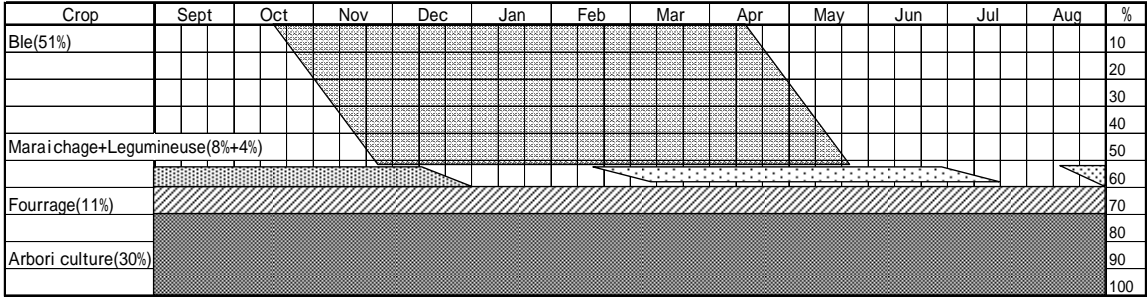


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in the Kingdom of Morocco

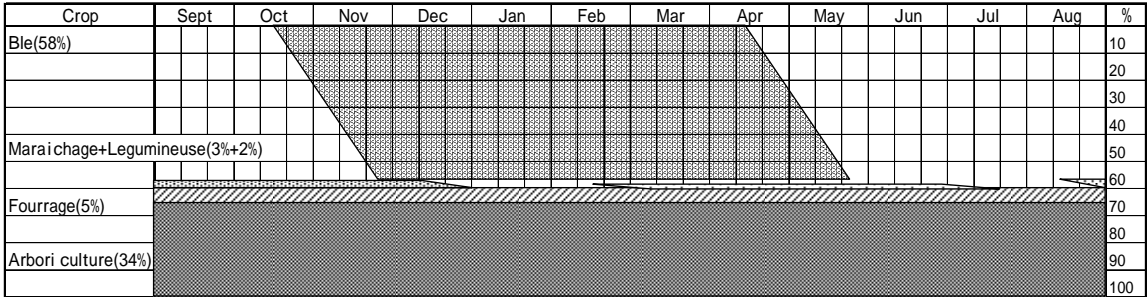
Figure J.4.2 (7)
Khettara Taoumart

Japan International Cooperation Agency

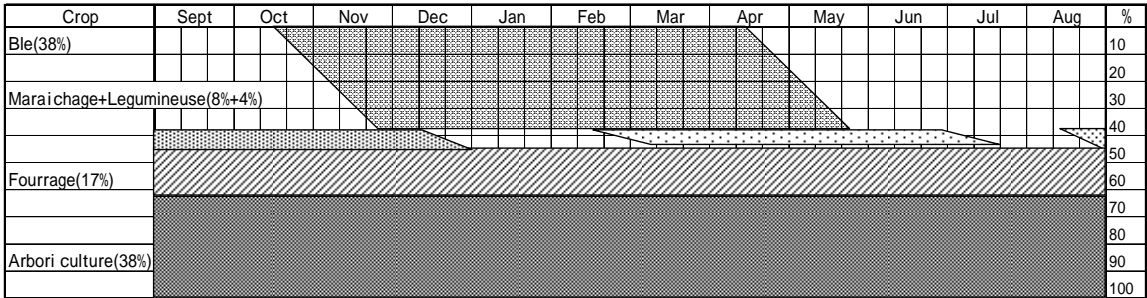
Ait Ben Omar



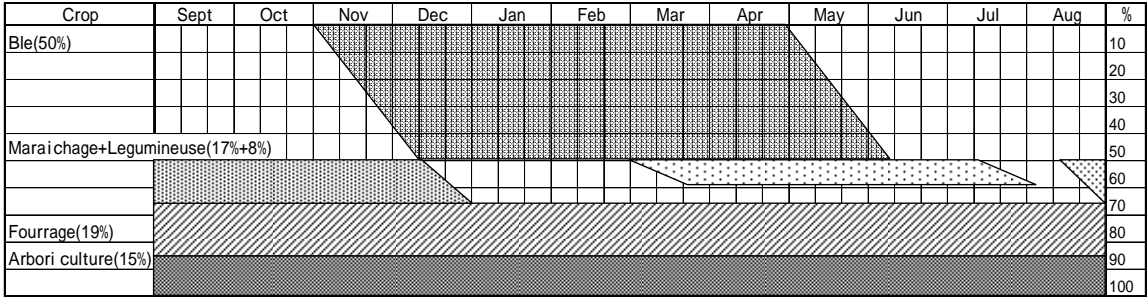
Diba



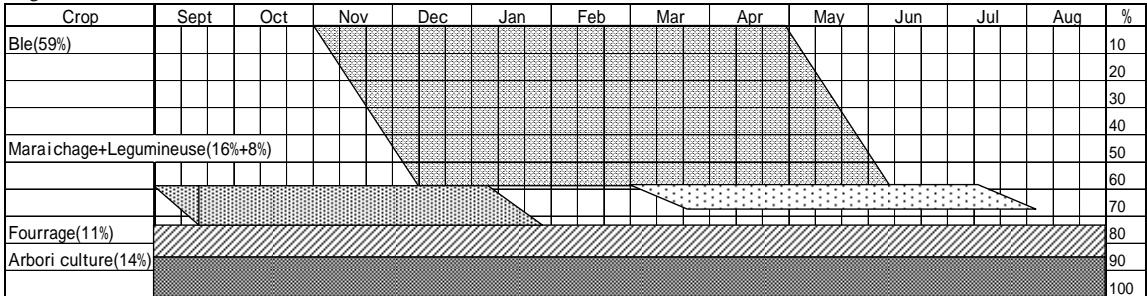
Lambarkia



Qustania



Lagrinia

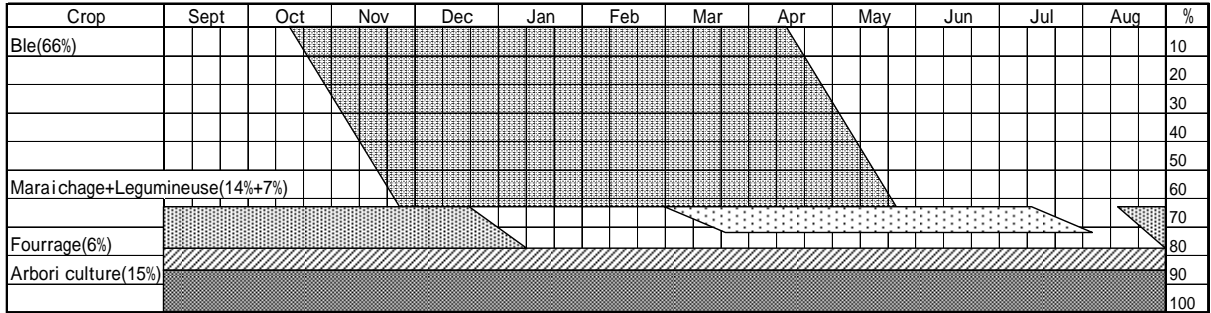


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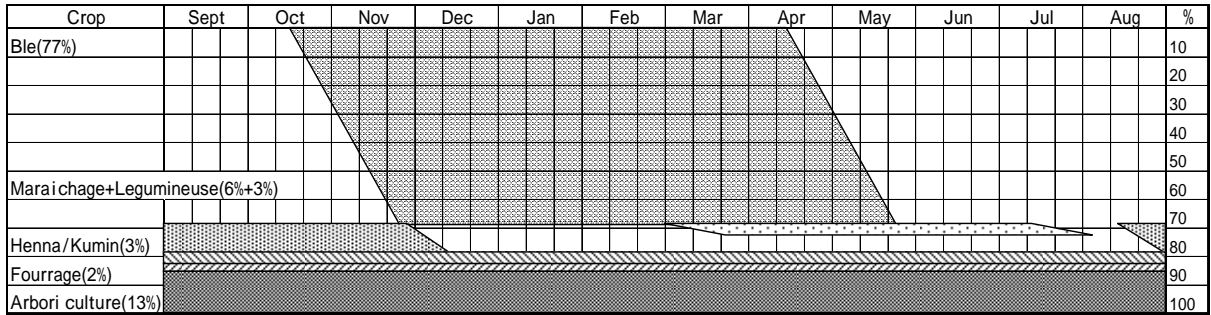
Figure J.4.3 (1/2)
Present Cropping Pattern

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Timzazite



Taoumart

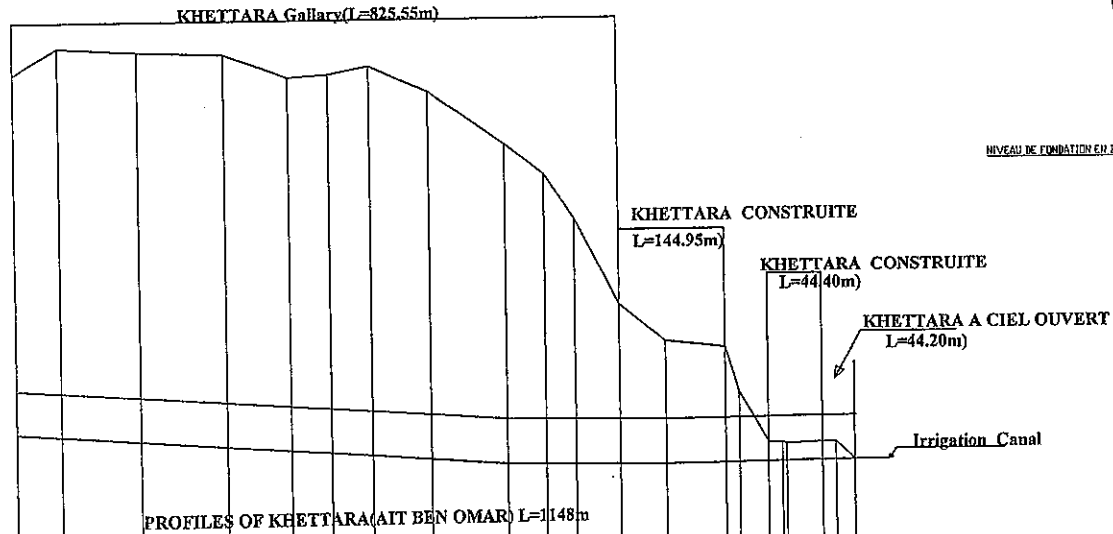
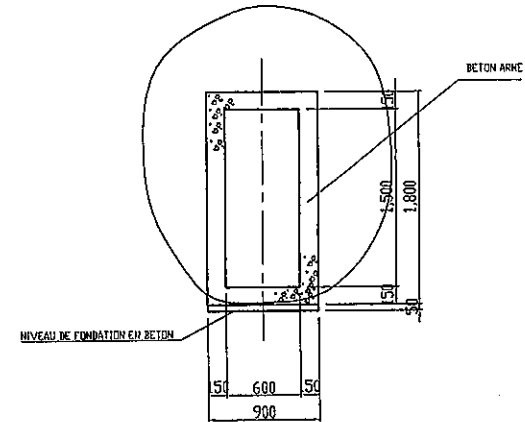
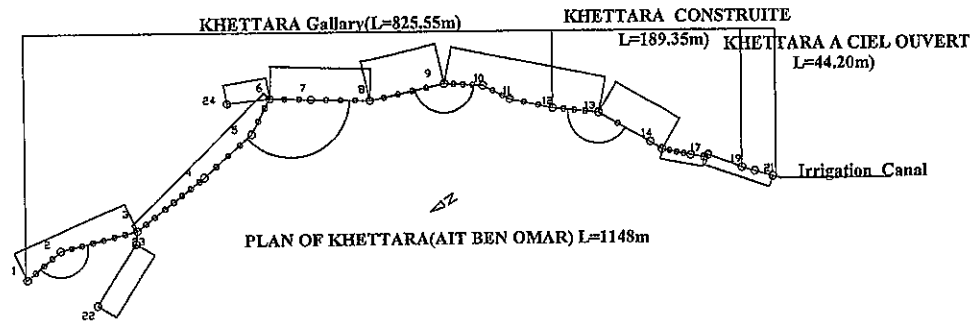


The Development Study on Rural Community Development Project
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Figure J.4.3 (2/2)
Present Cropping Pattern

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PLAN DE REHABILITATION DES KHETTARAS



SCALE EN X = 1/ 5000
SCALE EN Y = 1/ 100

PLAN DE COMPARAISON

GROUND ELEVATION	1000.281	1001.001	1001.873	1002.784	1003.145	1003.216	1003.427	1003.718	1003.253	1007.410	1005.181	1003.812	1002.713	1002.604	1002.281	999.876	999.847	999.818	999.843	999.882	999.341
DISTANCES	60.76	107.42	117.56	87.53	55.01	56.34	88.72	105.02	53.54	41.04	60.62	63.43	81.48	29.76	19.08	43.22	18.39	18.39	15.72		
ACUMULATED	00	60.76	168.18	285.74	372.27	428.29	487.01	565.35	670.36	723.90	764.94	825.56	886.99	970.48	989.28	1029.56	1048.64	1097.91	1124.21	1148.14	1148.14
CANAL BED ELEVATION	1000.27			999.94					999.37				999.30								
DECLIVITES PROJET																					
ALIGNEMENTS & CURVE		L=107.42	L=117.56						L=105.02												

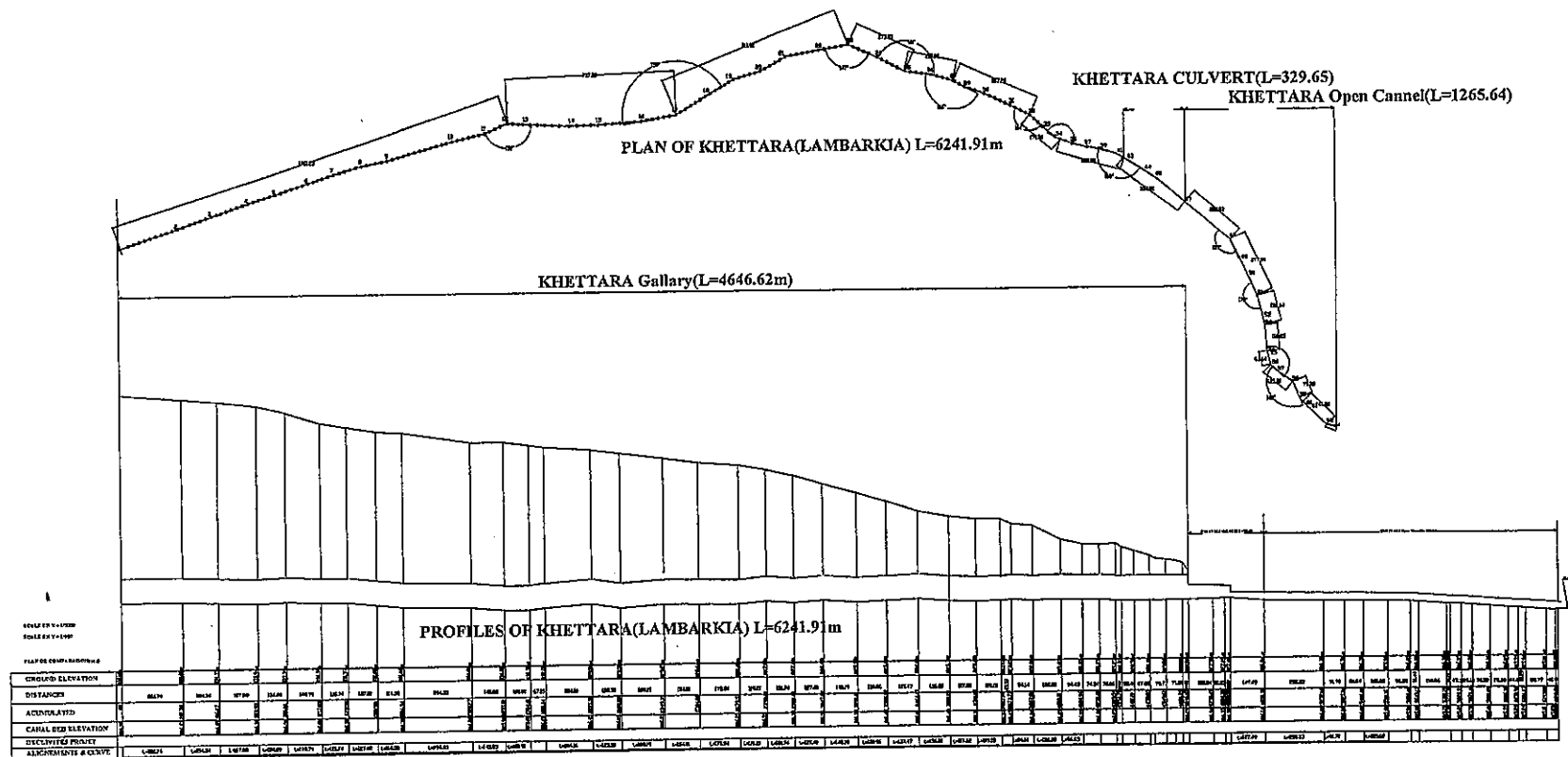
Figure J.4.4 (1)

Plan of Khetara Rehabilitation (Ait Ben Omar)

PROJET DE DEVELOPPEMENT DES COMMUNAUTES RURALES A TRAVERS LA REHABILITATION DES KHETTARAS DANS LES REGIONS SEMI-ARIDES DE L'EST SUD-ATLANTIQUE DU ROYAUME DU MAROC

AGENCE JAPONAISE DE COOPERATION INTERNATIONALE

PLAN DE REHABILITATION DES KHETTARAS

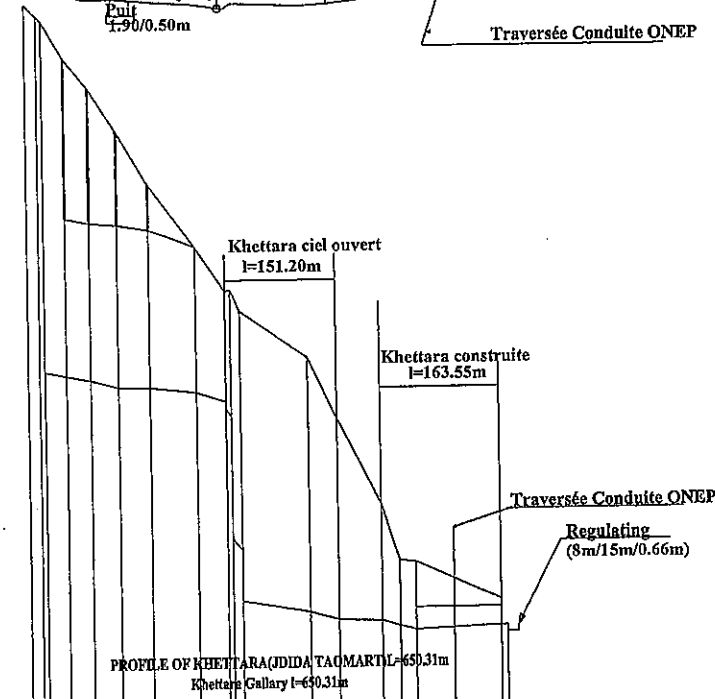
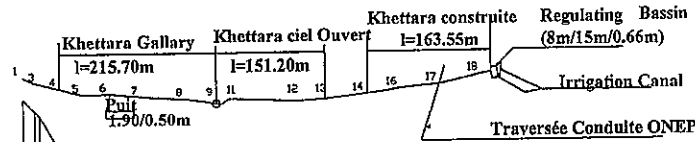


CIRCUITS ELEVATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
DISTANCES	0+00	0+10	0+20	0+30	0+40	0+50	0+60	0+70	0+80	0+90	0+100	0+110	0+120	0+130	0+140	0+150	0+160	0+170	0+180	0+190	0+200	0+210	0+220	0+230	0+240	0+250	0+260	0+270	0+280	0+290	0+300	0+310	0+320	0+330	0+340	0+350	0+360	0+370	0+380	0+390	0+400	0+410	0+420	0+430	0+440	0+450	0+460	0+470	0+480	0+490	0+500	0+510	0+520	0+530	0+540	0+550	0+560	0+570	0+580	0+590	0+600	0+610	0+620	0+630	0+640	0+650	0+660	0+670	0+680	0+690	0+700	0+710	0+720	0+730	0+740	0+750	0+760	0+770	0+780	0+790	0+800	0+810	0+820	0+830	0+840	0+850	0+860	0+870	0+880	0+890	0+900	0+910	0+920	0+930	0+940	0+950	0+960	0+970	0+980	0+990	1+000	1+010	1+020	1+030	1+040	1+050	1+060	1+070	1+080	1+090	1+100	1+110	1+120	1+130	1+140	1+150	1+160	1+170	1+180	1+190	1+200	1+210	1+220	1+230	1+240	1+250	1+260	1+270	1+280	1+290	1+300	1+310	1+320	1+330	1+340	1+350	1+360	1+370	1+380	1+390	1+400	1+410	1+420	1+430	1+440	1+450	1+460	1+470	1+480	1+490	1+500	1+510	1+520	1+530	1+540	1+550	1+560	1+570	1+580	1+590	1+600	1+610	1+620	1+630	1+640	1+650	1+660	1+670	1+680	1+690	1+700	1+710	1+720	1+730	1+740	1+750	1+760	1+770	1+780	1+790	1+800	1+810	1+820	1+830	1+840	1+850	1+860	1+870	1+880	1+890	1+900	1+910	1+920	1+930	1+940	1+950	1+960	1+970	1+980	1+990	2+000	2+010	2+020	2+030	2+040	2+050	2+060	2+070	2+080	2+090	2+100	2+110	2+120	2+130	2+140	2+150	2+160	2+170	2+180	2+190	2+200	2+210	2+220	2+230	2+240	2+250	2+260	2+270	2+280	2+290	2+300	2+310	2+320	2+330	2+340	2+350	2+360	2+370	2+380	2+390	2+400	2+410	2+420	2+430	2+440	2+450	2+460	2+470	2+480	2+490	2+500	2+510	2+520	2+530	2+540	2+550	2+560	2+570	2+580	2+590	2+600	2+610	2+620	2+630	2+640	2+650	2+660	2+670	2+680	2+690	2+700	2+710	2+720	2+730	2+740	2+750	2+760	2+770	2+780	2+790	2+800	2+810	2+820	2+830	2+840	2+850	2+860	2+870	2+880	2+890	2+900	2+910	2+920	2+930	2+940	2+950	2+960	2+970	2+980	2+990	3+000	3+010	3+020	3+030	3+040	3+050	3+060	3+070	3+080	3+090	3+100	3+110	3+120	3+130	3+140	3+150	3+160	3+170	3+180	3+190	3+200	3+210	3+220	3+230	3+240	3+250	3+260	3+270	3+280	3+290	3+300	3+310	3+320	3+330	3+340	3+350	3+360	3+370	3+380	3+390	3+400	3+410	3+420	3+430	3+440	3+450	3+460	3+470	3+480	3+490	3+500	3+510	3+520	3+530	3+540	3+550	3+560	3+570	3+580	3+590	3+600	3+610	3+620	3+630	3+640	3+650	3+660	3+670	3+680	3+690	3+700	3+710	3+720	3+730	3+740	3+750	3+760	3+770	3+780	3+790	3+800	3+810	3+820	3+830	3+840	3+850	3+860	3+870	3+880	3+890	3+900	3+910	3+920	3+930	3+940	3+950	3+960	3+970	3+980	3+990	4+000	4+010	4+020	4+030	4+040	4+050	4+060	4+070	4+080	4+090	4+100	4+110	4+120	4+130	4+140	4+150	4+160	4+170	4+180	4+190	4+200	4+210	4+220	4+230	4+240	4+250	4+260	4+270	4+280	4+290	4+300	4+310	4+320	4+330	4+340	4+350	4+360	4+370	4+380	4+390	4+400	4+410	4+420	4+430	4+440	4+450	4+460	4+470	4+480	4+490	4+500	4+510	4+520	4+530	4+540	4+550	4+560	4+570	4+580	4+590	4+600	4+610	4+620	4+630	4+640	4+650	4+660	4+670	4+680	4+690	4+700	4+710	4+720	4+730	4+740	4+750	4+760	4+770	4+780	4+790	4+800	4+810	4+820	4+830	4+840	4+850	4+860	4+870	4+880	4+890	4+900	4+910	4+920	4+930	4+940	4+950	4+960	4+970	4+980	4+990	5+000	5+010	5+020	5+030	5+040	5+050	5+060	5+070	5+080	5+090	5+100	5+110	5+120	5+130	5+140	5+150	5+160	5+170	5+180	5+190	5+200	5+210	5+220	5+230	5+240	5+250	5+260	5+270	5+280	5+290	5+300	5+310	5+320	5+330	5+340	5+350	5+360	5+370	5+380	5+390	5+400	5+410	5+420	5+430	5+440	5+450	5+460	5+470	5+480	5+490	5+500	5+510	5+520	5+530	5+540	5+550	5+560	5+570	5+580	5+590	5+600	5+610	5+620	5+630	5+640	5+650	5+660	5+670	5+680	5+690	5+700	5+710	5+720	5+730	5+740	5+750	5+760	5+770	5+780	5+790	5+800	5+810	5+820	5+830	5+840	5+850	5+860	5+870	5+880	5+890	5+900	5+910	5+920	5+930	5+940	5+950	5+960	5+970	5+980	5+990	6+000	6+010	6+020	6+030	6+040	6+050	6+060	6+070	6+080	6+090	6+100	6+110	6+120	6+130	6+140	6+150	6+160	6+170	6+180	6+190	6+200	6+210	6+220	6+230	6+240	6+250	6+260	6+270	6+280	6+290	6+300	6+310	6+320	6+330	6+340	6+350	6+360	6+370	6+380	6+390	6+400	6+410	6+420	6+430	6+440	6+450	6+460	6+470	6+480	6+490	6+500	6+510	6+520	6+530	6+540	6+550	6+560	6+570	6+580	6+590	6+600	6+610	6+620	6+630	6+640	6+650	6+660	6+670	6+680	6+690	6+700	6+710	6+720	6+730	6+740	6+750	6+760	6+770	6+780	6+790	6+800	6+810	6+820	6+830	6+840	6+850	6+860	6+870	6+880	6+890	6+900	6+910	6+920	6+930	6+940	6+950	6+960	6+970	6+980	6+990	7+000	7+010	7+020	7+030	7+040	7+050	7+060	7+070	7+080	7+090	7+100	7+110	7+120	7+130	7+140	7+150	7+160	7+170	7+180	7+190	7+200	7+210	7+220	7+230	7+240	7+250	7+260	7+270	7+280	7+290	7+300	7+310	7+320	7+330	7+340	7+350	7+360	7+370	7+380	7+390	7+400	7+410	7+420	7+430	7+440	7+450	7+460	7+470	7+480	7+490	7+500	7+510	7+520	7+530	7+540	7+550	7+560	7+570	7+580	7+590	7+600	7+610	7+620	7+630	7+640	7+650	7+660	7+670	7+680	7+690	7+700	7+710	7+720	7+730	7+740	7+750	7+760	7+770	7+780	7+790	7+800	7+810	7+820	7+830	7+840	7+850	7+860	7+870	7+880	7+890	7+900	7+910	7+920	7+930	7+940	7+950	7+960	7+970	7+980	7+990	8+000	8+010	8+020	8+030	8+040	8+050	8+060	8+070	8+080	8+090	8+100	8+110	8+120	8+130	8+140	8+150	8+160	8+170	8+180	8+190	8+200	8+210	8+220	8+230	8+240	8+250	8+260	8+270	8+280	8+290	8+300	8+310	8+320	8+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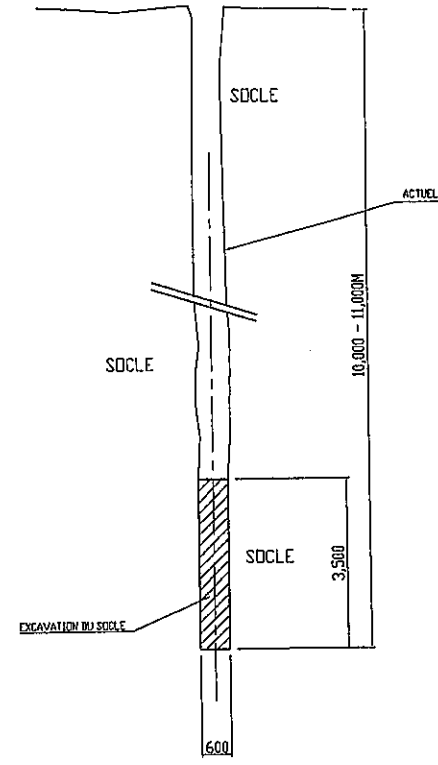
PLAN DE REHABILITATION DES KHETTARAS

PLAN OF KHETTARA(JDIDA TAOMART)L=650.31m

Khettara Gallery l=650.31m



PROFILE OF KHETTARA(JDIDA TAOMART)L=650.31m
Khettara Gallery l=650.31m



SCALE EN X = 1/ 5000
SCALE EN Y = 1/ 100

PLAN DE COMPARAISON 921.0

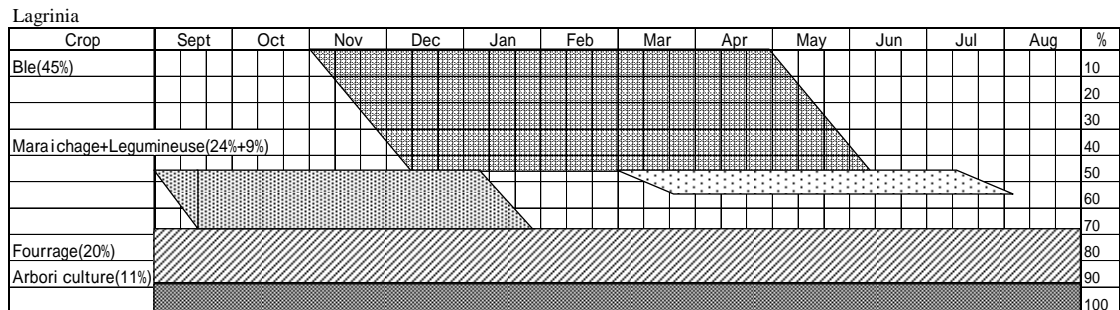
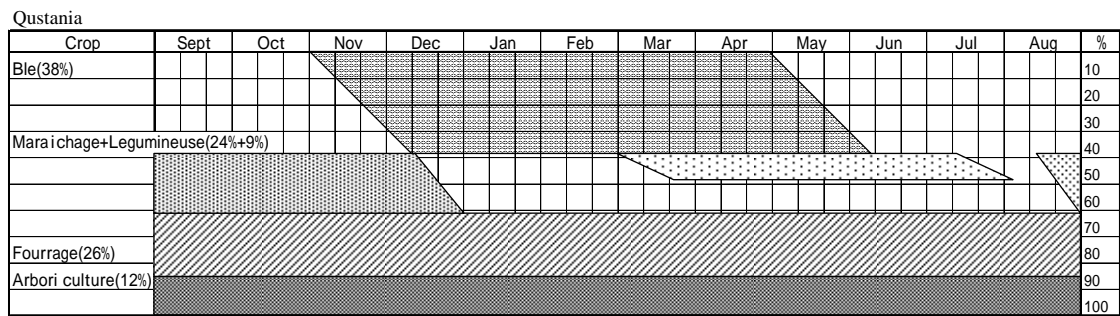
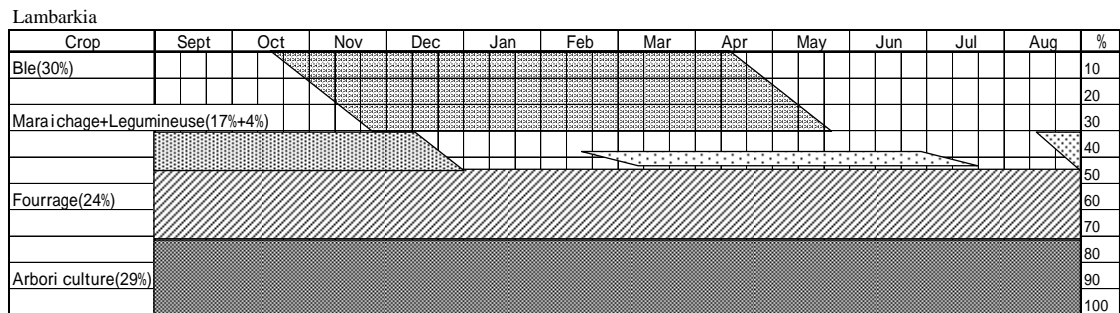
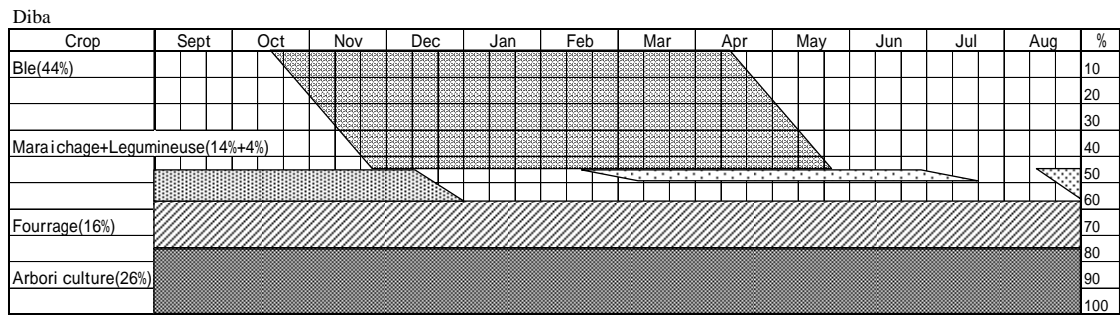
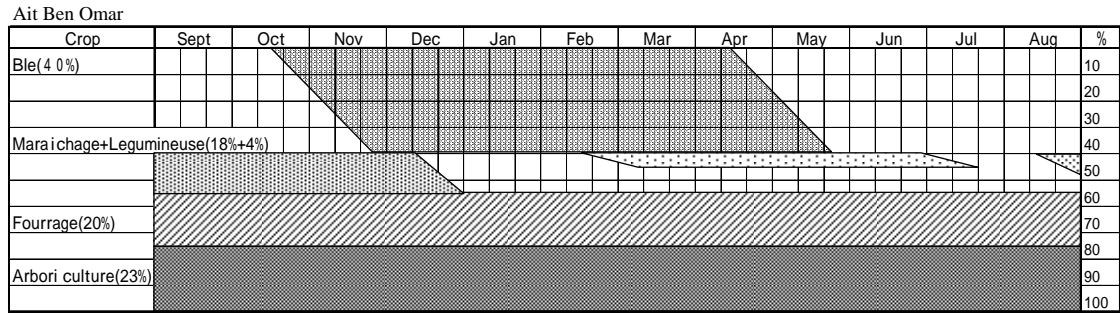
GROUND ELEVATION	941.42	941.11	939.92	939.00	937.90	936.38	934.64	933.39	932.32	931.50	929.80	927.46	925.89	925.81	924.86	924.15
DISTANCES	19.75	22.87	32.52	37.44	42.73	63.09	39.92	92.36	39.12	59.08	27.64	22.16	52.59	64.17		
ACUMULATED	15.90	38.77	84.45	121.89	164.62	227.71	267.63	359.99	452.35	544.85	643.97	703.61	756.20	820.37	884.52	948.67
CANAL BED ELEVATION	921.00	921.00	921.00	921.00	921.00	921.00	921.00	921.00	921.00	921.00	921.00	921.00	921.00	921.00	921.00	921.00
DECLIVITES PROJET																
ALIGNEMENTS ET CURVE																

Figure J.4.4 (7)

Plan of Khettara Rehabilitation (Taoumart)

PROJET DE DEVELOPPEMENT DES COMMUNAUTES RURALES A TRAVERS LA REHABILITATION DES KHEYTARAS DANS LES REGIONS SEMI-ARIDES DE L'EST SUD-ATLASIQUE DU ROYAUME DU MAROC

AGENCE JAPONAISE DE COOPERATION INTERNATIONALE

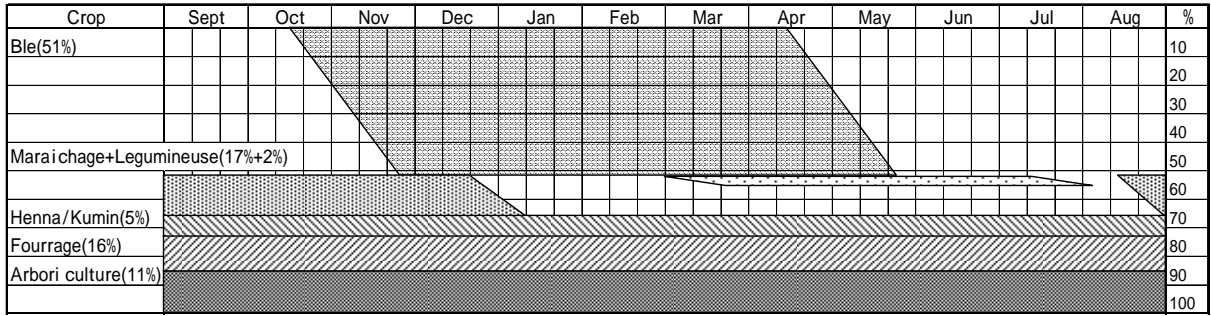


The Development Study on Rural Community Development Project
in Semi-Arid East Atlas Regions with Khetarra Rehabilitation
in the Kingdom of Morocco

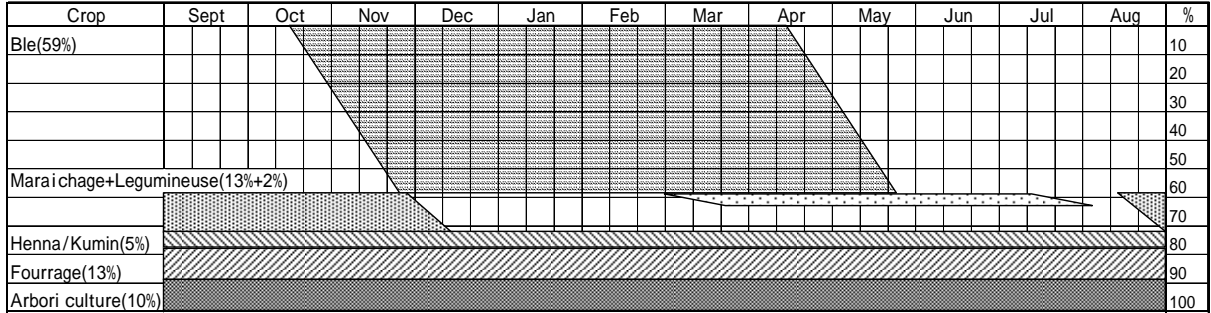
Figure J.4.5 (1/2)
Proposed Cropping Pattern

Japan International Cooperation Agency

Timzazite



Taoumart



The Development Study on Rural Community Development Project
in Semi-Arid East Atlas Regions with Khetara Rehabilitation
in the Kingdom of Morocco

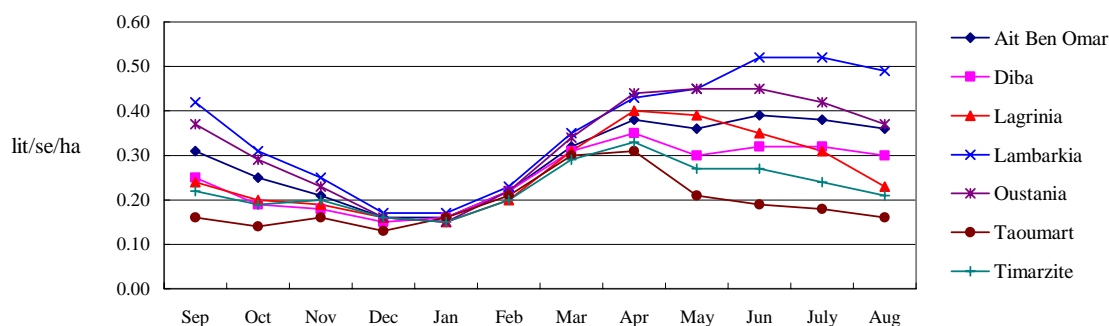
Japan International Cooperation Agency

Figure J.4.5 (2/2)
Proposed Cropping Pattern

Water requirement (lit/sec/ha) Present

Khettara	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Average
Ait Ben Omar	0.31	0.25	0.21	0.16	0.16	0.22	0.32	0.38	0.36	0.39	0.38	0.36	0.29
Diba	0.25	0.19	0.18	0.15	0.16	0.22	0.31	0.35	0.30	0.32	0.32	0.30	0.25
Lagrinia	0.24	0.20	0.19	0.16	0.15	0.20	0.31	0.40	0.39	0.35	0.31	0.23	0.26
Lambarkia	0.42	0.31	0.25	0.17	0.17	0.23	0.35	0.43	0.45	0.52	0.52	0.49	0.36
Oustania	0.37	0.29	0.23	0.16	0.15	0.22	0.34	0.44	0.45	0.45	0.42	0.37	0.32
Taoumart	0.16	0.14	0.16	0.13	0.16	0.21	0.30	0.31	0.21	0.19	0.18	0.16	0.19
Timarzite	0.22	0.19	0.20	0.16	0.15	0.20	0.29	0.33	0.27	0.27	0.24	0.21	0.23
Average	0.28	0.22	0.20	0.16	0.16	0.21	0.32	0.38	0.35	0.36	0.34	0.30	0.27

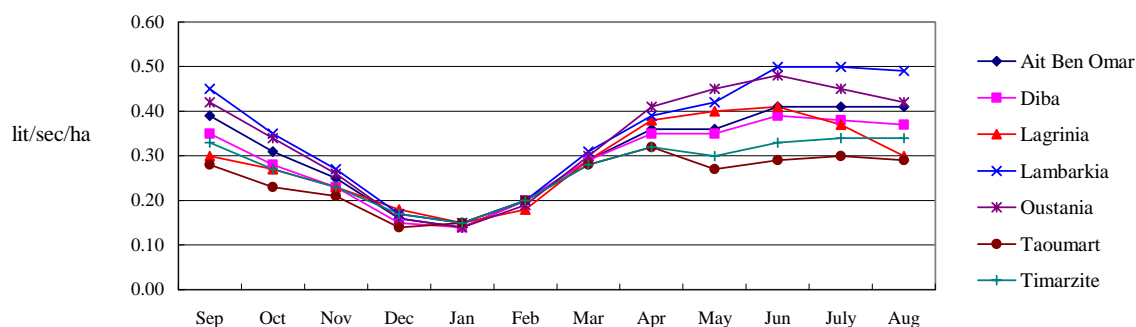
Water requirement: Present



Water requirement (lit/sec/ha) Proposed

Khettara	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Average
Ait Ben Omar	0.39	0.31	0.25	0.16	0.14	0.20	0.29	0.36	0.36	0.41	0.41	0.41	0.31
Diba	0.35	0.28	0.23	0.15	0.14	0.20	0.29	0.35	0.35	0.39	0.38	0.37	0.29
Lagrinia	0.30	0.27	0.23	0.18	0.15	0.18	0.29	0.38	0.40	0.41	0.37	0.30	0.29
Lambarkia	0.45	0.35	0.27	0.17	0.15	0.20	0.31	0.39	0.42	0.50	0.50	0.49	0.35
Oustania	0.42	0.34	0.26	0.16	0.14	0.19	0.30	0.41	0.45	0.48	0.45	0.42	0.34
Taoumart	0.28	0.23	0.21	0.14	0.15	0.20	0.28	0.32	0.27	0.29	0.30	0.29	0.25
Timarzite	0.33	0.27	0.23	0.17	0.15	0.20	0.28	0.32	0.30	0.33	0.34	0.34	0.27
Average	0.36	0.29	0.24	0.16	0.15	0.20	0.29	0.36	0.36	0.40	0.39	0.37	0.30

Water requirement: Proposed



The Development Study on Rural Community Development Project
in Semi-Arid East Atlas Regions with Khettara Rehabilitation
in the Kingdom of Morocco

Japan International Cooperation Agency

Figure J.5.1
Water Requirement

Annexe K Verification Study

Annexe K Verification Study

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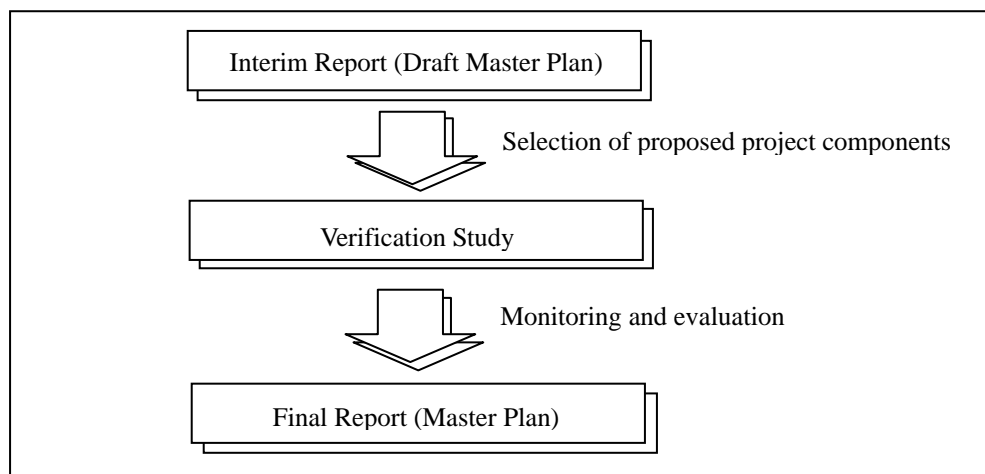
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K.1 Objectives and Implementation Framework of Verification Study

K.1.1 Objectives of Verification Study

Verification study aims at completing the Master Plan based on the verification study results on the proposed components in the draft Master Plan (Rural Community Development Project with Khettara Rehabilitation) described in the Interim Report from the technical, social and economical points of views. The Study furthermore includes a capacity building of the ORMVA/TF through project monitoring and evaluation activities and participation to seminars and workshops.

In addition to the above, the study aims at activating farmers' group activities such as enrollment of their groups to associations to acquire technical and financial supports for a khettara rehabilitation works from the outside organizations.



Purpose of Verification Study

K.1.2 Components of Verification Study

The Verification study is carried out for the purpose of verifying the proposed project components in the draft Master Plan prepared in the second field study taking account of its economical and social appropriateness, effectiveness and so forth.

Eight proposed components have proposed, i.e. 1) capacity building of the ORMVA/TF, 2) Khettara rehabilitation works, 3) water use, 4) farming and extension services, 5) organization strengthening, 6) life improvement plan, 7) prevention of farmland devastation and 8) meteor-hydrological data collection for further recharge facility planning. Areas for the verification study are located at Jorf, Tinejdad, Alnif, Rissani and Boudenib. During the Verification study, monitoring and evaluation are conducted to verify relevance, effectiveness, efficiency, supplementary revise of the Master Plan, as well as technical transfer on organization strengthening to the ORMVA/TF and beneficiaries.

K.1.3 Framework of Verification Study

Master plan includes proper implementation program and scheduling, which are easily adopted by the beneficiaries. For these purposes, direction of the development scheme, needs of the beneficiaries shall be established in the process of Plan -> Do -> Check -> Action during the Verification study.

The Master Plan shall be further revised in corresponding to the social and financial circumstances surrounding the rural life. The Verification study shall be conducted taking these respects into account.

Attachment 1.1.1 shows the organizational structure, and the following table shows responsible personnel in each verification study components. Since latter period of the verification study, INRA (National Institute of Agricultural research) has participated to water saving irrigation (demonstration farms) and planting schemes.

Responsible Personnel of ORMVA/TF

Component	Name	Position
1. Capacity building of ORMVA/TF	Moumen Bouchra	SER
	Saada Mohamed	SER
2. Kheffara rehabilitation	Sossey My Lhassan	SER
	Saada Mohamed	SER
3. Water use (irrigation)	Hachimi S. Lahbib	SER
	Skourane Moha	SER
(Operation and maintenance)	Meftah Abdelhafid	SER
	Ait Ihaj Ahmed	SGRID
	El Hindi Abderrahmane	SGRID
		INRA
4. Farming and extension (Water saving irrigation)	Naaza Driss	SVOP
(food processing)	Fatni Mohamed	SVOP
	Ait Bella Zahra	SVOP
5. Organization strengthening	Allioui Abdelghani	SVOP
6. Life improvement plan (Hygiene)	Maarouf Hassan	SER
	Khaldi Abdeslam	SVOP
(Income generation)	Jari Fatima	SVOP
7. Preventing farm devastation	Benjira Mohamed	SPA
	Dribi Lhabib	SPA
	Ouabi Haddou	S. Eaux et Forêts INRA
8. Meteor-hydrological data collection	Meftah Abdelhafid	SER
	Saada Mohamed	SER
	Ait Ihaj Ahmed	SGRID
	El Mouquadem Kamal	DRH
	El Laouzi Said	DRH
	Eddahby Lhou	FST

SER (Service de l'Équipement Rural) Rural Equipment Service

SGRID (Service de Gestion du Réseau d'Irrigation et de Drainage) Irrigation water management service

SVOP (Service de Vulgarisation) Extension service

SPA (Service de la Production Agricole) Crop production service

S. Eaux et Forêts Forestry and water Department

DRH (Direction Régionale de l'Hydrolique) Regional Hydraulic Directorate

FST (Faculte des Sciences et Techniques, Université d'Errachidia)

INRA (National Institute for Agricultural Research)

K.2 Contents of Verification Study

K.2.1 Capacity Building of ORMVA/TF

K.2.1.1 Establishing Network between ORMVA/TF and Farmers' Organization

(1) Contents and progress

The Tafilalet region is situated in jurisdiction of the ORMVA/TF, however insufficient information regarding khettaras and irrigation networks as well as rural communities is an impediment to establish appropriate project planning on khettara rehabilitation and rural community development. In this fact, khettara inventory survey (updating) and GIS mapping have been conducted for 410 khettaras and their related communities during the 3rd to 4th field survey.

Sharing of inventory data and GIS mapping information between the offices of the ORMVA/TF and farmers' groups is an important to accelerate their motivation for rural community development

During this study period (5th field survey), update works of inventory data have been carried out by the ORMVA/TF offices including the Sub-division and CMVs offices based on the inventory data and GIS maps.

(2) Monitoring

Employment conditions of the inventory database and GIS mapping are monitored. CMVs, Sub-divisions and SER are responsible for monitoring data collection and analysis, respectively. Indicator for Output and target are as follows. SER is also responsible for maintenance of original computer files. Achievement of target in this final evaluation is concluded as follows considering work progress for inventory updating:

Indicator for Output, Target and Achievement

Indicator for Output	Target	Achievement
<ul style="list-style-type: none">- Inventory database are employed.- Update manual for inventory database is prepared.	<ul style="list-style-type: none">- Inventory database files are distributed and used in 4 Sub-division.- Update manual for inventory database is distributed to Sub-division and utilized by them.	100% Inventory data base is utilized for its updating.

(3) Observation

Distribution of the inventory database and GIS maps which show each khettara location may raise their incentives to collect fundamental data to establish and revise the khettara rehabilitation plan.

K.2.1.2 Update of Inventory Data and GIS Data Distribution

(1) Contents and progress

For further revision and review of the Master Plan for the khettara rehabilitation and rural community development, it is essential to update inventory database, especially the data of khettara discharge, irrigation area and rehabilitation records of the khettara and irrigation canals. Update activities by the staff of the four Sub-divisions and CMVs are an object of a monitoring.

As described in 3.1.1 above, inventory files and GIS maps have been distributed to the SER, and Sub-divisions of the ORMVA/TF. The following are items for updating inventory:

- consecutive discharge measurement of khettara discharge
- review of irrigation area using the satellite images
- update of khettara rehabilitation records

(2) Monitoring

The final monitoring for updating activities of the inventory database was conducted on July 2005.

Indicator for Output and target are as follows:

Indicator for Output, Target and Achievement

Indicator for Output	Target	Achievement
<ul style="list-style-type: none"> - Inventory database are updated. 	<ul style="list-style-type: none"> - Discharge measurement is carried out at more than 70% of khettaras out of 191 khettaras by July 2005. - Farmland area is reviewed by means of GIS (satellite image). - Records of khettara rehabilitation works are updated. 	<p style="text-align: center;">100%</p> <p>Goulmima: 74 sites Benitadjid: 20 sites Errachidia: 8 sites Erfoud: 89sites Total: 191 sites</p> <p>Farmland area was estimated by GIS and field survey. Records of khettara rehabilitation works were studied by field survey.</p>

Khettara Inventory

Zone	Number of Khettaras	Khettaras with water flow
A	137	80
B	24	20
C	8	8
D	69	21
E	25	14
F	44	11
G	103	37
Total	410	191

(3) Observation

Discharge data are most important parameters for estimate of irrigable area and for economic analysis of the project. Final updated data has been reflected to the project evaluation in the Master plan.

Estimation of Water Increase

Discharge of khettara Q(lit/sec)	10 < Q	5 < Q < 10	Q < 5
Decrease of leakage loss (lit/sec/km)	2.5	2.0	1.5

Source: Interim Report

Engineers of the SER have continued to input geo-topographical information and inventory updating based on khettara inventory.

The following are the updating works of the khettara inventory:

- 1) Schematic diagrams of khettaras (Location, discharge, length of khettaras and irrigation canals, etc.)
- 2) Schematic diagrams of pump stations for potable water supply (Location, conductivity, etc.)
- 3) Detailed inventory survey (30 khettaras)

K.2.1.3 Data Collection and Information Sharing on Agricultural Development Scheme

(1) Contents and progress

Information sharing on agricultural and water development scheme in arid regions may contribute to elevate an initiative of related government staff and beneficiaries.

Data collection and information sharing are realized through workshops and seminars, in which study

results are reported for such as water saving irrigation, food processing (2.4 Farming and Extension), improvement plan of living condition (animal breeding and rural health), etc.

Study tours for activating women and farmers' groups have been carried out in the 5th field survey period.

(2) Monitoring

The monitoring for data collection and information sharing were conducted on July 2005. Indicator for output and target are as follows:

Indicator for Output, Target and Achievement

Indicator for Output	Target	Achievement
- Workshops about verification study are held.	- Workshop about progress of verification study is held twice a year. - Participants of the workshops correctly understand the study.	100% Works shops were held in November 8, 2004, January 14 and July 21, 2005 with attendance of ORMVA/TF Sub-division and CMVs offices.

(3) Observation

Project component in the Master Plan, especially water saving irrigation and improvement plan of living condition effectively contribute to achieve the project target, "stability and improvement of farm income". It is important that these study activities and results are widely disseminated to the ORMVA/TF and khettara villages of the whole study area, furthermore these activities arise farmers' incentive for rural community development.

K.2.1.4 Strengthening of Project Evaluation and Monitoring Capability

(1) Contents and progress

The Master Plan is prepared premising that it is at all times reviewed and revised with project cycle of Plan -> Do -> Check -> Action. Monitoring of a capacity building on project monitoring and evaluation of the ORMVA/TF is carried out during the verification study.

Strengthening of project evaluation and monitoring capability is enhanced during seminars held on January 14, 2005 with participation of the ORMVA/TF staff.

(2) Monitoring

The monitoring on strengthening of project evaluation and monitoring capability were scheduled on October 2004 and February 2005. Indicator for Output, target and achievement are as follows:

Indicator for Output, Target and Achievement

Indicator for Output	Target	Achievement
- Workshops about project evaluation and monitoring are held.	- ORMVA/TF staff including Sub-division and CMVs participate the seminar. - Monitoring and evaluation related V/S is carried out by ORMVA/TF staff.	Around 100 staffs of the ORMVA/TF have attended the seminar.

(3) Observation

1) Progress of activities, 2) achievement of output, 3) achievement of project target are primary subjects for the monitoring. In addition, monitoring on progress of “input”, charge of “assumption” and “pre-condition” is inevitable to improve and review the proposed project components. The study aims at training and strengthening of the ORMVA/TF staff though OJT and workshop opening.

K.2.1.5 Technical Seminar on Project Evaluation and Monitoring Related to Verification Study

(1) Contents and Progress

Considering that an insufficient information on water development and farming skill are constraints of the rural development, technical transfer of farming skill and its dissemination activities are important in the project. In this connection, workshop is scheduled during the Verification study.

A seminar is schedule on the latest stage of the 6th field survey period. The subject matter during the seminar consists of an explanation of the Master Plan report (draft) and other presentations in terms of framing skill and water saving irrigation.

(2) Monitoring

The monitoring is schedule immediately after the seminar opened on October 2005. Indicator for Output and target are as follows:

Indicator for Output, Target and Achievement

Indicator for Output	Target	Achievement
- ORMVA/TF staff including Sub-divisions and CMVs, farmers' groups are elevated their understandings on khattara rehabilitation and rural community development scheme during seminar.	- 70% of participants comprehend the contents of the Master Plan on khattara rehabilitation and rural community development scheme.	Monitoring is held in October 2005.

K.2.2 Rehabilitation of Khettaras

K.2.2.1 Evaluation and Feedback on Khettara Rehabilitation (Master Plan)

(1) Contents and progress

The khettaras have been continuously rehabilitated with concrete culvert by the ORMVA/TF. The rehabilitation works were in most instances commenced from the most downstream sections, however mid to upstream sections have not rehabilitated due to a difficulty of the tunnel works, drainage, and so forth. The rehabilitation length was 3 to 4 km per annum with rehabilitation cost of DH5,000,000 in average. Total length of the 191 khettaras (of which constant water flow is observed) is estimated at about 520 km, Master Plan indicates that about 30 % of the total khettara length is rehabilitated with a concrete culvert during 10 year short - medium term plan, on the other hand, it is also fact that rehabilitation of whole khettara sections is impracticable because of financial ceiling.

Evaluation and feedback on khettara rehabilitation planning has been made in terms of:

- (a) scope of rehabilitation works (structure and section),
- (b) discussion what rehabilitation works should be, considering some responsibility by the water users' associations themselves.

Evaluation and feedback on khettara rehabilitation planning has been made during the Verification study based on the survey results of routine maintenance works, labor input required to remove sediment in the khettara gallery, etc. As to water fee, its appropriateness and possibility were discussed with the ORMVA/TF.

(2) Monitoring

Evaluation and feedback on khettara rehabilitation planning require study results of not only khettara rehabilitation work, but water use (water saving irrigation), farming and extension, organization strengthening.

Indicator for Output and target are as follows.

Indicator for Output, Target and Achievement

Indicator for Output	Target	Achievement
- Scope of khettara rehabilitation is decided from economical, financial and social points of views.	- Khettara rehabilitation plan in the Master Plan is reviewed taking account of study results of cost and benefit analysis	Verification study results have been reflected to the Master plan (draft)

(3) Observation

(a) Scope of rehabilitation works

- 1) Reinforcement of gallery and vertical shafts, 2) extension of gallery, 3) digging down of gallery

base and re-profiling of gallery, 4) protection from flood damages such as retaining wall construction are principal rehabilitation methods of khettaras to increase discharge as well as reduction of maintenance labor or cost. It is however difficult to extend the gallery without permission at where several khettaras are adjacent each other because extension of particular khettara may result in reduction of yield volume of other khettaras. While as revealed in the Alnif area, extension and digging of the gallery are often applied during the rehabilitation works because each khettara is scattered, accordingly traditional restriction on khettara rehabilitation is limited in these area.

The rehabilitation records by the ORMVA/TF indicate that such works as restricted by the traditional users' groups were excluded in the rehabilitation works to avoid conflict between farmers' groups. In addition, extension of gallery has not been conducted because the work may cause deterioration of yield volume even though the khettara was isolated from others.

In consideration for the above, scope of rehabilitation work is limited to:

- 1) Reinforcement of existing gallery and shafts to reduce leakage loss and labor for the maintenance works, and
- 2) Dike construction and reinforcement of galley and shafts from flood damages.

(b) Rehabilitation cost

The table below shows rehabilitation cost of each khettaras:

Rehabilitation Cost for Khettara Gallery

Khettara	Type	Earth work (DH / m)	Concrete work (DH / m)	Total (DH / m)
Ait Ben Omar	(Tunnel work)	140	1,220 (1,090)	1,360 (1,230)
Diba	Rock excavation + degradation of bed Concrete canal	500	300	800
Lambarkia	Open excavation Concrete culvert	270	1,630 (1,390)	1,900 (1,660)
Oustania	Open excavation Concrete culvert	250	1,630 (1,390)	1,880 (1,640)
	Pipe installation (400mm)	90	520	610
Azag	Pipe installation (200mm)	---	240	240
	Dike protection (Wet masonry)	190	960	1,150

Cost in () : tensile stress is 2/3 of a yield point of reinforcing bar in line with a Moroccan standard.

(Open excavation + concrete culvert) is preferable to ensure an ease construction, however its depth is limited to around 5 m. Tunnel work is selected when its depth is more than 5 m and present section is considerably wide and aliment is almost linear, otherwise it requires higher cost especially for the

earthwork.

As shown in the rehabilitation works of the Khettara Diba, concrete canal work is limitedly applicable to the tunnel work. Concrete canal work requires less cost, however diversion cost may require higher cost when khettara discharge is large.

Rehabilitation cost of DH 1,200 /m is applicable to the cost estimate in the draft Master plan in accordance with the accomplishments during the Verification study.

K.2.2.2 Verification of Benefits by Khettara Rehabilitation (Water loss)

(1) Contents and progress

The khettara rehabilitation works mainly aim at reduction of water loss through a gallery by means of concrete canal and concrete culvert construction. Basic information on the discharge increase data of the khettaras by the rehabilitation works is collected for an evaluation and feedback on khettara rehabilitation (see Sub clause 2.2.1).

The rehabilitation works by the ORMVA/TF have in most cases launched from downstream section of the gallery to maximize a rehabilitation length because rehabilitation works of the shallow open excavation section at the most downstream required less construction cost per meter. In the Verification study, rehabilitation cost and benefit by a reduction of a water leakage are studied though the rehabilitation works including rehabilitation works through a remarkable leakage section of the gallery based on the detailed discharge measurement. Furthermore, an effectiveness of rehabilitation works using PVC pipe is studied for reduction of water leakage.

The following are rehabilitation works of the khettaras:

Rehabilitation Works of the Khettaras

Khettara	Type of construction	Length
Khettara Ait Ben Omar	Concrete culvert	300 m
Khettara Diba	Concrete lining canal including rock excavation	300 m
Khettara Lambarkia	Concrete culvert	450 m
Khettara Oustania	Concrete culvert	300 m
	PVC pipe installation (D400mm)	200 m
Khettara Azag	PVC pipe installation (D200mm)	360 m

(2) Monitoring

Reduction of water leakage by the rehabilitation works is monitored at both ends of the rehabilitation sections. The Study team and the ORMVA/TF, CMV staffs are responsible for the discharge measurement scheduled at before and after the rehabilitation works, i.e. December 2004 to January 2005. Indicator for output, target and achievement are as follows:

Indicator for Output, Target and Achievement

Indicator for Output	Target	Achievement
- Water loss is reduced along the rehabilitation section.	- No water loss is observed along the rehabilitation section.	100% There found no water loss along the rehabilitation portions.

The following table indicates monitoring results:

Khettara Discharge before Rehabilitation (Rehabilitation Section) October 2004

Khettara	Upstream (lit/sec)	Downstream (lit/sec)	Leakage (lit/sec/km)	Length
Ait Ben Omar	7.9	7.2	2.3	300 m
Diba	2.5	2.2	1.0	300 m
Lambarkia	18.4	18.0	0.9	450 m
Oustania (Culvert section)	10.5	9.8	2.3	300 m
Oustania (Pipe section)	17.3	16.1	1 ~ 2	200 m
Azag	6.0	5.3	2.0	360 m

Khettara Discharge before Rehabilitation (Rehabilitation Section) January, February 2005

Khettara	Upstream (lit/sec)	Downstream (lit/sec)	Leakage (lit/sec/km)	Length
Ait Ben Omar	5.5	5.4	0.3	300 m
Diba	3.2	3.2	0.0	300 m
Lambarkia	14.6	14.7	(-0.22)	450 m
Oustania (Culvert section)				300 m
Oustania (Pipe section)				200 m
Azag	4.6	4.6	0.0	360m

(3) Observation

As shown on table below, the rehabilitation effects (reduction of water leakage) are classified into 3 discharge extents based on the discharge measurements at 30 khettaras during the Master Plan preparation. This classification is advantageous to summarize rehabilitation effects of total 191 khettaras, which are proposed to rehabilitate in the short and medium rehabilitation schedule in the Master Plan.

Reduction Rate of Water Leakage by Rehabilitation Works

Discharge: Q (lit/sec)	10 Q	5 Q<10	Q<5
Reduction of water leakage (lit/sec/km)	2.5	2.0	1.5

The table below indicates reduction amount of water loss. The results satisfied expectations of reducing water loss with disregarding of few dispersion of observed data. These indicators are applicable to the benefit used in the project evaluation in the Master plan.

Reduction of Water Loss by Discharge Classification

Present discharge of khattara (lit/sec)	10 Q	5 Q<10	Q<5
Reduction of water loss (lit/sec/km)	2.5	2.0	1.5
Ait Ben Omar	-	2.3 0.3=2.0	-
Diba	-	-	1.0 0.0=1.0
Lambarkia	0.9 0.0=0.9	-	-
Oustania (Culvert section)	2.3 0.0=2.3	-	-
Oustania (Pipe section)	2.4 0.1=2.3	-	-
Azag	-	-	1.7 0.0=1.7

K.2.2.3 Verification of Benefits by Khettara Rehabilitation (Labor for maintenance)

(1) Contents and progress

Maintenance works of the khattaras are composed of removal of deposit in the gallery, reinforcement of vertical shafts and so forth. Periodical maintenance works are carried out four to five times per annum, and required labor force for the maintenance work is estimated at 150 to 250 man-day per one km per annum according to the field investigation in the study. The Master plan indicates that the reduction of labor force for the maintenance work is one of the important effect created by the khettara rehabilitation works. The said effects are verified during the Verification study.

Reduction or lightening of a labor force or cost by the khettara rehabilitation is surveyed by a questionnaire. The water users' associations are requested to fill out the questionnaire before and after the rehabilitation works.

(2) Monitoring

The CMV staff is responsible for the monitoring scheduled on February 2005 (this period) and July 2005. Indicator for output and target are as follows:

At present study, baseline data conducted during the feasibility study stage (February 2004) has been reviewed and its reliability was confirmed. Table below indicates survey results on khettara maintenance works in the social economic survey (extract):

Baseline Data on Khettara Maintenance Works

Items	Unit	Ait Ben Omar	Diba	Lambarkia	Oustania
Ksar name		Ait Ben Omar	Ksiba	Monkara	Hannabou
Population of Ksar	capita	1,200	1,500	1,824	5,130
House hold of Ksar	nos	110	120	304	560
No. of khettaras in use	nos	2	2	4	10
Removal of deposit in gallery	capita/year	294 capita/year	245 capita/year	1,800 capita/year	1,248 capita/year
Removal of deposit per km	capita/year/km	188 capita/year/km (Total length 1.5km)	139 capita/year/km (Total length 1.7km)	295 capita/year/km (Total length 6.1km)	162 capita/year/km (Total length 7.7km)
Problem for maintenance (gallery section)		Insufficient fund	(none)	Collapse of shaft, canal deposit, rock foundation	Insufficient fund, desertification, rock foundation, floods
Collection of fund		Levy to water users' group	Levy to water users' group	Levy to water users' group	Levy to water users' group
Problem s for gallery rehabilitation		Insufficient fund and equipment	Insufficient fund	Insufficient fund	Insufficient fund and skills

Source: Socio economic survey (JICA Study team)

Indicator for Output, Target and Achievement

Indicator for Output	Target	Achievement
- Rehabilitation work dispenses much hard labor.	- Maintenance cost (number of labor, or payment) reduces more than 20 % of previous one.	There is a little sediment in the gallery. It is obvious that labor force required for khettaras located at sand dune areas was reduced by the rehabilitation works

(3) Observation

There is a remarkable reduction of the sediment in the khettara gallery. In addition the wider gallery section acts as a sediment basin and decreases the maintenance work of the beneficiaries because widening of canal width reduces flow velocity.

Since it is difficult to obtain directly the reduction rate of the maintenance work from the monitoring, it is however assumed that rehabilitation work lessens the maintenance work up to at least 80% of previous one.

K.2.2.4 Capacity Building on Khettara Rehabilitation Planning

(1) Contents and progress

The ORMVA/TF has equally rehabilitated the khettaras with budget of local (ORMVA/TF), loans of ADS (Agence de Développement Social), FIDA (IFAD: International Fund for Agricultural Development) and grants from the Governments of Japan and countries of the European Unions, etc.

Construction is broadly classified into two types, one is a contract bases with contractor and the other is procurement of materials, machinery and equipment such as concrete mixer, small backhoe, etc. to the water users' association. The latter case, the water users' associations are responsible for provision of necessary labor force at their expense. Budget has in many cases allocated into a short construction section and cost for each rehabilitation work was estimated at about DH500,000 or less.

1) Preparation of standard design

Standard design of gallery and vertical shaft is prepared taking account of local conditions of each khettaras such as geological features and structural requirement as well as temporary work planning. Standard design includes study of inner dimension of the gallery and vertical shaft, thickness of members, etc.

2) Preparation of material supply plan

Dispersion of grain size distribution affects compression strength of a concrete. As coarse and fine aggregates are collected from natural river deposits, proper screening is required to produce well qualified concrete. Fundamental data on aggregates and concrete mixing design as well as quarry site information are provided through the tests on the said materials during the rehabilitation works.

3) Reconstruction plan for decrepit structures of khettaras

Rehabilitation plan is prepared for the khettaras which have decrepit structure and extremely narrow sections.

4) Improvement of supervision activities of rehabilitation works

Insufficient expert knowledge of the local contractors on construction materials, quality control, construction planning and management hinders proper construction supervisory works by the ORMVA/TF. In the course of the study, several discussions were held between the Study team and ORMVA/TF at the construction sites. The following are important issues:

- consistency between contractor's capability (number of machinery and equipment, site engineers) and construction schedule
- diversion plan of khettara taking account of irrigation use downstream of khettaras
- improvement of contractor's liability, especially for quality control

- preparation of detailed drawings and careful explanation to the contractor
- proposal of rehabilitation section corresponding to a geological condition, etc.

(2) Monitoring

1) Preparation of standard design

The standard drawings including sections for gallery and shafts as well as pipe installation are prepared for the khattara rehabilitation works. The Study team and ORMVA/TF provide mutual efforts on this requirement.

Indicator for output and achievement in this period are as follows:

Indicator for Output, Target and Achievement

Indicator for Output	Target	Achievement
- Standard design is prepared.	- Proposed sections for the rehabilitation works are examined through the rehabilitation works.	Primary requirements for plan, designs of khattara rehabilitation were described in the guideline for khattara rehabilitation works.

2) Preparation of material supply plan

Quality control on concrete tests and grain size distribution is conducted during the rehabilitation works. The Study team and ORMVA/TF are responsible for the analysis of these tests.

Indicator for Output, Target and Achievement

Indicator for Output	Target	Achievement
- Information about quarry site is collected.	- Quarry sites are proposed. (Tinejda and Jorf areas)	Proposed quarry sites for aggregates and masonry were found during the rehabilitation works.
- Specification of aggregates is prepared.	- Report on required grain size distribution is prepared. (Standard design)	Test results of grain size of concrete aggregates are referred to the guideline for khattara rehabilitation works.

3) Reconstruction plan for decrepit structures of khattaras

Questionnaire survey was conducted for existing 12 khattaras aiming at finding problems of decrepit structures and necessity countermeasures during rehabilitation works.

Indicator for Output, Target and Achievement

Indicator for Output	Target	Achievement
- Information about decrepit structures is collected.	- Report on reconstruction plan for decrepit structures of khattaras including 10 sites analysis is prepared. (attached into standard design)	Technical issues for decrepit Khattara were discussed with reference of 12 khattaras survey.
- Rehabilitation plan is proposed.		Study results are described in the guideline for khattara rehabilitation works.

4) Improvement of supervision activities of rehabilitation works

Supervisory work was conducted by the OJT method. Monitoring was scheduled on February 2005 focusing on an improvement of supervisory activities of the ORMVA/TF.

Indicator for Output, Target and Achievement

Indicator for Output	Target	Achievement
- Supervisory capability of the ORMVA/TF is improved.	- ORMVA/TF acquires quality control of the concrete production.	Engineers of ORMVA/TF already mastered technical skill on concrete design. In addition, they acquired necessary construction data of concrete culvert and pipe installation works so as to conduct economic evaluation of these construction methods.

(3) Observation

The following activities are proposed during the Verification study to continuously achieve khettara rehabilitation works in line with the proposed schedule described in the Master Plan:

- Preparation of standard design
- Preparation of material supply plan
- Reconstruction plan for decrepit structures of khettaras
- Improvement of supervision activities of rehabilitation works

Verification study through the khettara rehabilitation works aims at employing following issues based on the construction experiences using a concrete culvert undertaken by the ORMVA/TF.

1) Khettara gallery

Gallery inside height of 1.5 m was applied to the rehabilitation works for the purpose of improvement of working condition during the maintenance works in the gallery, meanwhile the ORMVA/TF applied to 1.2 m high in his experience. 1.5 m gallery in height requires incremental concrete consumption of 14 % compared to 1.2 m gallery when the construction cost is equal, other words it reduces rehabilitation length 14 %. Appropriate height of the khettara gallery shall be studied from the technical and economical points of view.

2) Tunnel construction (Khettara Ait Ben Omar)

It is concluded that the earthwork deeper than 5 m from the ground surface requires comparatively high cost because of limited arm length of around 5 m of large capacity backhoe. Accordingly, earthwork by manual in a tunnel may be economically advantageous when gallery lies lower than 5 m in depth. While wider gallery section must be secured for the installation and removal of about 1.85 m height concrete form. With respect to this fact, proper section planning and construction planning are established from the economical point of view.

3) Route plan

On selection of the khattara route during the rehabilitation works, by-pass route along the existing gallery is most appropriate because of facility of diversion work. Whereas by-pass route is not found due to land acquisition problem including renting from owner(s) or adjoining khattaras are located closely, rehabilitation route shall be selected on the existing route. In this occasion, diversion method, e.g. pumping to the ground surface or pipeline in the gallery shall be deliberated during construction planning.

4) Machinery and equipment plan

Availability of machinery and equipment (excavator and rock breaker) is most critical factor to determine the construction schedule. Both equipments are in short in the Tafilalet region, and difficulty of their mobilization causes delay of the construction completion. Proper construction plan shall be established considering the availability of machinery and equipment, especially the works in the tunnel.

5) Pre-fabricated concrete product

It is advantageous to utilize pre-fabricated concrete products for the khattara rehabilitation works because of its readiness of quality control, rapid installation as far as its production is simultaneously carried out with gallery concrete casting. Use of pre-fabricated concrete shall be encouraged for khattara rehabilitation works considering standardization of gallery and shaft section by the use of pre-fabricated concrete products.

6) Materials

PVC pipe has proposed for in two khattaras in the verification study. PVC pipe has favorable because of its shorter installation time and economical advantage on material price compared to concrete. The following conditions are examined for its use:

- Since PVC pipe length has gauge of 6.0 m during production, they does not suit to the galleries which have several bends in short extent.
- Some devices to flush out sediment in the pipe are necessary as sediment flow into pipe is inevitable.
- Small diameter pipe (e.g. less than 100 mm) requires large head difference between entrance and outlet portions because of higher friction loss. khattara which has relatively steeper profile shall appropriate for small pipe installation.

K.2.3 Water Use

K.2.3.1 Minimization of Water Conveyance Loss on Irrigation Canal

(1) Contents and progress

Master plan describes that minimizing water conveyance loss, which will be achieved by main canal lining (for the existing earthen canal) and inlet improvement (with installation of distribution gates etc), lead to an increase of irrigation water amount and an expansion of cultivable farmland.

In order to verify above mentioned effects, construction works consisting of canal rehabilitation and inlet improvement as shown in table below was implemented on the main canals in the irrigation area of three khattaras, Ait Ben Omar, Lambarkia and Taoumart. (Figure K.2.3.1, K.2.3.2, K2.3.3)

On the 4th field survey, JICA study team prepared the contract drawings and documents necessary for the construction works in consultation with ORMVA/TF and made contracts with two contractures on July 12, 2004. The rehabilitation works for the evaluation on minimizing water conveyance loss were completed on schedule (December 11, 2004) through the joint supervision of JICA study team and ORMVA/TF, SD, CMV during 4th field survey.

JICA study team conducted the water discharge measurement at before and after the rehabilitation works in collaboration with ORMVA in order to evaluate an effect of decreasing the water conveyance loss given by the irrigation canal rehabilitation.

Construction Works for Canal Rehabilitation and Inlet Improvement

Khattara	Components	Canal name	Type and Size	Quantity
Ait Ben Omar	Canal rehabilitation	Seguia Harch	Rectangular canal B=0.4m×H=0.4m Trapezoid canal B=0.2-0.7m×H=0.4m	L=380m L=200m
		Seguia Jdida	Box culvert canal B=0.4m×H=0.4m PVC pipe 250	L=100m L=150m
	Inlet improvement	-	Simple steel gate type	N=50nos
Lambarkia	Canal rehabilitation	Seguia Gauche	Rectangular canal B=0.5m×H=0.5m	L=590m
		Seguia Droite	Box culvert canal B=0.5m×H=0.5m	L=450m
	Inlet improvement	-	Simple steel gate type	N=50nos
Taoumart	Inlet improvement	-	PVC pipe type	N=50nos

(2) Monitoring

Indicator for outputs is the extent of increase in water discharge. In accordance with monitoring plan, water discharge without rehabilitation was measured on 1st phase of 4th field survey and water discharge with rehabilitation was measured on 3rd phase of 4th field survey. Figure K.2.3.4, K.2.3.5, K.2.3.6 show the result of water discharge measurement at several points along the irrigation canal. Discharge at beginning point and end point of each irrigation canal is compiled as follows:

Reduction of Water Loss by Canal Rehabilitation Works

Khattara	Canal name	Discharge without rehabilitation (lit/sec)			Discharge with rehabilitation (lit/sec)		
		Beginning point	End point	End point / Beginning point	Beginning point	End point	End point / Beginning point
Ait Ben Omar	*Seguia Harch	7.8	6.4	82% (18%)	7.3	6.6	90% (10%)
	**Seguia Jdida	7.8	6.7	86% (14%)	5.4	5.1	93% (7%)
Lambarkia	*Seguia Gauche	16.6	12.9	78% (22%)	19.9	18.5	95% (5%)
	*Seguia Droite	17.4	14.3	82% (18%)	18.5	17.4	94% (6%)
Taoumart	**Principal-1	2.8	2.5	89% (11%)	1.8	1.7	94% (6%)
*Irrigation canal	Ratio of water discharge	(82+78+82)/3=		81%	(90+93+94)/3=		92%
	Ratio of water conveyance loss	(18+22+18)/3=		(19%)	(10+7+6)/3=		(8%)
**Inlet improvement	Ratio of water discharge	(86+89)/2=		88%	(94+94)/2=		94%
	Ratio of water conveyance loss	(14+11)/2=		(13%)	(6+6)/2=		(6%)

Notes: Percentages outside parentheses indicate the ratio of water discharge.

$$\text{Ratio of water discharge} = Q_e/Q_b \times 100 (\%)$$

Percentages in parentheses indicate the ratio of water conveyance loss.

$$\text{Ratio of water conveyance loss} = (Q_b - Q_e)/Q_b \times 100 (\%)$$

Q_b: Water discharge at the beginning point of the irrigation canal (lit/sec)

Q_e: Water discharge at the end point of the irrigation canal (lit/sec)

Indicator for Output, Target and Achievement

Indicator for Output	Target	Outcome
Increase water amount resulted from reducing filtration loss with lining of existing earthen canal.	Irrigation water amount increase by more than 10% through lining of existing earth canal.	11% (19% - 8%=11%)
Increase water amount resulted from reducing leakage and operation loss with the improvement of existing inlets.	Irrigation water amount increase by more than more than 5% through improving the existing inlets.	7% (13% - 6%=7%)

(3) Observation

The effects of irrigation canal rehabilitation can be evaluated based on the water discharge measured in the main canal “Seguia Harch” in Ait Ben Omar, and “Seguia Gauche” and “Seguia Droite” in Lambarkia. In existing earthen canals, water discharge at end point is on the average 81% of that at beginning point, i.e. around 19% is lost by the infiltration. After lining the existing earthen canals with concrete or PVC pipe, water discharge at end point is on the average 92 % of that at beginning point, i.e. water conveyance loss

decreases to 8% more and less. Accordingly, it might be said that concrete lining of main canal results in around 11% increase of irrigation water amount.

Besides, the effect of inlet improvement can be evaluated based on water discharge measured in the main canal "Seguia Jdida" in Ait Ben Omar, and "Principal-1" in Taoumart. Under the traditional water diversion by means of using soil, water discharge at end point is on the average 88 % of that at beginning point, i.e. around 13% is lost by the infiltration from the inlets. On the contrary, water discharge at end point is on the average 94 % of that at beginning point, i.e. water conveyance loss decreases to 6% on the average after improving the inlets with steel gates or PVC pipes. This result suggests that the inlet improvement of main canal has a possibility to increase around 7% of irrigation water amount.

Rehabilitation works with PVC pipe was done at the downstream of main canal "Seguia Jdida" in Ait Ben Omar where irrigation water has not reached for several years due to the damage caused by desertification. As a result of the rehabilitation works, water distribution was recovered at the downstream of this irrigation area, and 40 farmers owning water rights there restarted wheat and/or pasture cultivation.

Similar experience of irrigation area expansion was observed at right main canal in Lambarkia. Concrete lining of the existing earthen canal, where has been suffered from desertification, brought the recovery of water supply and the restart of cultivation by 10 farmers at the downstream of this canal.

It is concluded that main canal rehabilitation itself contributes to not only expansion of irrigable area through minimizing conveyance loss, but recovery of the devastated farmlands located at sand dune area through regaining water flow.

K.2.3.2 Evaluation on the Construction Methods for Irrigation Canal Rehabilitation

(1) Contents and progress

Rectangular concrete canal has been applied to irrigation canal rehabilitation without any exception. However, design and construction method suited for the canal rehabilitation in khattara irrigation area shall be reviewed in terms of construction cost, durability, and workability as well as operation & maintenance. This study proposed the verification of four types of irrigation canal (Rectangular canal, Trapezoid canal, Box culvert canal, and PVC pipe: see Figure K.2.3.7) and two types of inlet improvement (Simple steel gate and PVC pipe: see Figure K.2.3.8).

JICA study team collected necessary information for the evaluation on the adaptability of these rehabilitation methods through the monitoring activities such as joint supervision together with ORMVA/TF and questionnaire to irrigation water users.

(2) Monitoring

1) Joint supervision and inspection of JICA study team and ORMVA/TF

Joint supervision; September 7, 2004

Joint inspection; January 27, 2005

The subjects discussed at the joint supervision and inspection, are summarized as follows.

Item	Comments	Remarks
Alignment of irrigation canal	Alignment of irrigation canal should be decided in consideration of date trees planted along irrigation canal because date trees are valuable income resources for farmers.	
Profile planning of irrigation canal	In principal, proposed elevation of irrigation canal bed should be kept to be same elevation as present.	Reference Maximum: 10cm difference
Proposed site of inlets	Prior to the construction, the sites of the inlets should be decided based on the consensus of users because the sites of inlets are fixed by concrete lining.	
Structure and size on gate type inlet	Since it is impossible to stop water flow completely with the gate itself, a space for additional soil filling should be kept in front of the gate.	Gate must be installed 30 cm behind the inside surface of side wall of the canal

2) Questionnaire for irrigation water users

In order to collect user's opinions over the canal rehabilitated and the inlet improved in the verification study, questionnaire was made twice just after the completion of the construction works and after a certain period passed.

1st questionnaire: February 2 to 4, 2005 on the 1st phase of 4th field survey

(Ait Ben Omar: 18farmers, Lambarkia; 10farmers, Taoumart; 21farmers)

2nd questionnaire: June 21 to 23, 2005 on 5th field survey

(Ait Ben Omar: 16farmers, Lambarkia; 21farmers, Taoumart; 21farmers)

The Result of Questionnaire for Irrigation Water Users

Khattara	Evaluation item	Questionnaire result(%):Evaluation on canal rehabilitation and inlet improvement					
		Very good	Good	Fair	Bad	Very bad	No answer
Ait Ben Omar	Rectangular canal	67 69	33 31	-	-	-	-
	Trapezoid canal	50 0	11 12	27 44	11 44	-	-
	Box culvert canal	61 19	17 81	-	-	-	17 0
	PVC pipe	56 81	22 19	-	-	-	22 0
	Simple steel gate type	38 0	22 19	0 12	0 69	-	39 0
Lambarkia	Rectangular canal	100 0	0 42	0 48	0 10	-	-
	Box culvert canal	100 86	0 14	-	-	-	-
	Simple steel gate type	10 43	90 57	-	-	-	-
Taoumart	PVC pipe type	100 95	0 5	-	-	-	-

Note) The result of 1st questionnaire is shown in left and the result of 2nd questionnaire is shown in right.

Indicator for Output, Target and Achievement

Indicator for Output	Target	Outcome
Preparation of design manual for irrigation canal rehabilitation	Design manual is prepared based on the result of the verification study for the adaptability of each irrigation canal rehabilitation methods.	Mentioned in Manual for Khettara Water Use.

(3) Observation

The effectiveness of irrigation canal rehabilitation and inlet improvement was basically confirmed judging from that answers of most users are as a whole “Very good” or “Good”.

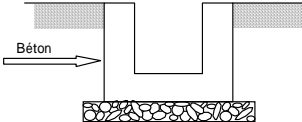
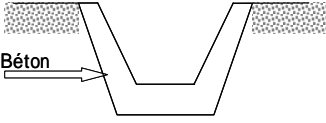
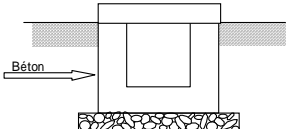
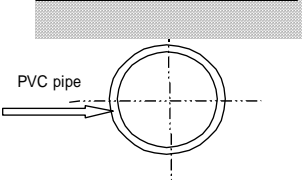
The evaluation of 2nd falls in comparison with 1st questionnaire in the terms of simple steel gate and trapezoid canal. These results revealed several problems to be solved or improved for betterment of the irrigation canal rehabilitation works.

The following table gives final evaluation based on the conclusion obtained by the joint supervision and inspection of JICA study team and ORMVA/TF as well as user’s opinions indicated in the questionnaire.



Meanwhile, irrigation canal rehabilitation works satisfied expectations of reducing maintenance burden. Taking Khettara Lambarkia for example, maintenance works (to eliminate accumulated soil in the canal) have been done every 20 days in summer season and every two months in winter season. However no maintenance work was done after the completion of the rehabilitation according to the interview with farmers. Same situation was as well observed in Khettara Ait Ben Omar. No maintenance work was done so far after the rehabilitation works, although it has been done four times per annum.

Final Evaluation on Canal Rehabilitation

Irrigation canal rehabilitation

Canal type	Evaluation	Standard section	Remarks (Construction cost)
Rectangular canal	<ul style="list-style-type: none"> - Easy construction and repair - Easy maintenance and reduction of maintenance burden. - Construction cost is lower than box culvert type. - Quality control is more difficult than pre-cast product. - Applicable in the site where much soil does not come into. 		<p>B=0.4m × H0.4m 336DH/m</p> <p>B=0.5m × H0.5m 405DH/m</p>
Trapezoid canal	<ul style="list-style-type: none"> - Cheap construction cost - Applicable site is specified to the following section due to construction method and canal structure. • Existing ground level is not higher than the top of canal sidewall. • Excavated slope can be kept stable. • Number of inlets is not so many. - Width of canal bed is kept more than 0.25m from the maintenance aspect. 		<p>B=0.2-0.7m × H0.4m 201DH/m</p>
Box culvert canal	<ul style="list-style-type: none"> - Applicable in sand dune area, since cover helps to prevent the canal from sand accumulation. - Construction cost is highest. - Quality control is more difficult than pre-cast product. 		<p>B=0.4m × H0.4m 454DH/m</p> <p>B=0.5m × H0.5m 539DH/m</p>
PVC pipe	<ul style="list-style-type: none"> - Applicable in sand dune area, since cover helps to prevent the canal from sand accumulation. - Construction cost is not so high. - To eliminate the accumulated sand, sand entrapped manholes must be installed at the interval of 30m and less. - PVC pipe is favorable on quality control because of pre-cast product. - Applicable in the site where number of inlets is not so many. 		<p>PVC 250mm 211DH/m</p>

Inlet improvement

Inlet type	Evaluation	Photo	Remarks (Construction cost)
Simple steal gate	<ul style="list-style-type: none"> - Applicable for the canal where water discharge is 5 lit/sec and more. - Complete waterproof is not guaranteed without additional soil. - Defects on waterproof and handling should be improved as follows. <ul style="list-style-type: none"> • Thickness of steel gate is kept more than 5mm. • Width of flame for the steel gate should be kept wider, or other type of flame structure should be applied in order to avoid soil entrapping. - Installation of chain on the steel gate is recommendable from safety reason. 		<p>B=0.4m × H0.4m 184DH/site</p> <p>B=0.5m × H0.5m 234DH/site</p>
PVC pipe	<ul style="list-style-type: none"> - Applicable in the canal where water discharge is 5 lit/sec and less. However, application to the canal more than 5 lit/sec should be examined in terms of the extension of this type. - High evaluation is given to PVC pipe type owing to several advantages in cost, waterproof, and handling. - Following consideration shall be taken for better application. <ul style="list-style-type: none"> • The size and number of PVC pipe should be decided corresponding to water discharge. • Simple handle is recommendable to fix on PVC cap for better handling. • Sand entrapped small pit should be equipped in front of inlet to protect sand entrapping. 		<p>PVC pipe D=160m 117DH/site</p>

K.2.3.3 Demonstration and Comparison of Each Water Saving Irrigation Method

(1) Contents and progress

Basin irrigation method has been applied to all of khattara farmlands under rigid water distribution rotation based on traditional water right. However, this method has disadvantages on irrigation efficiency and watering schedule against keeping optimum soil moisture content for proper crop growth. Water saving irrigation techniques therefore is inevitable to accelerate rational water use in khattara irrigation area.

Four types of irrigation method as stated below; were compared through actual farming practice in terms of water saving and water management with on-farm reservoir at the demonstration farms established at three khattara irrigation area in Ait Ben Omar, Lambarkia, and Taoumart.(see Figure K.2.3.9, K.2.3.10, K.2.3.11)

Irrigation type

- 1) Basin irrigation without on-farm reservoir
- 2) Furrow irrigation without on-farm reservoir
- 3) Furrow irrigation with on-farm reservoir
- 4) Drip irrigation with on-farm reservoir

Cultivation stage and crops

- 1) 1st stage (from September 2004 to February 2005): carrot, turnip
- 2) 2nd stage (from March 2005 to July 2005): melon, water melon, tomato, gumbo

On the 1st phase of 4th field survey, ORMVA and the Study team conducted site selection for demonstration farms, and decided three demonstration farm sites with consensus of owners. JICA study team then finalized the drawings and documents necessary for the contract in cooperation with ORMVA/TF and made contracts with contractors on July 26, 2004. The irrigation facilities for evaluating irrigation water amount were completed on schedule (September 9, 2004) with joint supervision of the Study team and ORMVA/TF, SD, CMV on the 2nd phase of 4th field survey.

The Study team and the ORMVA/TF, CMV staff manage the monitoring activities in cooperation with Association to collect the data necessary for the evaluation of above irrigation techniques.

Comparison Case of Irrigation Techniques at each Demonstration Farm

Khattara		Ait Ben Omar	Lambarkia	Taoumart
Traditional irrigation method	Basin irrigation	Low irrigation efficiency		
Water saving irrigation methods	Furrow irrigation without on-farm reservoir	More water saving technique than basin irrigation because impoundment is limited to partial area.		
	Furrow irrigation with on-farm reservoir	To keep the optimum soil moisture content by shortening irrigation intervals with on-farm reservoir.		
	Drip irrigation with on-farm reservoir	Most water saving irrigation technique. For the operation, on-farm reservoir and drip equipment must is equipped.		
				-

Irrigation period in Demonstration Farms

Irrigation period (1st stage)

Khattara	Irrigation period (Crops : Turnip / Carrot)			
	Basin irrigation	Furrow irrigation without reservoir	Furrow irrigation with reservoir	Drip irrigation with reservoir
Ait Ben Omar	Sep 23-Feb 16	Sep 26-Dec 10	Sep 26-Dec 10	Sep 16-Dec 6
Lambarkia	Sep 13-Feb 18	Sep 15-Feb 18	Sep 11-Feb 18	Sep 14-Feb 18
Taoumart	Sep 10-Feb 18	Sep 09-Jan 11	Sep 12-Feb 18	/

Irrigation period (2nd stage)

Khattara	Irrigation period (Crops : Melon / Water melon / Tomato / Gumbo)			
	Basin irrigation	Furrow irrigation without reservoir	Furrow irrigation with reservoir	Drip irrigation with reservoir
Ait Ben Omar	Mar 12-July 31	Apr 7- July 30	Apr 7- July 30	Mar 30- July 31
Lambarkia	Mar 27- July 28	Mar 4- July 28	Mar 4- July 31	Mar 4- July 31
Taoumart	Mar 10- July 22	Mar 9- July 24	Mar 12- July 27	/

(2) Monitoring

Following data over on-farm water management were collected through the monitoring activities in three demonstration farms.

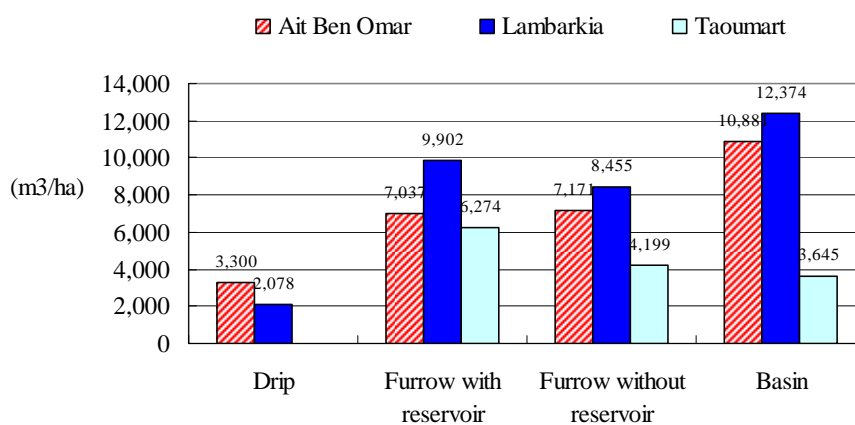
- 1) Daily evaporation (A-pan) and daily rainfall
- 2) Water discharge, irrigation date, and irrigation hours
- 3) Soil moisture content

Monitoring data mentioned above 2) provided the total irrigation amount expressed in an irrigation area of one ha as shown on figure below, which is summed up monthly irrigation water amount consumed at each irrigation plot.

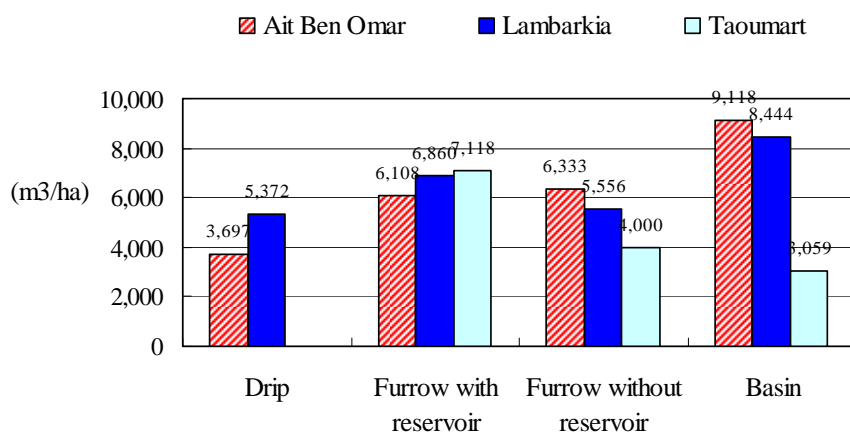
On an average of 1st stage and 2nd stage, water consumption ratio of drip irrigation against basin irrigation is 36 % in Ait Ben Omar, 41 % in Lambarkia, and water consumption ratio of furrow irrigation against basin irrigation is 66 to 68 % in Ait Ben Omar, 67 to 81 % in Lambarkia.

Monthly Water Consumption by Irrigation Method

Total amount of irrigation water (1st stage)



Total amount of irrigation water (2nd stage)



Water Consumption Ratio of Drip Irrigation and Furrow to Basin Irrigation

		Drip irrigation / Basin irrigation	Furrow irrigation With reservoir / Basin irrigation	Furrow irrigation Without reservoir / Basin irrigation
Ait Ben Omar	1st stage	30%	65%	66%
	2nd stage	41%	67%	69%
	Average	36%	66%	68%
Lambarkia	1st stage	17%	80%	68%
	2nd stage	64%	81%	66%
	Average	41%	81%	67%
Average		38%	73%	67%

In order to compare water consumption among irrigation methods in monthly basis, both of irrigation water amount and evapotranspiration ETo expressed in unit mm/day is shown in Figure K.2.3.12, K.2.3.13. Meanwhile, Figure K.2.3.14 and K.2.3.15 give the crop yield volume per one cubic meter water consumption (ton/m³) which is obtained dividing crop yield volume (ton /ha) by water consumption (m³/ha).

Figure K.2.3.16, K.2.3.17 shows the result of soil moisture content measured in each irrigation plot at the frequency of once a month.

On 4th field survey, following soil investigation and soil laboratory analysis were conducted as baseline survey.

- 1) Soil investigation; cylinder intake rate (see Figure K.2.3.18), soil hardness
- 2) Soil physical analysis; water content, bulk density, dry density, void ratio, porosity, degree of saturation, density of soil particles, consistency, particle size distribution, and pF analysis (see Table K.2.3.1)
- 3) Soil physical analysis for the calibration between actual soil moisture content and soil moisture meter value. (see Figure K.2.3.19)

Indicator for Output, Target and Achievement

Indicator for Output	Target	Outcome
To grasp water saving effects through demonstration and comparison of water saving irrigation techniques. • Total irrigation water amount and soil moisture content	Water saving techniques lead to the decrease of water consumption, comparing with traditional basin irrigation. Drip irrigation: water saving more than 20%, Furrow irrigation: water saving more than 10%	Drip irrigation 62% Furrow irrigation 27-33%
	It is confirmed that soil moisture content is kept within proper range with water saving techniques.	-

(3) Observation

1) Comparison of irrigation techniques on water saving effect

Irrigation practice for vegetable farming of winter season (1st stage) and summer season (2nd stage) show the following fact-findings.

- (a) It is concluded that drip irrigation has a remarkable high effect on water saving. Irrigation water amount consumed in drip irrigation plot is on the average 38% of that in traditional basin irrigation plot.
- (b) It can be said that furrow irrigation is also categorized into water saving irrigation technique. Irrigation water amount consumed in furrow irrigation plot is on the average 70% of that in traditional basin irrigation plot. On the other hand, there is no remarkable deference between furrow irrigation with reservoir (73%) and furrow irrigation without reservoir (67%). It might be however said that water consumption of furrow irrigation with reservoir is slightly bigger than furrow irrigation without reservoir due to much irrigation frequency.

- (c) It is concluded that traditional basin irrigation method is recognized to be worst in terms of water utilization efficiency.
- (d) As shown on Figure K.2.3.14, K.2.3.15, the irrigation water amount consumed in 1st stage (winter season) is much bigger than reference evapotranspiration ETo, and the irrigation amount consumed in 2nd stage (summer season) is close to ETo.
- (e) Water consumption of drip irrigation is equivalent to the value of reference evapotranspiration (ETo); however, water consumption of other irrigation methods fairly exceeds the value of reference evapotranspiration (ETo). Accordingly, drip irrigation technique can supply proper water amount, but furrow and basin irrigation might supply excessive water amount.
- (f) Irrigation water amount in Taoumart is on the whole smaller than that in other demonstration farms. That is the reason why water discharge in Khezzara Taoumart is extremely small comparing with other two khezzara. (Water discharge at the demonstration farm site; Ait Ben Omar: Q=7l/s, Lambarkia: Q=12l/s, Taoumart: Q=1.5l/s)
- (g) Drip irrigation provides the richest crop yield per one cubic meter irrigation water amount, next is furrow irrigation. Crop yield in basin irrigation plot is lowest due to low efficiency in term of water utilization.
- (h) Soil moisture content in winter season is kept within the range of available moisture zone or at the wet side. By contrast, soil moisture in summer season is fairly deferent from that in winter season. Soil moisture content near the ground surface declines to the dry side due to high evaporation from ground surface, but soil moisture at the lower part in available soil layer is kept within the range of available moisture zone.

Soil moisture in drip irrigation plot is kept higher than other irrigation plot because watering is done every day in principle, but soil moisture in furrow and basin irrigation plot is located at dryer side because of longer watering interval.

As a result, drip irrigation has favorable from the viewpoint of soil moisture control.

2) Effectiveness of on-farm reservoir

Readily available soil moisture (RFU) is estimated to be within the range of 20mm and 29mm based on the soil-pF analysis, which was conducted with sampling soil taken from three demonstration farms. It seems that water-holding capacity of the soil in demonstration farms is slightly low and moisture range available for optimum crop growth is limited.

Carrot and Turnip were cultivated on the 1st stage (September to January) and tomato, gumbo, watermelon, and melon on the 2nd stage (March to July). Water consumption (WC) of each growth stage is obtained by reference evapotranspiration (ETo) and crop coefficient (Kc) according to the cultivation calendar.

Maximum irrigation interval days of each month were calculated with below equation using readily available soil moisture (RFU) and water consumption (WC).

$$\text{Maximum irrigation interval days} = \text{Readily available moisture (RFU)} \div \text{Consumptive use of water (WC)}$$

Maximum irrigation interval days vary from 3 days to 14 days on monthly basis. On the other hand, water right interval days are fixed to be 13 days in Ait Ben Omar, 15 days in Lambarkia, and 9 days in Taoumart. If water right interval days are longer than maximum irrigation interval days, soil moisture content might fall to below the wilting point (=lower limit of available soil moisture zone). It may cause negative impact for the crop growth.

Despite water right interval of each individual water right holder is in principal fixed, water right has some flexibility by exchanging water use hour. For example, water right interval in Lambarkia is regulated to be 15 days; however, it could be actually reduced to be 7 days in winter season and 4 days in summer season. Shortening the water right interval was observed in Ait Ben Omar and Taoumart as well. Even though, the range of its adjustment has a limit depending on khettara and water right holder.

At the 1st stage, actual watering interval days did not exceed the maximum irrigation interval days because of low water consumption in winter season; therefore, we could not confirm the effectiveness of on farm reservoir in this stage. At 2nd stage, watering interval could not be fully adjusted because the maximum irrigation interval days are too short within the range of 3 to 5 days due to high water consumption.

In Lambarkia and Taoumart, crop growth in furrow irrigation plot with reservoir was better than that in furrow irrigation without reservoir and basin irrigation, which proved the effectiveness of on-farm reservoir.

It is needless to say that on-farm reservoir is indispensable to apply drip irrigation in khettara irrigation area.

Maximum irrigation interval days

Cultivation stage			1st stage					2nd stage				
			Sep	Oct	Nov	Dec	Jan	Mar	Apr	May	Jun	July
Water consumption (WC) mm/day			2.5	2.4	2.3	1.5	1.5	1.5	2.7	4.4	5.7	5.2
Ait Ben Omar	Water right interval days 13 days	Readily available moisture RFU 29 mm	11	12	12	19	19	19	10	6	5	5
Lambarkia	15 days	20 mm	8	8	8	13	13	13	7	4	3	3
Taoumart	9 days	25 mm	10	10	10	16	16	16	9	5	4	4

K.2.4 Farming and Extension

K.2.4.1 Adaptability Test and Demonstration for Water saving Irrigation

(1) Contents and progress

In the Study Area, crop production has decreased to 50% during past 10 years due to decrease of rainfall. Therefore, efficient use of irrigation water is needed. Three khattara sites as demonstration for vegetable cultivation with efficient water use has been selected, namely: Ait Ben Omar, Lambarkia, and Jdida Taoumart

Farmers in charge of demonstration plots measured harvest volume of cultivated crops. Based on the measurement results, the unit yield of each plot is estimated as shown below.

The Unit Yields by Crops and Irrigation Methods (First Crop)

Name of Khettara	Irrigation Method	Unit Yield (ton/ha)			
		Turnip		Carrot	
National Average*		15.0	-	20.0	-
Ait Ben Omar (Tinejdad)	Drip irrigation	17.3	(91%)	10.3	(98%)
	Furrow irrigation with reservoir	7.1	(37%)	3.0	(29%)
	Furrow irrigation without reservoir	5.8	(30%)	2.5	(24%)
	Traditional irrigation	19.1	(100%)	10.5	(100%)
Lambarkia (Jorf)	Drip irrigation	27.9	(125%)	38.5	(170%)
	Furrow irrigation with reservoir	23.8	(106%)	39.7	(175%)
	Furrow irrigation without reservoir	24.7	(110%)	17.3	(76%)
	Traditional irrigation	22.4	(100%)	22.7	(100%)
Taoumart (Alnif)	Furrow irrigation with reservoir	38.8	(162%)	60.7	(110%)
	Furrow irrigation without reservoir	52.3	(219%)	42.0	(76%)
	Traditional irrigation	23.9	(100%)	55.4	(100%)

Note: Source of national average is referring to the data of Ministry of Agriculture.

The Unit Yields by Crops and Irrigation Methods (Second Crop-1)

Name of Khettara	Irrigation Method	Unit Yield (ton/ha)			
		Tomato		Gumbo	
National Average *		24.0	-	15.0	-
Ait Ben Omar (Tinejdad)	Drip irrigation	50.3	(729%)		
	Furrow irrigation with reservoir	40.9	(593%)		
	Furrow irrigation without reservoir	15.1	(219%)		
	Traditional irrigation	6.9	(100%)		
Lambarkia (Jorf)	Drip irrigation	58.7	(618%)	46.1	(475%)
	Furrow irrigation with reservoir	28.9	(304%)	24.8	(256%)
	Furrow irrigation without reservoir	27.6	(291%)	30	(309%)
	Traditional irrigation	9.5	(100%)	9.7	(100%)
Taoumart (Alnif)	Furrow irrigation with reservoir	69.2	(276%)	42.5	(720%)
	Furrow irrigation without reservoir	71.0	(283%)	11.0	(186%)
	Traditional irrigation	25.1	(100%)	5.9	(100%)

Note: Source of national average is referring to the data of Ministry of Agriculture.

The Unit Yields by Crops and Irrigation Methods (Second Crop-2)

Name of Khettara	Irrigation Method	Unit Yield (ton/ha)			
		Melon		Water Melon	
National Average *		18.0	-	20.0	-
Ait Ben Omar (Tinejdad)	Drip irrigation	10.4	(212%)		
	Furrow irrigation with reservoir	9.1	(186%)		
	Furrow irrigation without reservoir	5.8	(118%)		
	Traditional irrigation	4.9	(100%)		
Lambarkia (Jorf)	Drip irrigation	15	(133%)	19.3	(117%)
	Furrow irrigation with reservoir	13.7	(121%)	19.0	(115%)
	Furrow irrigation without reservoir	8.7	(77%)	18.9	(115%)
	Traditional irrigation	11.3	(100%)	16.5	(100%)
Taoumart (Alnif)	Furrow irrigation with reservoir	55.0	(585%)	22.9	(107%)
	Furrow irrigation without reservoir	9.7	(103%)	14.0	(65%)
	Traditional irrigation	9.4	(100%)	21.5	(100%)

Note: Source of national average is referring to the data of Ministry of Agriculture.

The above table shows the following fact-findings.

- ✓ In the plots for furrow irrigation with and without reservoir in Ait Ben Omar in the first cropping, yields of both turnips and carrot were extremely low. In addition, yields of melon in the second crop were extremely low.
- ✓ The yield in drip irrigation plots are high in both first and second cropping compared with traditional basin irrigation plots.
- ✓ Excluding the plots for furrow irrigation with and without reservoir in Ait Ben Omar, furrow irrigation plots with reservoir indicate yield increase in the first cropping. On the other hand, furrow irrigation plot without reservoir indicates yield increase in turnip cultivation, while furrow irrigation plot without reservoir indicates yield decrease in carrot cultivation.
- ✓ The furrow irrigation plots with reservoir indicate yield increase in the second cropping. On the other hand, furrow irrigation plot without reservoir indicates yield increase in tomato and gumbo cultivation, while furrow irrigation plot without reservoir indicates yield decrease in melon and watermelon cultivation in some cases.

The selling price and products were recorded. Based on the sales records on products, unit gross income is estimated.

Unit Gross Income by Crops and Irrigation Method (First Crop)

Name of Kheffara	Irrigation Method	Unit Gross Income (DH/ha)			
		Turnip		Carrot	
Ait Ben Omar (Tinejda)	Drip irrigation	17,700	(89%)	15,900	(126%)
	Furrow irrigation with reservoir	7,120	(36%)	-	-
	Furrow irrigation without reservoir	5,760	(29%)	-	-
	Traditional irrigation	19,900	(100%)	12,600	(100%)
Lambarkia (Jorf)	Drip irrigation	17,500	(44%)	20,300	(46%)
	Furrow irrigation with reservoir	12,200	(31%)	22,000	(50%)
	Furrow irrigation without reservoir	11,600	(29%)	12,700	(29%)
	Traditional irrigation	39,500	(100%)	43,700	(100%)
Taoumart (Alnif)	Furrow irrigation with reservoir	37,300	(285%)	59,860	(103%)
	Furrow irrigation without reservoir	45,400	(347%)	37,900	(65%)
	Traditional irrigation	13,100	(100%)	58,400	(100%)

Unit Gross Income by Crops and Irrigation Method (Second Crop-1)

Name of Khetara	Irrigation Method	Unit Gross Income (DH/ha)			
		Tomato		Gumbo	
Ait Ben Omar (Tinejda)	Drip irrigation	67,960	(531%)		
	Furrow irrigation with reservoir	64,170	(502%)		
	Furrow irrigation without reservoir	28,040	(219%)		
	Traditional irrigation	12,790	(100%)		
Lambarkia (Jorf)	Drip irrigation	105,910	(657%)	209,600	(495%)
	Furrow irrigation with reservoir	53,330	(331%)	132,510	(313%)
	Furrow irrigation without reservoir	40,000	(248%)	162,610	(384%)
	Traditional irrigation	16,130	(100%)	42,370	(100%)
Taoumart (Alnif)	Furrow irrigation with reservoir	80,830	(226%)	154,490	(322%)
	Furrow irrigation without reservoir	39,540	(111%)	53,230	(111%)
	Traditional irrigation	35,710	(100%)	48,000	(100%)

Unit Gross Income by Crops and Irrigation Method (Second Crop-2)

Name of Khetara	Irrigation Method	Unit Gross Income (DH/ha)			
		Melon		Water Melon	
Ait Ben Omar (Tinejda)	Drip irrigation	25,100	(560%)		
	Furrow irrigation with reservoir	6,150	(137%)		
	Furrow irrigation without reservoir	7,530	(168%)		
	Traditional irrigation	4,480	(100%)		
Lambarkia (Jorf)	Drip irrigation	40,950	(142%)	32,850	(105%)
	Furrow irrigation with reservoir	35,810	(124%)	31,730	(102%)
	Furrow irrigation without reservoir	19,420	(67%)	35,170	(113%)
	Traditional irrigation	28,840	(100%)	31,170	(100%)
Taoumart (Alnif)	Furrow irrigation with reservoir	78,290	(356%)	66,570	(198%)
	Furrow irrigation without reservoir	20,290	(92%)	25,940	(77%)
	Traditional irrigation	21,980	(100%)	33,670	(100%)

The above table shows the following fact-findings.

- ✓ In the plots for furrow irrigation with and without reservoir in Ait Ben Omar in the first cropping, quantity and quality of both turnips and carrot production were extremely low. As results, those products were not sold. In the plots for furrow irrigation with and without reservoir in Ait Ben Omar in the second cropping, quantity and quality of melon production were also extremely low.
- ✓ The unit gross income made from traditional basin irrigation in Lambarkia site was extremely high in the first cropping, since the farmer in charge of this plot management directly sold products in the local market without intervention of middleman. In the second cropping, the farmer in Lambarkia site sold most of the products to middle man.
- ✓ In Taoumart, the unit gross income was relatively high, since yields and farm gate prices of products were higher than other demonstration sites.

Based on the purchasing record of farm inputs, daily cultivation records made by farmers, depreciation cost of irrigation facilities, and irrigation cots, the total cultivation cost is estimated. The costs are summarized below: (see Table K.2.4.1, Table K.2.4.2)

Unit Cultivation Cost Based on Actual Expenditures for First Cropping (Unit: DH/ha)

Irrigation Method	Farming Cost	Irrigation Cost	Total Cultivation Cost
Drip irrigation	6,820	10,580	17,400
Furrow irrigation with reservoir	6,820	3,450	10,270
Furrow irrigation without reservoir	6,820	940	7,760
Traditional irrigation	6,820	1,400	8,220

Unit Cultivation Cost Based on Actual Expenditures for Second Cropping (Unit: DH/ha)

Irrigation Method	Farming Cost	Irrigation Cost	Total Cultivation Cost
Drip irrigation	19,420	11,200	30,620
Furrow irrigation with reservoir	19,420	2,760	22,180
Furrow irrigation without reservoir	19,420	970	20,390
Traditional irrigation	19,420	1,590	21,010

The above table shows the following fact-findings.

- ✓ The cultivation cost using drip irrigation is much higher than other irrigation methods due to high facility cost.
- ✓ The cultivation cost using furrow irrigation without reservoir is cheapest amongst irrigation methods compared, since water saving effect caused minimum irrigation cost.

In the middle of December 2004 and June 2005, SVOP with cooperation of JICA Study carried out the study tours for extension staff and farmers to the demonstration plots. The outline of the study tour is summarized below:

Outline of Study Tour to Demonstration Plots

Target	Date	Zone Covered	Demonstration Plot	Content
Extension staff of ORMVA (55 persons in total)	Dec 09, 2004 (Participants: 25 persons)	All	Ait Ben Omar, Lambarkia	1. Explanation of JICA Study Team on cultivation techniques introduced 2. Presentation of farmers on waster saving effects
	June 09, 2005 (Participants: 30 persons)			
Farmers (207 persons in total)	Dec 13, 2004 (Participants: 30 persons)	Goulmima Tinejdad	Ait Ben Omar, Lambarkia	1. Explanation of SVOP on outline of demonstration plots 2. Explanation of JICA Study Team on cultivation techniques introduced 3. Presentation of farmers on waster saving effects
	June 10, 2005 (Participants: 24 persons)			
	Dec 14, 2004 (Participants: 30 persons)	Alnif	Ait Ben Omar, Lambarkia	
	June 15, 2005 (Participants: 24 persons)			
	June 14, 2005 (Participants: 15 persons)	Beni Tadjit, Rcih, Boudenib	Ait Ben Omar, Lambarkia	
Dec 15, 2004 (Participants: 30 persons)	Erfoud, Jorf, Rissani	Ait Ben Omar, Lambarkia		
June 13, 2005 (Participants: 24 persons)				
Dec 16, 2004 (Participants: 30 persons)	Alnif	Taoumart		

In the study tour, SVOP and JICA Study Team carried out questionnaire survey. The responses to questionnaire are summarized below:

Summary of Responses to Questionnaire Survey in Study Tour Made in December 2004

Date	Demonstration Plot	Cultivation Method	Reason	Irrigation Method to be Interested	Remarks
Dec 13, 2004 (Participants: 30 persons) June 10, 2005 (Participants: 24 persons)	Ait Ben Omar, Lambarkia	Good	High productivity Small irrigation water requirement	Drip Irrigation	More study tour should be made.
Dec 14, 2004 (Participants: 30 persons) June 15, 2005 (Participants: 24 persons)	Ait Ben Omar, Lambarkia	Good	High quality of products	Drip Irrigation	Cooperative for drip irrigation will be required.
Dec 14, 2004 (Participants: 15 persons)	Ait Ben Omar, Lambarkia	Very Good	High productivity	Drip Irrigation	Cooperative for drip irrigation will be required.
Dec 15, 2004 (Participants: 30 persons) June 13, 2005 (Participants: 24 persons)	Ait Ben Omar, Lambarkia	Very Good	High productivity	Drip Irrigation	High cost for introduction of drip irrigation will be problem. Khattara also should be rehabilitated.
Dec 16, 2004 (Participants: 30 persons)	Taoumart	Very Good	Easy techniques introduced High productivity	Furrow irrigation with reservoir	-

Source: Result of questionnaire survey in the study tour to demonstration plots.

The above table shows the following fact-findings.

- ✓ The most of participants showed their interesting in most modernized irrigation method in each demonstration plot such as drip irrigation in Ait Ben Omar and Lambarkia as well as furrow irrigation with reservoir in Taoumart, since farmers appreciated effectiveness of irrigation water saving and high quality and quantity of products using modernized irrigation method.
- ✓ On the other hand, participants pointed out that the high introduction costs of drip irrigation would be problem.

In the verification study, adaptability test for caper crop was made in Ait Ben Omar and Lambarkia sites, since caper crop is well known as medical crop. The main activities for the adaptability test of caper crop are as follows:

The Main Activities for the Adaptability Test of Caper

Target	Date	Location	Content
Workshop for farmers	March 22, 2005 (Participants: 50 persons)	Ait Ben Omar, Lambarkia	1. Explanation on advantage of caper crop 2. Explanation on caper cultivation method
Site training for farmers	April 15, 2005 (Participants: 20 persons)	Ait Ben Omar, Lambarkia	1. Practice of plantation of caper crop at sites 2. Explanation on caper cultivation method
Lecture for ORMVA staff	May 19, 2005 (Participants: 39 persons)	All area of ORMVA-TF	1. Explanation on technical and economical advantages of caper crop 2. Explanation on caper cultivation method(density, soil, fertilization and irrigation method)

As of July 2005, the survival ratios of caper crop are 60% in Ait Ben Omar and 80% in Lambarkia, respectively. It is judged that the growth condition of the caper crop in the plots is fair or slightly good, since survival ratios of caper crop are normally around 70%. In addition, it has been confirmed that i) no application of fertilizer is not required, ii) the irrigation interval is around 10 days and no irrigation will be required in the second year, and iii) the harvest will be expected in the second year.

(2) Monitoring

For the demonstration of vegetable cultivation under water saving irrigation, the following indicators and targets as “Outputs” are set up.

Indicators and Targets for Outputs of Demonstration for Water Saving Irrigation

Indicators	Target
<u>Vegetation and Caper Crop</u>	
Technical aspect: Yield of vegetable production	More than 70% of target yield
Possibility of Caper crop cultivation	Confirmation of caper crop cultivation
Financial aspect: Benefit/cost ratio (excluding caper crop)	More than 1.1 of Benefit/cost ratio
Other aspects: Interests of farmers	More than 50% of participants of study tour indicate their interesting in vegetable cultivation under water saving irrigation

Achievements to targets by irrigation method and by crops are as follows:

Achievements to Targets of Indicators

1) First crops (Turnip and Carrot)

Name of Khettara	Irrigation Method	Achievement		
		Yield	B/C	Interests of farmer
Target			> 1.1	50%
Ait Ben Omar (Tinejdad)	Drip irrigation	Not Achieved	Not Achieved	Achieved
	Furrow irrigation with reservoir	Not Achieved	Not Achieved	-
	Furrow irrigation without reservoir	Not Achieved	Not Achieved	-
	Traditional irrigation	Not Achieved	Achieved	Not Achieved
Lambarkia (Jorf)	Drip irrigation	Achieved	Not Achieved	Achieved
	Furrow irrigation with reservoir	Achieved	Achieved	Not Achieved
	Furrow irrigation without reservoir	Achieved	Achieved	Not Achieved
	Traditional irrigation	Achieved	Achieved	Not Achieved
Taoumart (Alnif)	Furrow irrigation with reservoir	Achieved	Achieved	Achieved
	Furrow irrigation without reservoir	Achieved	Achieved	Not Achieved
	Traditional irrigation	Achieved	Achieved	Not Achieved

2) Second crop (Tomato, Gumbo, Melon and Water Melon)

Name of Khettara	Irrigation Method	Achievement		
		Yield	B/C	Interests of farmer
Target			> 1.1	50%
Ait Ben Omar (Tinejdad)	Drip irrigation	Partially Not Achieved	Partially Not Achieved	Achieved
	Furrow irrigation with reservoir	Partially Not Achieved	Partially Not Achieved	-
	Furrow irrigation without reservoir	Not Achieved	Not Achieved	-
	Traditional irrigation	Not Achieved	Not Achieved	Not Achieved
Lambarkia (Jorf)	Drip irrigation	Achieved	Achieved	Achieved
	Furrow irrigation with reservoir	Achieved	Achieved	Achieved
	Furrow irrigation without reservoir	Partially Not Achieved	Almost Achieved	Not Achieved
	Traditional irrigation	Not Achieved	Almost Achieved	Not Achieved
Taoumart (Alnif)	Furrow irrigation with reservoir	Achieved	Achieved	Achieved
	Furrow irrigation without reservoir	Not Achieved	Almost Achieved	Not Achieved
	Traditional irrigation	Not Achieved	Almost Achieved	Not Achieved

(3) Observation

Based on the monitoring results for the demonstration of vegetable cultivation under water saving irrigation, the following issues and countermeasure will be identified in terms of technical, financial and farmers' participatory aspects.

Issues and Countermeasures Identified through the Demonstration of Water Saving Irrigation

	Issue	Coarse Analysis	Countermeasures
Technical aspect	<ul style="list-style-type: none"> - Poor growth of both carrot and turnip in furrow irrigation with and without reservoir in Ait Ben Omar (Tinejdad) - No achievement of target yield of carrot and melon cultivation in Ait Ben Omar (Tinejdad), 	<ul style="list-style-type: none"> - Pump trouble and rehabilitation work of khattara caused delay of cultivation period. - Technical level of farmer in Ait Ben Omar is lower than other demonstration sites. - Soil fertility of farmer in Ait Ben Omar is lower than other demonstration sites. 	<ul style="list-style-type: none"> - CMV and JICA Study Team should more guide proper irrigation management and farming practice. - Number of crops will be reduced from 4 to 2 for second cropping. - Beneficiary for demonstration plot should be selected more carefully in terms of technical skill and flexibility. - The sand will be added to the farmland, so that soil will be improved.
Financial aspect	<ul style="list-style-type: none"> - Low profit from drop irrigation in the first cropping, while profit from drop irrigation is not bad in the second cropping since the yield is very high. 	<ul style="list-style-type: none"> - High facility cost causes low profit. 	<ul style="list-style-type: none"> - Co-use of drip irrigation facility should be considered. - Cultivation area per one drip irrigation facility should be examined from a financial viewpoint. - Subsidy to drip irrigation facility should examined form a institutional viewpoint.
Farmers' participatory aspect	<ul style="list-style-type: none"> - Less interesting in furrow irrigation system than drip irrigation system in the first cropping. On the other hand, many farmers showed high interest to furrow irrigation with reservoir in the second cropping since the yield is very high. 	<ul style="list-style-type: none"> - It is not enough to explain farmers about financial advantage in furrow irrigation, since the financial analysis was not completed in the study tour made in December 2004. 	<ul style="list-style-type: none"> - Financial analysis result is explained in the next study tour.

K.2.4.2 Demonstration on Agro-Processing

In the Study Area, most of agricultural products are used as home consumption. Only a part of the products are soled in the local markets without any added value through agro-processing activity. In order to increase market value of agriculture products, demonstrations of agro-processing for date palm, henna and gumbo were proposed. Based on the demonstration and post-demonstration results, the feasibility of proposed agro-processing activity will be examined from technical and financial viewpoints. The following sites were selected through discussion between ORMVA/TF and JICA Study Team

considering that: i) capacity of associations/cooperative is confirmed, ii) production of target crops is sufficient, and iii) the target Ksar should be Khettara Ksar. In addition, willingness of people to participations was confirmed in August 2004.

Demonstration Sites for Agro-Processing

Ksar Name	Kind of Processing	CMV	Khettara Name	Association
Beni Ouzième	Date Palm Paste	Boudenib	Beni Ouzième	Beni Ouzième
Ait Malay Lmamoune	Date Palm Paste	Tinejdad	Ait Malay Lamoure	Nahda Lmamounia, Ait Moulay Lmamoune
Taoumart	Henna Mill	Alnif	Jdida Taoumart	Agdal, Taoumart
Sifa	Gumbo Processing	Erfoud	Haj Allal	Lamharza

The demonstrations for agro-processing and study tour on henna processing were made in September and October 2004. The results of demonstrations and study tour are summarized below:

Summary Results of d Demonstration and Study Tour for Agro-Processing

Ksar Name	Content	Date	Number of Participants	Result
Taoumart etc.	Study tour to Zagora for observation of henna processing activities	Sep. 28 – 30 (3 days), 2004	18 persons	Participants were satisfied by opinion exchange with Zagora cooperative.
Beni Ouzième	Demonstrations for Date Palm Paste	Oct.14, 2004	30 persons including 20 women	Participants were satisfied by high quality and added value of products.
Ait Moulay Lmamoune	Demonstrations for Date Palm Paste	Oct.13, 2004	43 persons including 30 women	Participants were satisfied by easy process and high quality of products.
Taoumart	Demonstrations for Henna mill	Oct.4, 2004	11 persons	Participants demanded to add generator for supply of electricity. They were basically satisfied by easy process of products.
Sifa	Demonstrations for Gumbo processing	Oct.15, 2004	8 persons	Participants were basically satisfied by easy process of products. However, some participants were apprehensive for low price of gumbo.

The above table shows the following fact-findings.

- ✓ It was clear that participants could do agro-processing work using processing machine provided by the JICA Study Team through demonstration. Participants were also satisfied by easy process.
- ✓ For gumbo processing, some participants were apprehensive for low price of gumbo. On the other hand, no participants were not worried about prices of products for henna and date palm

processing, since home consumptions of those products are high.

After implementation of the demonstrations, the associations in charge recorded operation condition of processing machines including number of participants, operation hours, weight of materials and production, selling volume. Based on the records, the operation of processing machines is as follows:

Operation of Processing Machines (October 2004 – July 2005)

Name of Ksar	Kind of Processing	Participants	Operation hour	Materials (kg)	Production (kg)	Sales (kg)	Remarks
Beni Ouzième	Date Palm Paste	60	35	2,200	1,760	1,150	Income was DH 17,250
Ait Moulay Lmamoune	Date Palm Paste	105	26	1,400	1,110	-	All consumed as home consumption
Taoumart	Henna Mill	48	13	167	119	-	All consumed as home consumption
Sifa	Gumbo Processing	30	30	450	300	-	Sales will be made in the next winter season.

The above table shows the following fact-findings.

- ✓ Participants for processing machines of dates could not fully use the machines, since the machine was distributed during harvest season of date. However, it was confirmed that participants are very keen to use the processing machine. Therefore, operation hour and production volume will be improved in the next season.
- ✓ In the processing machines for date palm and henna, the demand on home consumption was very large and, accordingly, the production could not sometime be used for sales.
- ✓ Most of gumbo harvested in July was consumed at home due to shortage of irrigation water. Therefore, it is difficult for local population to collect gumbo as materials of processing machine. However, JICA Study team appreciated the effort on collection of materials under such conditions.
- ✓ It was confirmed that the participants for the processing machines for date palm, henna and gumbo would like to continue those activities in the next year. In the processing machine for date palm, the other Ksar requested ORMVA/TF to assist introduction of this processing machine, since the effect to reduce working hours for women is large.

Based on the above records and purchase record for the processing machines, production cost and return are estimated and the result is as follows:

Production Cost and Return of Processing Machine

Item	Unit		Beni Ouzièmè	Ait Moulay Lmamoune	Taoumart	Sifa
			Date Palm Paste	Date Palm Paste	Henna Mill	Gumbo
Depreciation	(DH)	(1)	6,300	6,300	430	2,500
Materials	(kg)	(2)	2,200	1,400	170	450
Material Cost	(DH)	(3)	17,600	11,200	1,300	2,300
Production	(DH)	(4)=(1)+(3)	23,900	17,500	1,730	4,800
Production	(kg)	(5)	1,760	1,110	119	300
Gross Income	(DH)	(6)	26,400	16,650	3,570	4,500
Net Income	(DH)	(7)=(6)-(4)	2,500	-850	1,840	-300
B/C	-	(8)=(6)/(4)	1.10	0.95	2.06	0.94

Notes: The price of date paste is estimated based on the actual market price of Beni Ouzièm (15 DH/kg)

The price of processed henna is estimated on the actual local market price (30 DH/kg).

The price of processed gumbo is estimated on the price which will be applied by beneficiaries (15 DH/kg).

The above table shows the following fact-findings.

- ✓ The financial feasibility of henna mill processing is good, since the initial costs for henna mill is small and the market price of processed henna is high.
- ✓ The balance between cost and return will be improved in the date paste and gumbo processing, if the unit production volume increases.

(2) Monitoring

The following indicators and targets for “Outputs” are set up for monitoring of agro-processing demonstration. Indicators and Targets for Outputs of Agro-Processing Demonstration

Indicators	Target
<u>Gumbo and Henna</u>	
Technical aspect: Completion of production	Confirmation of that participants could complete processing
Financial aspect: Benefit/cost ratio	More than 1.0 of Benefit/cost ratio
Other aspects: Interests of farmers	More than 50% of participants indicate their willingness to continue gumbo or henna processing
<u>Date Palm</u>	
Technical aspect: Completion of production	Confirmation of that participants could complete processing
Financial aspect: Benefit/cost ratio	More than 1.0 of Benefit/cost ratio
Other aspects: Interests of farmers	More than 50% of participants indicate their willingness to continue dates processing

Achievements to targets by irrigation method and by crops are as follows:

Achievements to Targets of Indicators

Name of Ksar	Kind of Processing	Completion of Production	B/C	Willingness to Continue
Target		Confirmation in	More Than 1.0	More Than 50 % of
Beni Ouzièrne	Date Palm Paste	Achieved	Achieved	Achieved
Ait Moulay	Date Palm Paste	Achieved	Not Achieved	Achieved
Taoumart	Henna Mill	Achieved	Achieved	Achieved
Sifa	Gumbo Processing	Achieved	Not Achieved	Achieved

(3) Observation

Based on the monitoring results for the demonstration of agro-processing machines, the following issues and countermeasure will be identified in terms of technical, financial and farmers' participatory aspects.

Issues and Countermeasures Identified through the Demonstration of Water Saving Irrigation

	Issue	Coarse Analysis	Countermeasures
Technical Aspect	- It was clear that participants could do agro-processing work using processing machine through demonstration.	-	- The monitoring will be continues. Technical assistance will be made, if necessary.
Financial Aspect	- Profitability of date processing machine is limited. - Profitability of gumbo processing machine is limited. -	- Participants for processing machines of dates could not fully use the machines, since the machine was distributed during harvest season of date. Therefore, operation hour and production volume were limited. - Most of gumbo harvested in July was consumed at home due to shortage of irrigation water. Therefore, it is difficult for local population to collect gumbo as materials of processing machine.	- The operation hour and production volume will be improved in the next season, if people use the machine from the begging of harvest season. - The production of gumbo should be stabilized. The water saving irrigation in addition to the gumbo processing should be considered.
Farmers' participatory aspect	- Willingness to continue the processing machines for date paste and henna mill are confirmed. - The other Ksar requested ORMVA-TF to assist introduction of processing machine for date paste.	-	- The monitoring will be continues. Necessary assistance will be continues. - ORMVA-TF is trying to find other fund source for the request of date processing machine from other Ksar

K.2.5 Organization Strengthening

K.2.5.1 Facilitating Establishment of Association

(1) Contents and progress

In this component, ORMVA/TF and JICA hold seminars for traditional khattara water user's groups in Alnif area to facilitate establishment of association. The first seminar was held on September 15, 2004. Totally 57 farmers from 43 Ksars in Alnif area, with having 49 khattaras, participated in the seminar. Benefited from the seminar and continuous supports by CMV Alnif, totally 12 associations have been established in the area by January 2005.

On 4th field survey (phase 3), association management seminar was held on January 31, 2005, targeting at newly established associations in Alnif area including above mentioned 12 associations. Totally 111 representatives from 33 associations attended this seminar.

Program for Seminar (Outline)	
9:00	Opening remark, explanation on objective of seminar and the program (ORMVA/TF and JICA Study Team)
9:30	Presentation 1; Necessity of capacity building of farmer's organization for cooperation with outside organizations (ORMVA/TF SVOP)
10:00	Presentation 2; Basic knowledge on Association management (ODECO Expert)
11:00	Presentation 3; Practical skills on Association management (General Assembly, preparation of minutes and accounting records etc.) (ODECO Expert)
12:00	Questions and Answers
12:30	Lunch Break
14:30	Workshop; Preparation of minutes of meeting on General Assembly, accounting report, etc. (ODECO Expert)
16:30	Questions and Answers
17:30	Closing remarks

(2) Monitoring

According to the questionnaire survey carried out for traditional khattara water user's groups in 43 Ksars which participated in the first seminar, it is confirmed that almost all traditional groups had some discussions for establishment of association. Among them, 17 associations have been formally established by July 2005.

From these monitoring results, achievements of each indicators and targets for "Outputs", set by ORMVA/TF and JICA Study Team at the beginning of the 4th field survey, can be presented as follows.

Indicator for Output, Target and Achievement

Indicator for Output	Target	Achievement
Activities carried out by traditional khettara water user's group for establishing an association. (Number of meeting, consultation to outside organizations, preparation of documents, etc.)	More than 1/2 of traditional khettara water user's group participated in seminar take action for establishing an association by July 2005. (Number of meeting, consultation to outside organization, preparation of documents, etc.)	100%
Number of newly established association.	More than 1/3 of traditional khettara water user's group participated in seminar establish associations by July 2005.	100 % (21% increase)

(3) Observation

Judging from the high achievement rates, the 1st seminar was considered as effective in order to facilitate establishment of association. However, it is also observed that there are many associations which have not started any activity yet because of lack of knowledge, skill, information and financial resource, according to the result of questionnaire survey. Continuous supports through seminars and study tours, as well as individual consulting to associations by CMV, are recommended to activate association activities in the future.

K.2.5.2 Training for Association

(1) Contents and progress

ORMVA/TF and JICA held a two days training seminar on September 16 and 17 for newly established associations in Jorf and Tinejdad area aiming at strengthening management knowledge and skills of these associations. Totally 26 associations from these areas attended this training seminar.

On 4th field survey (phase 3) and 5th field survey, questionnaire survey was carried out for these associations to confirm an effectiveness of the previous training seminar.

(2) Monitoring

The questionnaire survey identified that 12 associations among 26, which participated in the previous seminar, held General Assembly and kept appropriate minutes, activity report and financial records in accordance with a guideline provided in the seminar.

Indicator for Output, Target and Achievement

Indicator for Output	Target	Achievement
<ul style="list-style-type: none"> - Number of General Assembly held - Contents and quality of prepared documents including minute of meeting, activity report, and financial record. 	<p>More than 1/2 of associations participated in the training seminar hold general assembly and keep appropriate minutes of meeting, activity report and financial record according to a guideline provided by ODECO.</p> <p>(Except associations established within 1 year)</p>	<p>92%</p> <p>(12 against 1/2 of 26)</p>

(3) Observation

From the monitoring result, contents of training seminar held in September 2004 were considered as effective and contributed to improve management skill of associations.

However, in the questionnaire, some associations pointed out that lack of understanding and un-cooperative attitude of traditional water user's group is one of the serious obstacles for association management. In addition to an improvement of association skill, actual activity or project is required for improving this relationship. Actual activity or project is expected to facilitate understanding of traditional organization for a benefit of cooperation between them.

K.2.5.3 Strengthening Capacity of Association for Applying Support from Outside Organizations

(1) Contents and progress

In order to strengthen capacity of association to make a request for support on khattara rehabilitation works, ORMVA/TF and JICA prepare a brochure which explains details of assistance from outside organizations, including ORMVA/TF, ADS and others. The brochure explains contents of several assistance schemes as well as the procedure and criteria for application.

The brochure was finalized and printed in December 2004, and distributed to all sub-divisions and CMVs of ORMVA/TF. It is posted on these offices and also delivered to *Kiada*, associations and other farmer's organizations concerned through CMV. It is also publicized to the participants of seminar and study tour respectively held in January 31 and February 1 and 2, 2005.

(2) Monitoring

Although publication of this brochure was originally scheduled in September 2004, it was delivered in December 2004 owing to several modifications with updated information. Since it was considered too early to monitor the effect of this brochure on January 2005, ORMVA/TF and JICA decided that monitoring activity would be carried out only at the end of verification study period. The monitoring result is shown below.

Indicator for Output, Target and Achievement

Indicator for Output	Target	Achievement
Number of applications submitted to outside organizations for khettara rehabilitation	More than 20% increase in the number of application submitted to outside organizations compared to the previous year.	100% (21% increase)

(3) Observation

Publication of assistant schemes for khettara rehabilitation work would be effective for strengthening capability of association to request assistance from outside organizations. However, on the other hand, it may also create some dependent mentality among associations. Therefore, it is also important to explain to associations that appropriate management as well as good cooperation with local people is required to receive assistance from outside organization. Although this point is highlighted on the brochure, appropriate understanding by association should be reinforced through seminar, study tour and direct explanation by CMV staffs on site.

In addition, achievement on the above monitoring result might be resulted not only from the prepared brochure but also from other sensitization activities carried out by ORMVA/TF. These activities are expected to be continued.

K.2.5.4 Implementation of Khettara Rehabilitation Work by Association in Cooperation with Traditional Khettara Water User's Group

(1) Contents and progress

In this component, ORMVA/TF and JICA newly established a free equipment lending scheme, called "Partnership Scheme", for facilitating khettara rehabilitation works by village people. On this scheme, a compressor with concrete breaker(s), which have highest demand for carrying out rehabilitation works of khettara, is lent to association without charging any fee.

Following table shows the record of equipment lending scheme during the verification study period.

Name of Association (Name of <i>Ksar</i>)	Lending Period	Name of Khettara Rehabilitated	Content of Rehabilitation Work
Khettara Association Mharza (Sifa)	3 months from Sep. 2004	Khettara Haj Allal	Base lowering and extension of gallery in recharge and yield zone.
Khettara Association Kheir (Krair, Hannabou)	3 months from Dec. 2004	Khettara Kdima Khettara Jadida	Removing protuberance rocks on gallery in water conveyance zone.
Khettara Association Ghirss Hannabou (Hannabou)	3 months from Jul. 2005	Khettara Oustania	Base lowering and extension of gallery in recharge and yield zone.

(2) Monitoring

Progress of rehabilitation work, financial expenses and situation of money collection are continuously recorded by association on weekly monitoring sheet prepared by ORMVA/TF and JICA.

According to the monitoring sheet, Association Mharza regularly collected totally DH3,600 per week from khattara water users and compensated expenses on rehabilitation works including cost for hiring operators and workers as well as fuel cost for compressor. On the other hand, average expense on these cost items were identified as DH4,600/week and DH97/week respectively. As a result, DH12,480 of financial deficit was recorded at the end of rehabilitation work. However, association continued money collection of DH3,600/week even after the rehabilitation work, and consequently all expenses were covered by money collection from the khattara water users.

Association Kheir in Jorf area carried out rehabilitation work on Khettara Kdima from December 12, 2004 to January 28, 2005, then started rehabilitation work on Khettara Jadida from the following week. The monitoring sheet also identified financial deficit at the end of rehabilitation work. But it was confirmed that the association president temporary paid this expenses and had a plan to collect this money even after the rehabilitation works.

Association Ghriss Hannabou in Jorf area has started rehabilitation work for 3 months from July 2, 2005. Based on hearing survey carried out on July 16, the association, in cooperation with the chef of khattara, has so far collected DH6,500 from water users for this rehabilitation work. The money collected is used for the payment on labor and fuel expense. The association leader thinks there would be not a big problem on money collection from water users. They would not make any objection on additional money collection when the remaining amount becomes small.

Indicator for Output, Target and Achievement

Indicator for Output	Target	Achievement
Number of application submitted for the equipment lending scheme.	More than 8 applications are submitted from associations to ORMVA/TF by July 2005.	75% (6 applications)
Number of realized project of rehabilitation	More than 5 projects of rehabilitation are realized by the new "Partnership" scheme by July 2005.	80% (4 khattaras)
Difference between rehabilitation plan and actual works (work item and period)	Equipments are properly used according to original rehabilitation plan. (They should not be used for other purposes. Period of lending should not be extended without reasonable reason.)	100%
Actual result of money collection by associations for operation of lent equipments.	All associations collect money from traditional Khettara organization for covering expense on operation of equipments.	89% (100% for 1 st Khettara, 67% for 2 nd Khettara, 100% for 3 rd Khettara)

(3) Observation

Association Mharza and Association Kheir have been accumulated many experiences on association activity in each area. Also, relatively high water discharges are confirmed on Khettara Haj Allal and Khettara Kdima in Ksar Krair, approximately 20 lit/sec. and 15 lit/sec. respectively. These favorable conditions might contribute high achievement of money collection for these two rehabilitation works. In fact, there was a case of Association Ghriss Hannabou in Jorf area, which was selected as the first implementing body of this new scheme but declined their application owing to insufficient financial capability of the water users of Khettara Lagrinia. Thus, it was found that equipment lending scheme would be difficult for khettaras with small water discharge and low financial capacity. However, the hesitation to apply for equipment lending scheme by association might be explained by the mentality of them preferring donor supporting large scale rehabilitation to self-supporting small scale rehabilitation work. Hence, financial capacity of khettara farmers should be carefully verified.

Moreover, it was confirmed that money collection was carried out not by a president of association but by a chef of traditional khettara organization in both cases. This is considered that association president has not acquired the same level of trust from farmers as their chef of khettara has. Farmers accept a request from their chef of khettara for money collection, but same result cannot be expected in case of a request from association president.

K.2.5.5 Formulating Monitoring System in Cooperation with ORMVA/TF, Association and Traditional Khettara Water User's Group

(1) Contents and progress

In this verification study, monitoring system in cooperation with ORMVA/TF, association and traditional khettara water user's group is formulated. On the 4th field survey (phase 1), each expert of JICA study team prepared monitoring plan for confirming effectiveness of each component of verification study. They also discussed with ORMVA/TF on monitoring indicators, targets, method of data collection and aggregation. On the 4th field survey (phase 2), monitoring workshops were also held at 3 sites of demonstration farms upon the commencement of farming activity with new water saving irrigation technique. ORMVA/TF and JICA explained about monitoring items to representatives from association as well as farmers on demonstration farm. Method of data collection and recording on monitoring sheets were also demonstrated in the workshops.

On the 4th field survey (phase 3) and the 5th field survey, progress and quality of monitoring record, as well as a difference from the original plan, were confirmed.

(2) Monitoring

Monitoring data and information collected by association were confirmed sufficient in quantity and quality in accordance with the original monitoring plan. Although some unreliable data were observed on

monitoring sheets on irrigation water volume and water intake at the beginning, accuracy of these data was improved to an acceptable level after one month owing to an appropriate advice to association by ORMVA/TF and JICA.

Indicator for Output, Target and Achievement

Indicator for Output	Target	Achievement
Monitoring result by associations (period of monitoring activity, motoring results, difference from the plan)	Monitoring activities by associations are properly carried out following to the plan. When difference is observed, the cause is confirmed and countermeasures are considered.	100%

(3) Observation

Even though association member who are involved in monitoring activity have been improved their skills on collecting and recording accurate monitoring data, it is hardly to say that those people understand how these data can be utilized in the future activity. ORMVA/TF is required to feedback these monitored information to association and farmers in proper manner after analyses and summarization. Feedback is important for farmers to understand effectiveness of these new techniques and facilitate their future application of them.

In this verification study, feedback to association and farmers was realized through a seminar held in Ait Ben Omar on February 2, 2005. In this seminar, information on water saving techniques confirmed through monitoring activity on demonstration farm was presented to farmers in the village.

K.2.5.6 Spreading Knowledge on Water Saving Irrigation Technique by Association

(1) Contents and progress

President of Association El Moustakbal in Ait Ben Omar, which has been cooperating monitoring activities on demonstration farm, proposed ORMVA/TF and JICA to hold a seminar for farmers to present results of demonstration farm in the village. He thought that this kind of opportunity was very important for farmers to understand an effectiveness of new water saving techniques and facilitate their adoption in the future. Based on this idea, ORMVA/TF and JICA, in cooperation with the association, held a seminar for farmers in Ait Ben Omar on February 2, 2005. Totally 24 farmers from the village participated in the seminar. In this seminar, water saving effect as well as high yields and market values of harvested crops were presented as results of demonstration farm applying new water saving techniques. Association presented their activities on the demonstration farm including technical advice to farmers and support on monitoring activity. At the same time, the president facilitated discussion among farmers on future adoption of these techniques.

This seminar was also incorporated into a program of the study tour for association leaders from Alnif, Jorf

and Tinejdad, which was held on February 1 and 2, 2005. Totally 62 representative from 37 associations from these area attended and observed the seminar.

On Lambarkia demonstration site, new association called “Agriculture Association for Monkara Oasis Development” was founded on May 2005 aiming at disseminating output of demonstration farm to other farmers in the same Ksar. Although the association is quite new, it has been actively carrying out extension activity on drip irrigation with khattara water based on clearly prepared annual action plan, including acceptance of visitors to the demonstration farm and collection of technical data on 4 khattaras in the Ksar.

(2) Monitoring

Two associations out of three have made positive proposal and taken action for extension of water saving techniques. On the remaining Ksar of Taoumart, it was confirmed that the association helps farmers interested in drip irrigation to contact ORMVA/TF even though it has not taken organized way of supporting activity.

Based on these situations, achievement of this component can be presented as follows.

Indicator for Output, Target and Achievement

Indicator for Output	Target	Achievement
- Actual activity by association (meeting, training and organized seminars, etc.)	Associations located in 3 Ksars (Ait Ben Omar, Lambarkia, Taoumart), where verification studies on water saving irrigation are carried out, start any kind of activity for spreading knowledge on water saving irrigation, including seminar, technical guidance on farm land, meeting with ORMVA staff, etc.	100% (3 association out of 3)

(3) Observation

Farmers expressed the highest interest on drip irrigation technique which showed highest water saving effect with high yields. However, high cost for facility installation appeared as the biggest obstacle. This problem can be mitigated by formulating drip irrigation cooperative by some farmers so that they become able to share initial cost on facility installation. Government subsidy (40%) for drip irrigation facility is also available. JICA study team pointed out that the same kind of drip irrigation facility on a demonstration farm could be used to irrigate around 3 ha of agriculture land. Moreover, it becomes economically feasible when it is used for more than 1.5 ha. However, small and dispersed land plots as well as the traditional water rights were identified as obstacles for cooperative use of drip irrigation facility. It is important to continue discussions and seek countermeasures on these obstacles.

K.2.5.7 Exchange of Information, Sharing Knowledge and Experience between Associations

(1) Contents and progress

Two study tours are scheduled on this verification study for facilitating exchange of information and sharing knowledge between associations. The first study tour was held on February 1 and 2, 2005. Totally 62 representatives from 37 associations in Alnif, Jorf and Tinejdad areas participated and observed activities carried out by progressive associations in Jorf and Tinejdad area.

The 2nd Study Tour is held on July 14 and 15, 2005 on the purpose of dissemination of knowledge especially on water saving irrigation techniques. Association leaders from Alnif, Jorf, Rissani and Tinejdad participated in the tour (see Attachment K.2.5.1 for Record of Study Tour).

(2) Monitoring

Monitoring indicators and targets prepared in cooperation with ORMVA/TF, together with the achievements, are shown on the table below.

Indicator for Output, Target and Achievement

Indicator for Output	Target	Achievement
Number of associations participating to the study tour.	More than 50% of association representatives concerned by this verification study participate in the study tour.	100%
Contribution (output) of study tours (change of attitude)	20% of associations participated in the tour starts applying new knowledge or technique obtained.	94% (7 out of 37 Associations)
Development of information exchange between associations after the tours.	10% of associations participated in the tour start exchanging information with other associations by themselves.	246% (15 out of 37 Associations)

(3) Observation

According to the monitoring result, positive effects of study tour on association activity were confirmed especially on aspects of information exchange between associations and change in behavior of participants. However, by closely looking at replies on questionnaires, it is found that many associations pointed out “exchanging information on outside assistance” as a major change in their behavior. This suggests that main interest of association is still acquiring outside assistance than taking their own action. In addition to information exchange activities, projects yielding common benefit to different associations should be identified and formulated in the future in order to facilitate collective works between several different associations.

K.2.6 Rural Life Improvement

K.2.6.1 Income Generation Activities

(1) Contents and progress

In the Study Area, although agriculture has been main income source, the less rainfall in past ten years causes decrease of agriculture production. It is, therefore, understood that the additional income sources other than crop cultivation have to be found, since income source is very limited in the Study area. In the verification study, rabbits and pigeon breeding as potential income source was examined in terms of technical and financial aspects. The following five sites were selected and willingness of women groups to activities was confirmed in July 2004.

Sites for Income Generation Activities

Item	Ksar Name	Khettara Name	Association Name	Remarks
Rabbit Breeding	Tizougaghine, Goulmima	Bakassia	Taouassoul, Tizougaghine	Many women showed their willingness to participate into the activities. Association selected some of them considering their willingness.
	Oukhite, Mellaab	Oukhite	Amagha, Mellaab	It was observed that access to market is not so good. However women's group showed strong willingness to the activities.
	Jorf (Ouled Aissa, Ouled Moussa and Ouled Ghanem)	Lambarkia (Jorf), Souihla Lhaine, Souihla Ouled Ghanem	Lutte contre la desertification, Jorf	Association proposed that mother rabbit should be returned to association if number of rabbit increased.
	Dar Lbida, Rissani	Bidaouia	Mohamed Ben Abdellah, Rissani	Association has implemented education on literacy. Association expected that the income generation activities will contribute to more motivation of women.
	Boudenib	Jdida	Amis de la terre, Boudnib	Group shows the strong willingness to participate into the activities.
Pigeon Breeding	Boudenib	Jdida	Amis de la terre, Boudnib	Pigeon breeding will be made in the same Ksar of rabbit breeding. Market of pigeon is confirmed.

Based on the activity record made by women group and construction record made by the JICA Study Team, the progress of income generation activities is shown below:

Beneficiaries Data of Income Generation Activities (Pigeons and Rabbits) as of June 2006

Item	Ksar Name	No. of Participants	Training	Increase of Breeding Number	Decrease of Breeding Number	Beneficiaries who want to continue the activities
Rabbit Breeding	Tizougaghine, Goulmima	20persons	Field training program made by ORMVA-TF on Dec. 31 2004	19 persons	1 person	19 persons
	Oukhite, Mellaab	18 persons	Field training program made by ORMVA-TF on Dec. 31 2004	6 persons	12 persons	10 persons
	Jorf (Ouled Aissa, Ouled Moussa and Ouled Ghanem)	15 persons	Field training program made by ORMVA-TF on Dec. 30 2004	8 persons	7 persons	11 persons
	Dar Lbida, Rissani	15 persons	Field training program made by ORMVA-TF on Dec. 29 2004	12 persons	3 persons	12 persons
	Boudenib	15 persons	Field training program made by ORMVA-TF on Dec. 30 2004	10 persons	5 persons	13 persons
	Total	83 persons		55 persons (66%)	28 persons (34%)	65 persons (78%)
Pigeon Breeding	Boudenib	1 person	Field training program made by ORMVA-TF on Dec. 02 2004	0 person	1 person	1 person

Progress of Income Generation Activities (Pigeons and Rabbits) as of June 2006

Item	Ksar Name	No. of Participants	No. of Supply	Present Condition	No of Sales	Remarks
Rabbit Breeding	Tizougaghine, Goulmima	20persons	Male: 17 Female: 34 Hoses: 51	Male: 15 Female: 19 Baby: 73	None	Infant mortality rate : 63%(125 babies)
	Oukhite, Mellaab	18 persons	Male: 18 Female: 36 Hoses: 54	Male: 07 Female: 11 Baby: 26	None	Infant mortality rate : 76%(81 babies)
	Jorf (Ouled Aissa, Ouled Moussa and Ouled Ghanem)	15 persons	Male: 17 Female: 33 Hoses: 50	Male: 10 Female: 17 Baby: 72	None	Infant mortality rate : 49%(69 babies)
	Dar Lbida, Rissani	15 persons	Male: 17 Female: 33 Hoses: 50	Male: 06 Female: 14 Baby: 59	None	Infant mortality rate : 50%(58 babies)
	Boudenib	15 persons	Male: 15 Female: 30 Hoses: 45	Male: 10 Female: 21 Baby: 57	None	Infant mortality rate : 72%(148 babies)
	Total	83 persons	Male: 82 Female: 163 Houses: 245	Male: 48 Female: 82 Baby: 287	None	Infant mortality rate : 62%(481 babies)
Pigeon Breeding	Boudenib	1 person	Male: 50 Female: 50 Hoses: 1	Male: 45 Female: 45 Baby: 5	None	-

The above table shows the following fact-findings.

- ✓ For construction of rabbit house, supply of materials was responsibility of JICA Study Team, while assembling of house was responsibility of beneficiaries. It took long period to complete assembling of rabbit houses. However, all the works including distribution of rabbits has been completed in the end of January 2005.
- ✓ According to the observation made by ORMVA-TF, high Infant mortality rate is due to: i) abnormal cold weather, ii) careless management to rabbit babies, iii) damage caused by cats and rats) shortage of feed.
- ✓ Distribution of pigeon was slightly delayed due to delay of construction of pigeon houses. However, beneficiary utilized their house as temporary pigeon room. It was not reported that egg was hatched as of end of February 2005. Although the number decreased in the initial stage, it was confirmed the hatch of eggs and increase of numbers as of June 2005.
- ✓ No beneficiaries have sold rabbits or pigeons, since the number increase is not sufficient and stabilized.

(2) Monitoring

For the income generation activities, the following indicators and targets as “Outputs” are set up.

Indicators and Targets for Outputs of Income Generation Activities

Indicators	Target
Rabbit breeding Technical aspect: Number of breeding rabbits and rabbits sold Financial aspect: Benefit/cost ratio Other aspects: Interests of farmers	More than 70% of participants indicate their rabbits increased. More than 30% of participants indicate their rabbits was sold More than 1.0 of Benefit/cost ratio More than 70% of participants indicate their willingness to continue rabbit breeding
Pigeon breeding Technical aspect: Number of breeding pigeons and pigeons sold Financial aspect: Benefit/cost ratio Other aspects: Interests of farmers	Number of pigeons increased. Pigeons were sold More than 1.0 of Benefit/cost ratio A participant indicates her willingness to continue pigeon breeding.

Achievements to targets by schemes are as follows:

Achievements to Targets of Indicators

Item	Ksar	Achievement			
		No. of breeding	No. of selling	B/C	Willingness to Continue
Target		Increase	Confirmation	> 1.0	> 70%
Rabbit	Tizougaghine, Goulmima	Achieved	Not Achieved	Not Achieved	Achieved
	Oukhite, Mellaab	Not Achieved	Not Achieved	Not Achieved	Not Achieved
	Jorf (Ouled Aissa, Ouled Moussa and Ouled Ghanem)	Not Achieved	Not Achieved	Not Achieved	Achieved
	Dar Lbida, Rissani	Achieved	Not Achieved	Not Achieved	Achieved
	Boudenib	Almost Achieved	Not Achieved	Not Achieved	Achieved
Pigeon	Boudenib	Not Achieved	Not Achieved	Not Achieved	Achieved

(3) Observation

Based on the above monitoring result, the following issues have been identified and countermeasures are proposed in terms of technical aspect, financial aspect and farmers' participation.

Issues and Countermeasures on Income Generation Activities (Pigeons and Rabbits)

	Issues	Course Analysis	Countermeasures
Technical Aspect	<ul style="list-style-type: none"> - Number increase of rabbits is not stabilized due to high rate of infant mortality. - Number increase of pigeons is not so high compared with rabbits, even though mortality rate of pigeon was small. 	<ul style="list-style-type: none"> - All the babies of rabbits were killed by abnormal cold weather in January and February 2005. Careless management of rabbits breeding has been also observed. - It takes time to increase number of pigeons. 	<ul style="list-style-type: none"> - It is confirmed as of June 2005 that the number of rabbits and pigeons have increased. The monitoring will be continues. Technical assistance will be made, if necessary.
Financial Aspect	<ul style="list-style-type: none"> - No beneficiaries have sold rabbits or pigeons, since the number increase is not sufficient and stabilized. As results, not benefit has been produced. 	<ul style="list-style-type: none"> - Same reason as technical aspect. 	<ul style="list-style-type: none"> - Number increase should be stabilized through same approach as technical aspect. - A part of beneficiaries made self consumption of rabbits and, as a result, they have properly cared rabbits. The self consumption should be sometimes considered instead of sale.
Farmers' Participation	<ul style="list-style-type: none"> - Most of beneficiaries in Oukhite lost willingness to continue the rabbit breeding, since numbers of death were high. 	<ul style="list-style-type: none"> - In case of Oukhite, the main reasons are: i) monitoring is not enough due to poor accessibility, ii) management of association is not sufficient since the association come from other area, and iii) shortage of feed due to limitation of irrigation water for fodder crops. 	<ul style="list-style-type: none"> - In the verification or initial demonstration stage, the number of beneficiaries should be minimized, in case accessibility of Ksar was not good. - Local association of target Ksar is essential for management of activities and should be carefully selected.

K.2.6.2 Hygiene Control of Khettara

(1) Contents and progress

Water guided through khettara is not only used for irrigation but also for drinking, livestock breeding, washing and other living activities, before it reaches to agriculture land. In some khettara, laundry place is not properly equipped and after wash water flows into irrigation canal. This causes deterioration of water quality for agriculture. In this component, ORMVA/TF and JICA improve laundry places accompanied to khettara and also carry out enlightenment activities in cooperation with local associations in order to prevent after wash water from re-entering into irrigation canal. The observation results before and after improvement of laundry place and enlightenment activities are summarized as below.

Condition of Each Site before Implementation of Scheme

Ksar (Khettara)	Present Condition	Improvement Plan	Existence of Association / Interest on Project
Taoumart (Jdida Taoumart)	There is no laundry place at this moment. Previously, laundry using khettara water was rarely done since water discharge was too small. However, laundry using khettara water has been increased owing to increase in water discharge resulted from rehabilitation work supported by Embassy of Japan.	Construction of new laundry place with enlightenment activities	Association exists / Strong interest on the project
Ait Ben Omar (Ait Ben Omar)	Although ORMVA/TF constructed laundry places along main irrigation canal, rinsed water goes back to the canal.	Improvement of existing drainage facility with enlightenment activities	Association exists / Strong interest on the project
Ait Moulay Mamoun (Ait Moulay Mamoun)	There is a existing laundry place just up stream of irrigation basin, but the space is not enough (Some ladies come to the place around 5 am in order to avoid crowdedness). Moreover, water quality is deteriorated because rinsed water directly flows into irrigation basin.	Enlargement of existing laundry place and improvement of drainage facility (including enlightenment activity)	Association exists / Strong interest on the project

Condition of Each Site after Implementation of Scheme

Ksar (Khattara)	Enlightenment Activities	Laundry Place Condition	Interview Survey Results on Wash Water Flows into Irrigation Canal.	Impact to Water Quality Improvement.	Remarks
Taoumart (Jdida Taoumart)	Oct. 2004 – Feb. 2005: 6 times (around 400 participants)	Cleaning activities have been made twice per week. Users have kept rules of laundry place use.	According to interview survey made by association, all the interviewee noted that quality of khettara water was almost same as before.	<u>Base condition (no laundry practice)</u> COD: 1 ppm Surfactant: 0.5 ppm <u>At laundry practice (before project)</u> COD: - Surfactant: - <u>At laundry practice (after project)</u> COD: 1 ppm Surfactant: 0.5 ppm	To prevent excess use of irrigation water in khettara, number of users is limited to be 11 persons only per day.
Ait Ben Omar (Ait Ben Omar)	Oct. 2004 – Feb. 2005: 8 times (around 100 participants)	Cleaning activities have been made twice per week. Around 70% of users have kept rules of laundry place use.	According to interview survey made by association, all the interviewee noted that quality of khettara water was improved.	<u>Base condition (no laundry practice)</u> COD: 2 ppm Surfactant: 0.5 ppm <u>At laundry practice (before project)</u> COD: 50 ppm Surfactant: 2 ppm <u>At laundry practice (after project)</u> COD: 3 ppm Surfactant: 2 ppm	Number of users has decrease from 35 persons per day to 18 persons per day after the meeting for water quality improvement.
Ait Moulay Mamoun (Ait Moulay Mamoun)	Oct. 2004 – Feb. 2005: 6 times (around 150 participants)	Cleaning activities have been made once per week. Users sometimes have not kept rules of laundry place use.	According to interview survey made by association, all the interviewee noted that quality of khettara water was improved.	<u>Base condition (no laundry practice)</u> COD: 1 ppm Surfactant: 0.5 ppm <u>At laundry practice (before project)</u> COD: 30 ppm Surfactant: 5 ppm <u>At laundry practice (after project)</u> COD: 5 ppm Surfactant: 1.5 ppm	Rubbish was collected and burned after the meeting for water quality improvement.

(2) Monitoring

For the hygiene control of khettara, the following indicators and targets as “Outputs” are set up.

Indicator for Output and Target on Hygiene Control of Khettara

Indicator for Output	Target
Quantity of rinsed water poured into khettara from laundry place	Quantity of rinsed water poured into khettara is reduced.
Change on peoples' behavior at laundry place	It is confirmed that people have started doing laundry with following ways. - Do laundry at laundry place - Do not pour rinsed water to khettara canal, or return it to the canal according to a new rule - Do not do laundry inside khettara canal

Achievements to targets by schemes are as follows:

Achievements to Targets of Indicators

Scheme	Achievement			
	Quantity of Rinsed Water Poured into Khettara	Laundry at Laundry Place	Rule for Rinsed Water	No Laundry inside Khettara Canal
Target	Decrease	Confirmed	Confirmed	Confirmed
Taoumart	Achieved	Achieved	Achieved	Achieved
Ait Ben Omar	Achieved	Achieved	Almost Achieved	Achieved
Ait Moulay Mamoun	Achieved	Achieved	Not Achieved	Achieved

(3) Observation

As shown in the monitoring result, the awareness on water quality improvement of khettara has been improved through the pilot schemes. On the other hand, the following issues and countermeasure are identified.

Issues and Countermeasures Identified through the Hygiene Control Activity of Khettara

Scheme	Target	Issue	Coarse Analysis	Countermeasures
Taoumart	Achieved	Users have kept rules of laundry place use.	-	Farmers concern that improved laundry place would cause problems of decreasing water volume for irrigation. This issue was solved, since number of uses has been limited.
Ait Ben Omar	Almost Achieved	Around 70% of users have kept rules of laundry place use.	It takes more time to keep rules of laundry place use completely, since rule was newly established.	At initial stage, only 50% of users were kept rules of laundry place use. As results of enlightenment activities, no of uses who kept rule increased. The enlightenment activities should be continued.
Ait Moulay Mamoun	Partly Not Achieved	Users sometimes have not kept rules of laundry place use.	Due to 2 m intervals from khettara to drainage, some users do not keep the rules.	Although users sometimes have not kept rules, it was confirmed change on peoples' behavior such as activity of rubbish collection. The enlightenment activities should be continued.

K2.6.3 Environmental Improvement of Khettara Ksar

(1) Contents and progress

It is observed livestock dung and rubbish in Khettara Ksar, and, accordingly, those cause environmental deterioration. To improve environmental condition in Khettara Ksar, it is proposed to construct basins for organic manure for collection of livestock dung with awareness campaign of segregation between livestock dung and rubbish through local association. The observation results before and after construction of basins for organic manure are as shown below.

Condition of Each Site before Implementation of Scheme

Ksar Name	Khettara Name	Association	Present Condition	Improvement Plan
Alnif	Alnif	Association Bougafer	There is rubbish ground between settlement area and agricultural field. In the rubbish ground, rubbish and manures are mixed.	Activity needs are confirmed and association is active. It is proposed to construct basin for organic manure in the existing rubbish ground.
Bouya	Jdida Bouya	El Amal pour le développement	There are two rubbish grounds near settlement area. In the rubbish grounds, rubbish and manures are mixed.	Activity needs are confirmed and association is active. It was decided to install two manure basin (basin area should be half of basic specification), since two families use tow rubbish grounds, separately.
Ait Ben Omar	Ait Ben Omar	Al Moustakbal pour le développement et l'environnement	Rubbish is buried in the desert area. Ksar would like to produce manure using manure basin.	Activity needs are confirmed and association is active. It was decided to install four small manure basin (basin area should be one-fourth of basic specification) considering easy management and collection of livestock dung.

Condition of Each Site after Implementation of Scheme

Ksar Name	Association	Activities	Production of Organic Manure	Remarks
Alnif	Association Bougafer	Meetings at Ksar level: 3 times from November 2004 – June 2005 (Around 100 participants in total) Activities using manure basin: 7 times from February – June 2005	Seven times removal work of plastics in the basin has been made. Around 4 M ³ of organic manure was produced.	Somebody wasted the plastics to the manure basin when the basin was managed as communal use. Ksar decided that only one family manage the basin and use the organic manure.
Bouya	El Amal pour le développement	Meetings and activities using manure basin: 4 times from February – June 2005 (Around 70 participants in total)	Each basin has family in charge. As a result, the proper maintenance has been made and qualified manure has been produced. Around 10 M ³ of organic manure was produced.	Somebody wasted the plastics to the manure basin before the family for management was not appointed.
Ait Ben Omar	Al Moustakbal pour le développement et l'environnement	Meetings and activities using manure basin: 5 times from February – June 2005 (Around 70 participants in total)	Each basin has family in charge. As a result, the proper maintenance has been made and qualified manure has been produced. Around 12 M ³ of organic manure was produced.	No issue on mixing plastics in the manure has been made, since the family for the management was appointed in the initial stage of the scheme.

(2) Monitoring

Monitoring plan was prepared. It will be carried out in July 2005 for monitoring and evaluation of the verification study. For the environmental improvement of Khettara Ksar, the following indicators and targets as “Outputs” are set up.

Indicator for Output and Target on Environmental Improvement of Khettara Ksar

Indicator for Output	Target
Production of organic manure using manure basin	Production of organic manure using manure basin is confirmed
Change on peoples' behavior	It is confirmed that people have started doing the followings. - Do segregation between livestock dung and rubbish - Do application of organic manure in farm land

Achievements to targets by schemes are as follows:

Achievements to Targets of Indicators

Scheme	Achievement		
	Production of organic manure	Segregation	Application of organic manure in farm land
Target	Produced	Confirmed	More than 10 M ²
Alnif	Achieved	Achieved	Not achieved
Bouya	Achieved	Achieved	Achieved
Ait Ben Omar	Achieved	Achieved	Achieved

(3) Observation

The constructions of manure basins were completed and some finishing works has been made in January 2005. All the manure basins excluding Alnif produced more than 10 m³ of organic manures that was applied to the farm lands. In case of the manure basin installed in Alnif, it took time to properly produce organic manure. However, it was confirmed the production of organic manure in July 2005.

Key issue is communal management of manure basin. Under the communal managements in Alnif and Bouya, segregation between livestock dung and rubbish could not be properly made. After the discussion at Ksar level, Ksar appointed only one family to manage the basin and use the organic manure. As results, proper management of the manure basin and production of qualified manure have been made. It was, therefore, concluded in the environmental improvement through use of manure basin that; i) individual small basin for each family is recommendable for proper maintenance and management of the basin, and ii) rotational management system of basin should be considered if communal use is applied.

K.2.7 Prevention of Farmland Devastation

(1) Contents and progress

In the Verification study, “farmland devastation” is recognized that the farmland is covered with sand caused by sand dune movement by seasonal strong wind. To cope with this phenomenon, the double sack method is proposed as a suitable planting method in the arid regions, and its adaptability as well as planting method is verified during the study.

Instruction of planting by a double sack method, comparison of nursery growth between the said two methods, adaptability of the double sack method is proposed during the Verification study.

The species of plant in the experiment are *Atriplex* and *Tamarix*. These plants were planted by the double sack method, local method with digging hole at planting, and local method without digging holes at planting. JICA study team conducted test planting (the double sack: 20 trees and traditional method: 30 trees) in Jorf area on February 2004.

(2) Monitoring

Monitoring is scheduled on February and July 2005. Indicator for Output and target are as follows. Because of lower temperature after planting, plant growth was scarcely observed in each species of plants during winter season.

The monitoring items are survival rate, height of seedlings and depth of their roots. These monitoring items are used for the comparison among three methods of planting. The height of seedlings is measured once a month. The survival rate and depth of their roots are evaluated on June 2005.

The survival rate of *Atriplex* with double sack method tends to exceed both local methods’ ones. That of *Tamarix* has no difference among three methods.

The heights of seedlings are compared among survived seedlings. The difference among three methods is not found.

The seedlings with double sack method extend their roots until 50cm depth and 15 cm width. The seedlings with local method extend their root until 10 cm depth and 30cm width.

Indicator for Output, Target and Achievement

Indicator for Output	Target	Achievement
<ul style="list-style-type: none">- Adaptability of the double sack is examined.- Staff of ORMVA/TF and Forestry and water Department acquires the method.	<ul style="list-style-type: none">- Nursery growth with double sack method is observed.- Staff of ORMVA/TF and Forestry and water Department participate the planting.	Planting was carried out in December 2004. The seedlings with double sack method extend their roots deeper than the local method’s one. Monitoring is carried out continuously until September.

(3) Observation

Staff of ORMVA/TF, Forestry and water Department and INRA were invited during the planting as well as monitoring period.

The survey of root growth shows that the seedlings with double sack method extend their roots deeper than the ones with local method. This difference is attributed to the fact that the roots of double sack method can extend vertically under the good moisture condition within the sacks, and the ones of local method extend horizontally to catch the irrigation water by contraries.

The higher survival rate with double sack method rather than both local methods is assumed to be due to deeper extension of roots with double sack method. The JICA Study Team found that the new buds sprouted from some dried seedlings planted with double sack method, which were not irrigated from September 2004, in Jorf area in December 2004 at the survey in July 2005. The few years' durations experiment is expected to be done for monitoring the survival rate of seedlings and evaluating the difference between local and double sack method.

K.2.8 Data Collection for Further Recharge Facility Planning

(1) Contents and progress

It is inevitable to collect long term meteor-hydrological data and technical skill to establish a recharge facility planning. In this regard, the said data collection was started during the Verification study so as to realize the further water resources development in the Tafilalet region in cooperation with the DRH and the University of Errachidia.

1) Data collection of meteor-hydrological and groundwater level records

Available data of meteor-hydrological data and their observation points are compiled in the Groundwater Survey and Recharge Analysis Manual (Interim draft). The DRH had suspended groundwater level observation since 1997, however the ORMVA/TF has carried out data collection at the communal wells installed by himself.

2) Study for groundwater analysis

Modeling for groundwater analysis has been accomplished in collaboration with University of Errachidia aiming at technical transfer of groundwater analysis for the engineers of the ORMVA/TF. The details are shown in the said manual.

(2) Monitoring

1) Data collection of meteor-hydrological and groundwater level records

The SER, ORMVA/TF, Sub-division and CMVs are responsible for collecting the meteor-hydrological and groundwater data in the Tafilalet region. The Monitoring was scheduled on July, 2005 and indicator for output and target are as follows.

Indicator for Output, Target and Achievement

Indicator for Output	Target	Achievement
- Meteor-hydrological data in Tafilalet region are collected and analyzed.	- Data collection is carried out	Meteor-hydrological and groundwater data observed at ORMVA/TF offices were collected.

2) Study for groundwater analysis

Monitoring target is composed of modeling for the groundwater simulation and acquisition of simulation skill of the ORMVA/TF. The Monitoring was scheduled on July 2005. Target and achievement during this period are as follows.

In addition, well data located at Erfoud, Tinejda and Alnif area (coordination, well depth, water quality, etc) were collected and input in the GIS.

Indicator for Output, Target and Achievement

Indicator for Output	Target	Achievement
<ul style="list-style-type: none"> - Capability of groundwater analysis is improved amongst the ORMVA/TF. 	<ul style="list-style-type: none"> - Groundwater analysis is conducted by the ORMVA/TF. 	<p>Lectures on groundwater analysis were held in weekly basis by the Study team and Professor of the University of Errachidia.</p> <p>Initial test run was conducted using the model of groundwater analysis.</p>

(3) Observation

Enhancement of technical skills such as data analysis of meteor-hydrological, groundwater and groundwater analysis is essential to accomplish project planning and further implementation of the groundwater recharge facilities. The ORMVA/TF has attained fundamental knowledge through the Verification study. Further study on groundwater recharge may contribute to implement the project for the groundwater use and conservation together with the technical assistance of the DRH and Errachidia University.

K.3 Final Evaluation of Verification Study

K.3.1 Capacity Building of ORMVA/TF

The ORMVA/TF is responsible for project implementation for the khattara rehabilitation and rural development. The ORMVA/TF has an important role of 1) review of Master Plan, 2) update of khattara inventory data base, 3) monitoring and evaluation of the project, 4) budgetary appropriation, 5) strengthening of networks between the ORMVA/TF and beneficiaries including associations and cooperatives, and 6) knowledge management on water use and agricultural extension, etc. Activities on capacity building related to the items above are useful for the ORMVA/TF through the verification study.

(1) Effectiveness

During the verification study, several seminars and workshops were held to share and disseminate information on agricultural development between the ORMVA/TF and farmers' organizations. Information includes inventory data of khattaras, effects of khattara rehabilitation work such as reduction of water loss and maintenance work, water saving effects by drip and furrow irrigation method, introduction of cash crops, breeding of livestock, strengthening of farmers' organizations as well. In addition to this, activities for monitoring and evaluation by the ORMVA/TF in collaboration with the Study team have surely contributed to improve capacity of the ORMVA/TF for further review and revision of the Master Plan.

Sub-division offices have continued field investigation for inventory update, and its work progress has been periodically informed during the seminar. The ORMVA/TF recognizes that khattara discharge is most important information for economic evaluation of the khattara rehabilitation plan during compilation of Master Plan, accordingly the ORMVA/TF appreciates continuous survey of khattara discharge during updating inventory.

As for agricultural extension service, the ORMVA/TF has sufficient information, however there was not appropriate method to disseminate agricultural information such as farming skills to the beneficiaries. The study tours to the demonstration farms conducted during the verification study activated farmers' intension on acquiring farming skills and water saving irrigation method, and also positive impact of agricultural productivity. The ORMVA/TF has recognized that farming practice at the field level is one of the effective means to disseminate farming skills to the beneficiaries.

For the component of monitoring and evaluation, the ORMVA/TF justified its effectiveness for measuring achievement of the project target and input. Offers from the coordinators of the Sub-division offices to actively involving the monitoring and evaluation activities were one of the outcomes of the component. Thus this activity has elevated ORMVA/TF's initiatives and has contributed to a further review and revision of the Master Plan.

(2) Relevance

Component of capacity building of the ORMVA/TF consists of update of khattara inventory which is base

for khettara rehabilitation planning, dissemination of agricultural and irrigation information which is necessary for establish agricultural production plan to the ORMVA/TF, and knowledge transfer on monitoring and evaluation for review and revise of the Master Plan and so on. Relevance of the component related to the project target “Capacity building of the ORMVA/TF on review and revise of Master Plan” is explained by the following reasons:

- The ORMVA/TF is responsible for not only the construction, operation and maintenance of large scale irrigation networks and flood irrigation systems, but those for small scale irrigation systems such as khattaras and communal pumping systems. Master Plan on khettara rehabilitation and rural development proposes 20 years implementation schedule, and review and revise of the Master Plan is periodically necessary in accordance with a budgetary appropriation amongst whole ORMVA/TF programs as well as disbursement schedule for the khettara rehabilitation scheme. Capacity building of the ORMVA/TF on monitoring and evaluation is inevitable for review and revise of the Master Plan, accordingly activities related this purpose have relevance to the said study purposes.
- Smooth implementation of the khettara and irrigation canal rehabilitation, farm extension services and income generation schemes is realizes by a definite budgetary appropriation. The ORMVA/TF has acquired budget for the khettara rehabilitation works from his local annual fund and financial support by the IFAD, in addition by the ADS (Agency of Social Development) according to his experience. Since applicants (or recipients) are local population such as associations and cooperatives, their eligibility, i.e. capacity of project management and financial management is required for funding by the ADS, in addition it is necessary to have an authorization of the official authority, if the applicant is a local community. In this regard, activities to establish network for disseminating agricultural information and knowledge sharing under the component are expected to accelerate project implementation for the rural development.

K.3.2 Khettara Rehabilitation

“Firming and lift up of farm income” is over all project targets of the khettara rehabilitation and rural development as described in the Master Plan. As an improvement of water sources of the khattaras have a higher priority to realize preservation and development of rural community in the study area. Verification study aims at relevance of khettara rehabilitation works from the technical and economical points of views, and reflecting its study results to the project implementation plan in the Master Plan.

(1) Effectiveness

Rehabilitation works of the khattaras aim at 1) estimates of project benefit (reduction of water leakage, maintenance labor force and cost, 2) improvement of khettara rehabilitation work from technical point of view. The activities in the verification study effectively figure out the scope of the khettara rehabilitation works proposed in the Master Plan. Cost comparison survey between concrete lining and pipe

installation was made for economizing khattara rehabilitation cost, and technical research were made through several gallery sections such as concrete culvert, concrete open canal, enlargement of gallery section, concrete culvert construction in tunnel, PVC pipe installation, as well.

Both reduction of leakage loss and maintenance labor force satisfy requirement of the project benefit in the project evaluation in the Master Plan (see Sub-chapter 3.2). Alternative study on construction methods such as earth work (different geological condition, open and tunnel excavation), concrete works (in open excavation and tunnel), pipe installation works provide basic information for cost estimates of the rehabilitation works.

As respect to the rehabilitation cost from an economical point of view, it was verified by the project evaluation including all cost and benefit items such as rehabilitation costs for khattaras and irrigation canals, benefit originated directly by the rehabilitation works and indirectly through an effect by farm skill dissemination to the farmers. It was verified that 30 % of a rehabilitation rate in length proposed in the draft Master plan gave sufficiently higher EIRR of 12 %.

(2) Relevance

Target and overall goal of this verification component are “appropriateness of khattara rehabilitation is verified from technical and economical points of views” and “the ORMVA/TF proceeds to rehabilitate the khattaras based on the schedule in the Master Plan”, respectively.

In addition to the khattara rehabilitation works mentioned above, the Study team and the ORMVA/TF has commenced to prepare the manual for the khattara rehabilitation works comprising of proposal of khattara section, construction methods, construction supervisory work, etc. Manual preparation also raises technical knowledge of the ORMVA/TF for further khattara rehabilitation works, accordingly this component activities are relevant to the project target. Manual shall be completed based on the results of the verification study.

K.3.3 Water Use

On this verification study, project purpose for this component is set as “verification of effectiveness and relevance of water saving approaches” proposed in the master plan. Water saving approach is classified into irrigation canal level and on-farm level, based on the concept over water balance of khattara irrigation system.

Since the reduction of water loss is essential for water saving, effectiveness of minimizing water conveyance loss on irrigation canal level and effectiveness of water saving irrigation techniques on farm level were examined on the verification study.

(1) Effectiveness

Canal lining (for existing earthen canal) and inlet improvement (installation of steel gate or PVC pipe with cap), was commenced as a rehabilitation project, targeting on the main canal in three khattara irrigation

areas. Canal rehabilitation decreased water loss from 19 % to 7 % on the average, and inlet improvement decreased water loss from 13 % to 6 % as well. Namely, it might be said that available water discharge increased around 12% (target; 10%) by canal rehabilitation and around 7% (target; 5%) by inlet improvement. Results of the verification study shows the fact that the rehabilitation works are a reliable and quick acting approach for water saving.

After the rehabilitation project, 50 farmers in Ait Ben Omar and Lambarkia restarted the cultivation in their farmlands where have been abandoned by the desertification. It was recognized that main canal rehabilitation has a potential of not only expanding the irrigable area through decreasing water conveyance loss, but restoring the devastated farmlands through regaining water flow.

In this sense, it would be said that the canal rehabilitation is an economical approach in water saving compared with khattara rehabilitation, and an effective countermeasure for environmental preservation.

On the verification study, water saving irrigation techniques such as drip irrigation and furrow irrigation were compared with traditional basin irrigation through actual vegetable cultivation in the demonstration farms. Irrigation water amount consumed at drip irrigation plot was only 34% of that at basin irrigation plot, and drip irrigation plot shows the richest harvest. Therefore, it would be judged that drip irrigation technique is drastic water saving approach in khattara irrigation area as well as other irrigation area.

Beside, the verification result gives reliable evidence that furrow irrigation is recognized to be one kind of water saving irrigation technique. Irrigation water amount consumed at furrow irrigation plot was 65 to 72 % of that at basin irrigation plot. Especially, in summer season with high evaporation, furrow irrigation works more effective to minimize water consumption for the crops.

The feasibility of on-farm reservoir was examined by comparing with the result of furrow irrigation plot with reservoir and without reservoir as well. Even though traditional water right has some flexibility over the irrigation scheduling; the range of its adjustment is limited. Therefore, the necessity of on-farm reservoir would be enhanced in order to make watering schedule more flexible. Effectiveness of on-farm reservoir was confirmed from the viewpoints of soil moisture control and crop yield.

(2) Relevance

On the verification study, adaptability of the proposed construction method for canal rehabilitation was examined. It was revealed that rectangular open canal is applicable to general section of main canal, and box culvert canal type and PVC pipe type are applicable to the canal section located at sand dune area. Meanwhile, the results on the verification study identified some problems that newly proposed trapezoid open canal type has several disadvantages in terms of construction, structure, and maintenance.

Concerning inlet improvement, PVC pipe type which was applied to the main canal in Taoumart satisfied the expectation of water saving due to high waterproof. Moreover, easy handling and low cost shows a possibility of extending to other khattara irrigation canals with bigger water discharge. On the other hand, further remedy should be taken for the adaptability of steel gate type, because it is difficult to divert water flow without filling soil due to the defects in the structure (the thickness of steel gate and dimension of

flame).

In recent years, drip irrigation technique has been applied in Tafilalet region by using groundwater, which is lifted by diesel pumps from wells. On the contrary, the drip irrigation applied to the demonstration farms on the verification study is the first application using khattara water. In the demonstration of vegetable cultivation under drip irrigation, it was confirmed that this water saving technique can be adopted technically for khattara irrigation area when irrigation water is stored into on farm reservoir.

The farmer in charge of Lambarkia demonstration farm understood the advantages of drip irrigation not only on water saving but also on quality control of products and mitigation of irrigation labor force through his own farming practice. He is scheduled to expand drip irrigation techniques to his farmland on their own initiative.

Furrow irrigation technique combined with on farm reservoir is also recommendable to extend to on the whole khattara irrigation area because it is an economical approach due to low initial investment.

K.3.4 Farming and Extension

(1) Effectiveness

In this component, three activities have been made, namely: i) adaptability test and demonstration for vegetable cultivation with water saving irrigation, ii) demonstration of processing machine for henna, dates and gumbo, and iii) study tour to the demonstration plots. Through implementation of three activities, the following feasibilities are verified, namely i) introduction and expansion of vegetable cultivation with water saving irrigation, and ii) introduction of processing for henna, dates and gumbo.

Based on the evaluation results for the demonstration of vegetable cultivation under water saving irrigation, the technical, financial and farmers' participatory aspects could be examined to evaluate the feasibility. In addition, based on the evaluation results for the demonstration of processing machine for henna, dates and gumbo, the technical, financial and farmers' intension aspects could be examined as well. Considering these tangible outputs created through various activities proposed in the component, effectiveness of activities is confirmed.

(2) Relevance

On this verification study, purpose for this component is set as "verification of cropping pattern proposed in the master plan". For evaluation of achievement to the purpose, the technical, financial and farmers' participatory feasibilities could be examined for introduction of both adaptability test and demonstration for vegetable cultivation with water saving irrigation as well as processing machine for henna, dates and gumbo.

In the demonstration of vegetable cultivation under water saving irrigation, technical target was almost archived, even though it was confirmed that some places or some plots could not be successfully implemented. Financially target of drip irrigation could not be achieved in the first cropping, while other

water saving irrigation method was achieved. In the second cropping, financially target of drip irrigation could be achieved, since yield increase is very high. On the other hand, farmers' participatory target of drip irrigation could be achieved, while other water saving irrigation method was not achieved in the first cropping. In the second cropping, many farmers showed high interest to furrow irrigation with reservoir since the yield was very high.

In the demonstration of processing machine for henna, dates and gumbo, technical and farmers' participatory targets were almost archived. Financially target of dates and gumbo processing could not be achieved, while henna processing was achieved. However, the financial feasibility would be improved through increase of operation hour and production volume, if people use the machine from the begging of harvest season. The gumbo as materials will be stabilized, if the water saving irrigation in addition to the gumbo processing should be applied.

K.3.5 Organization Strengthening

(1) Effectiveness

As results of seminars and trainings organized on this verification study, establishment of association has been facilitated in Alnif area, and improvement on association management skills was confirmed in Jorf and Tinejda areas. Kheffara rehabilitation works in cooperation between association and traditional water user's group have been promoted by newly established equipments lending scheme. Moreover, monitoring activity by association motivated them to expand their activity to a field of agriculture extension. Positive intervention by an association in Ait Ben Omar for holding and supporting seminar was a good example. New association aiming at extension of water saving agriculture techniques was also established in Ksar Monkara where Lambarkia demonstration farm being located.

Considering these tangible outputs created through various activities in organization strengthening component, effectiveness of seminar, training, free equipments lending scheme and monitoring activity are confirmed.

On the other hand, even though an effectiveness of preparation of brochure on governmental supports being confirmed, at the same time, necessity of appropriate sensitization by ORMVA/TF was identified to prevent enlarging dependency syndrome among established associations. Study tour had positive impact on promoting information exchange among associations. However, it is considered that formulation of project yielding common benefit to several different associations is also required for promoting collective action among them.

(2) Relevance

On this verification study, Project Purpose for this component is set as "Established associations become able to support kheffara rehabilitation works in practical manner (not only on legal formality)".

Ability of association for supporting kheffara rehabilitation work can be divided into the following 3 aspects, a) ability on preparing rehabilitation plan, b) ability on coordinating concerned parties, and c)

ability on managing rehabilitation work or project. Results from verification study can be analyzed as follows in accordance with these categories.

Ability of association for supporting khettara rehabilitation work	Ability strengthened	Ability should be strengthened in the future
a) Ability on preparing rehabilitation plan.	Ability to collect khettara base data through monitoring activity.	Ability to summarize and analyze monitoring results and reflect them to the future rehabilitation plan.
b) Ability on coordinating concerned parties.	-	Coordination among concerned parties with different interests.
c) Ability on managing rehabilitation work or project.	Enhanced ability on collection of money, management of equipment and labor for rehabilitation work through implementation of equipment lending scheme.	Ability to manage rehabilitation project supported by outside organizations including progress, quality and financial management.

As you can see on the table above, abilities strengthened through verification study are only small parts of required abilities for association. In this sense, components in verification study appear not fully relevant to achieve its project purpose. Following activities should be continued to achieve further enhancement of association ability.

a) Ability on preparing rehabilitation plan

Association enhances planning ability based on acquired knowledge and data through monitoring activity. ORMVA/TF provides technical support and advice to associations.

b) Ability on coordinating concerned parties

It is very difficult for newly established association to take a leading role to coordinate concerned parties with different interests, especially on Khettara Ksars where strong individualism is observed. In this situation, association needs to support member khettaras in equal way and firstly acquires trust from member khettaras. Formulation and realization of project which provides benefit to all member khettaras is also recommended.

c) Ability on managing rehabilitation work or project.

Association should be involved in project management both on self-rehabilitation works and donor supported project. It enhances ability on progress, quality and financial management through actual implementation of rehabilitation works and projects.

K.3.6 Rural Life Improvement

K.3.6.1 Income Generation Activities

(1) Effectiveness

In this component, three activities have been made, namely: i) formulation of women groups, ii) construction of pigeons and rabbits houses, and, iii) pigeons and rabbits breeding. Through implementation of three activities, the output of “breeding of small animals is made by local people” is evaluated. The construction of rabbit and pigeon houses has been completed in the end of January 2005. However, all the babies of rabbits were killed by abnormal cold weather in January and February 2005. In addition, number increase of pigeons is not so high compared with rabbits, even though mortality rate of pigeon was small. Finally, it is confirmed as of June 2005 that the number of rabbits and pigeons have increased. Therefore, it would be said that the effectiveness of this component was almost confirmed, but further monitoring will be required.

(2) Relevance

In the evaluation, the target of “effectiveness of income generation promotion through findings of potential activities is confirmed” have to be verified through indicators in the proposed activities of i) benefit/cost ratio is more than 1.0, and ii) more than 70% of participants indicate their willingness to continue the breeding. In the benefit/cost ratio, no beneficiaries have sold rabbits or pigeons, since the number increase is not sufficient and stabilized. As results, not benefit has been examined. In the most of sites excluding one site, on the other hand, more than 70% of participants indicated their willingness to continue the breeding. Therefore, the monitoring should be continued to confirm the financial aspect, while willingness to continue was confirmed.

K.3.6.2 Environmental Improvement of Khettara Ksar

(1) Effectiveness

In sub-component of hygiene control of khettara, two activities have been made, namely: i) improvement of laundry place, and ii) enlightenment activity. Through implementation of those activities, the outputs of hygiene control of khettara such as “quantity of rinsed water poured into khettara is reduced” and “change on peoples’ behavior at laundry place is observed” could be verified.

In sub-component of environmental improvement of Khettara Ksar, the output of “production of organic manure using manure basin is confirmed” could be verified through the activities of i) construction of organic manure basin, and ii) implementation of awareness campaign. All the basins produced qualified manure that was used for farm land. In addition, segregation between livestock dung and rubbish was properly made, even though there were some problems in the initial stage.

Therefore, it is judged that the effectiveness of this component was confirmed through outputs generated by activities.

(2) Relevance

On this verification study, purpose for this component is set as “improvement of water quality and rubbish condition in Khettara Ksar”. For evaluation of achievement to the purpose, “quantity of rinsed water poured into khettara is reduced” and “production of manure using livestock rubbish is commenced” will be examined.

Through improvement of laundry place with enlightenment activity, quantity of rinsed water poured into khettara was reduced. It is also confirmed that people have started doing laundry with following ways: i) do laundry at laundry place, ii) do not pour rinsed water to khettara canal, or return it to the canal according to a new rule, and iii) do not do laundry inside khettara canal. Through constructions of manure basins with awareness campaigns, all the basins produced more than 10 M³ qualified manure that was used for farm land. Therefore, it is judged that relevance of the purpose of this component was confirmed.

K.3.7 Prevention of Farmland Devastation

Farm devastation caused by sand dune movement has been spreading in the study area, 24 % around the khettara areas and 18 % in and around the farm areas according to the inventory survey. The double sack method is proposed to mitigate farm devastation at the arid to semi arid areas in addition to the traditional planting method.

As described in Chapter 2, plants in the test farm has no growth after transplanting or have been damaged by extremely lower temperature (below 6 to 8 degrees of frost in Errachidia) since December 2004 and abnormal snowfall in the end of January to the beginning of February 2005.

Transplanting method with the double sack has been learned by the ORMVA/TF, provincial forest office, INRA and beneficiaries. Verification study on this component is continued for several months to realize project target, “ORMVA/TF and provincial forest office recognize advantage of the double sack method”.

K.3.8 Data Collection for Further Recharge Facility Planning

(1) Effectiveness

The Master Plan report proposes three (3) stage scheduling for total 410 khettaras rehabilitation plan, i.e. short, middle and long terms. The report also proposes construction of groundwater recharge facilities during middle and long terms so as to preserve water sources of 220 dry khettaras which water sources have been dried up by consecutive drought in these years.

Collection of long period observation data and technical transfer with regard to the groundwater analysis have been carrying out by the ORMVA/TF so as to establish a groundwater preservation plan including groundwater recharge. Specific activities are, meteor-hydrological data collection in whole Tafilalet

region and groundwater level records, and experimental groundwater analysis using simulation model. The component outputs higher capability on groundwater study of the ORMVA/TF, which is effectively utilized for recharge facilities planning, supplementary data collection on hydro-geological and meteor-hydrological data for project implementation through practicable groundwater simulation in the selected area. In this fact, the verification component is effective to establish groundwater recharge plan.

Besides groundwater recharge plan, groundwater preservation shall be positively accomplished for communal pump use for the rural communities at where khattaras have been dried up due to degradation of groundwater level as scheduled in the Master Plan. The ORMVA/TF is responsible for provide concrete plan on groundwater preservation.

(2) Relevance

Project target related to data collection for further recharge facility planning is “the ORMVA/TF programs groundwater recharge plan”. Preservation of water source for domestic and irrigation water use is fundamental requirement to subsist khattara rural communities. It is therefore relevant to transfer specific knowledge on groundwater analysis to the ORMVA/TF.

The DRH is responsible for water resources development in large scale such as dam project, while the ORMVA/TF is responsible for medium and small scale schemes including khattara rehabilitation works and communal pump system development. Establishing groundwater use and preservation plan in Tafilalet region in collaboration with University of Errachidia which has higher faculty and sufficient experience and the DRH has high relevance to efficiently and effectively implement recharge facilities plan in the Master Plan.

Tables

Table K.2.3.1 Soil Physical Characteristics on Demonstration Farm

Analysis item		unit	Ait Ben	Lambarkia	Taoumart	remarks
Water content W		%	12.4	10.2	19.6	
Bulk density		g/cm ³	1.746	1.757	1.311	
Dry density d		g/cm ³	1.638	1.469	1.240	
Void ratio e			0.749	0.852	1.203	
Porosity n			42.6	46.0	54.3	
Degree of saturation Sr		%	45.8	62.7	13.3	
Density of soil particles		g/cm ³	2.707	2.719	2.711	
Consistency	Liquid limit WL	%	26.9	32.8	30.5	
	Plastic limit WP	%	14.3	16.0	14.7	
	Plasticity index Ip		12.6	16.8	15.8	
Particle size distribution	Maximum size Dmax	mm	19.0	9.5	9.5	
	Gravel G	%	19.9	0.2	5.1	+2.000mm
	Sand S	%	38.4	21.3	43.2	2.000-0.075
	Silt M	%	17.4	38.5	26.2	0.075-0.005
	Clay C	%	24.3	40.0	25.5	- 0.005mm
Classification(Plasticity diagram)			CL	CL	CL	
Classification(Triangle coordination)			Sandy clay	Clay loam	Sandy clay	
Intake rate	Integrated infiltration D	mm	$4.11 \cdot T^{0.49}$	$5.03 \cdot T^{0.28}$	$5.55 \cdot T^{0.67}$	
	Intake rate I	mm/hr	$120.8 \cdot T^{-.51}$	$84.5 \cdot T^{-0.72}$	$223.1 \cdot T^{-0.33}$	
	Basic intake rate IB	mm	6.5	1.1	39.0	
Soil hardness	10cm	mm	19.3	11.3	24.3	Optimum 24mm
	20cm	mm	18.5	18.0	30.0	
	30cm	mm	26.3	19.5	24.7	
	40cm	mm	27.8	17.7	29.0	

Table K.2.4.1 Unit Cultivation Cost for 1st Cropping

Inputs Cost	Volume for One Ha	Unit Price	Unit Cost per Ha
Seeds			
Turnip	5.5 kg/0.5ha	48 DH/kg	260 DH
Carrot	5.5 kg/0.5ha	130 DH/kg	720 DH
Organic Manure	10 ton/ha	120 DH/ton	1,200 DH
Chemical Fertilizer			
14-28-14	622 kg/ha	2.95 DH/kg	1,830 DH
N-Amoni (21%)	484 kg/ha	1.84 DH/kg	890 DH
Agro-Chemicals	1.38 bottle/ha	40 DH/bottle	60 DH
Tractor	15.9 hr/ha	60 DH/hr	950 DH
Labor Cost	22.8 man-day/ha	40 DH/man-day	910 DH
Total Input Cost per ha			6,820 DH

Irrigation Cost	Volume for One Ha	Unit Price	Unit Cost per Ha
Water Charge			
Drip Irrigation	2,689 m ³ /ha	0.12 DH/m ³	320 DH
Furrow with reservoir	8,469 m ³ /ha	0.12 DH/m ³	1,020 DH
Furrow without reservoir	7,813 m ³ /ha	0.12 DH/ m ³	940 DH
Basin	11,627 m ³ /ha	0.12 DH/ m ³	1,400 DH
Fuel Charge for Pump			
Drip Irrigation	299 lit/ha	6.14 DH/lit	1,830 DH
Furrow with reservoir	282 lit/ha	6.14 DH/lit	1,730 DH
Furrow without reservoir	- lit/ha	6.14 DH/lit	0 DH
Basin	- lit/ha	6.14 DH/lit	0 DH
Depreciation Cost Per Crop Season			
Drip Irrigation			8,425 DH
Furrow with reservoir			695 DH
Furrow without reservoir			0 DH
Basin			0 DH
Total Irrigation Cost per ha			
Drip Irrigation			10,575 DH
Furrow with reservoir			3,445 DH
Furrow without reservoir			940 DH
Basin			1,400 DH

Total Cultivation Cost per ha	Inputs Cost	Irrigation Cost	Total
Drip Irrigation	6,820 DH	10,580 DH	17,400 DH
Furrow with reservoir	6,820 DH	3,450 DH	10,270 DH
Furrow without reservoir	6,820 DH	940 DH	7,760 DH
Basin	6,820 DH	1,400 DH	8,220 DH

Table K.2.4.2 Unit Cultivation Cost for 2nd Cropping

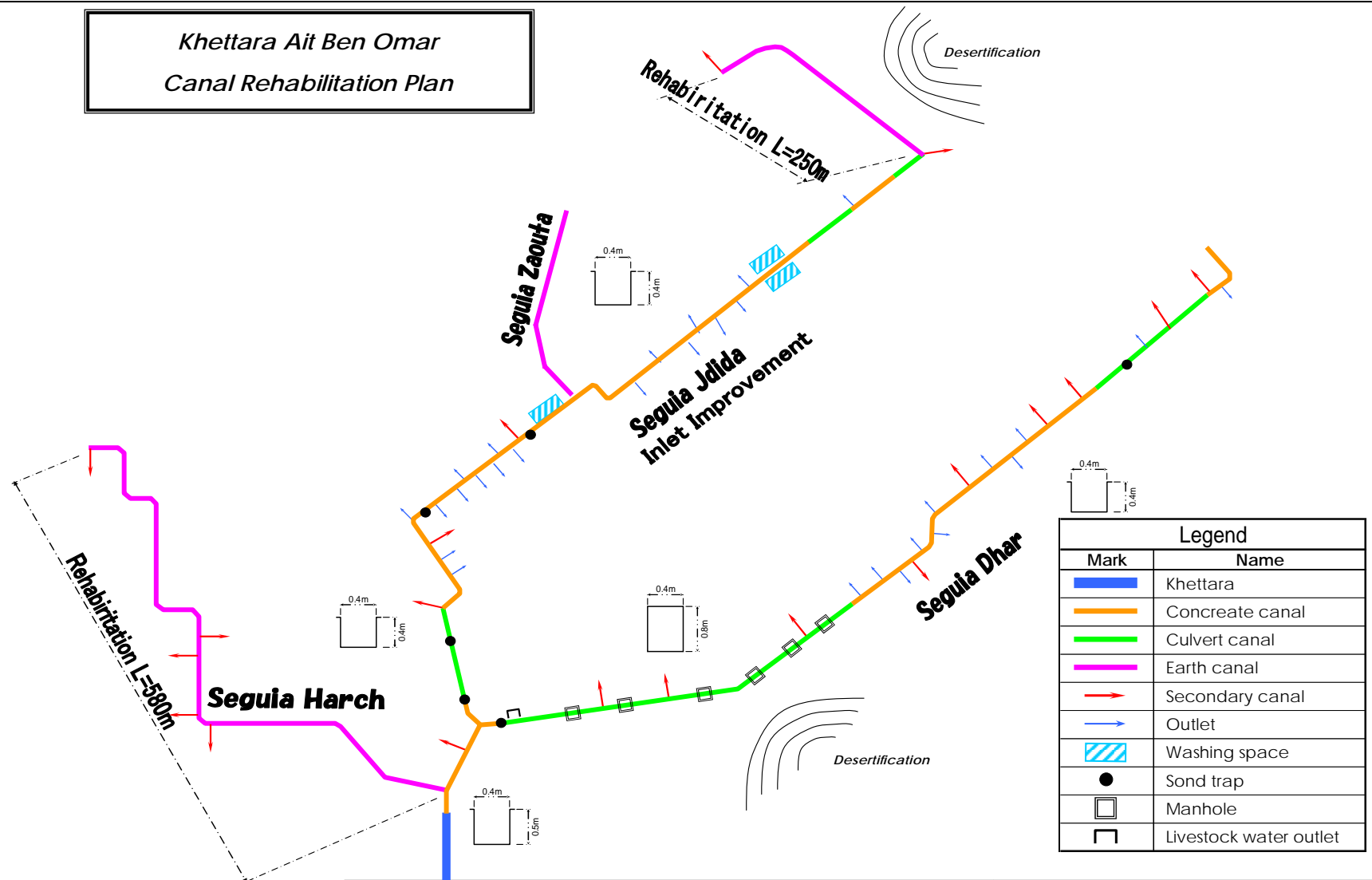
Inputs Cost	Volume for One Ha	Unit Price	Unit Cost per Ha
Seeds			
Tomato	0.1 kg/0.25ha	1,400 DH/kg	140 DH
Gumbo	10.1 kg/0.25ha	50 DH/kg	510 DH
Melon	1.4 kg/0.25ha	800 DH/kg	1,120 DH
Water Melon	1.5 kg/0.25ha	410 DH/kg	620 DH
Nursery Preparation			
Plates	151 nos/ha	9.5 DH/kg	1,430 DH
Peat	24 bag/ha	150 DH/kg	3,600 DH
Plastic sheet	21 m ² /ha	25 DH/ m ²	530 DH
Organic Manure	11.8 ton/ha	120 DH/ton	1,420 DH
Chemical Fertilizer			
14-28-14 (For basic fertilizer)	592 kg/ha	3.25 DH/kg	1,920 DH
14-28-14	426 kg/ha	3.25 DH/kg	1,380 DH
N-Amoni (33%)	149 kg/ha	3.0 DH/kg	450 DH
K-Sulfate (50%)	184 kg/ha	4.0 DH/kg	740 DH
Agro-Chemicals	11.1 bottle/ha	40 DH/bottle	440 DH
Bamboo	1 set/0.25ha	1700 DH/set	1,700 DH
Tractor	3.7 hr/ha	60 DH/hr	220 DH
Labor Cost	79.9 man-day/h a	40 DH/man-day	3,200 DH
Total Input Cost per ha			19,420 DH

Irrigation Cost	Volume for One Ha	Unit Price	Unit Cost per Ha
Water Charge			
Drip Irrigation	3,038 m ³ /ha	0.23 DH/ m ³	700 DH
Furrow with reservoir	4,758 m ³ /ha	0.23 DH/ m ³	1,090 DH
Furrow without reservoir	4,203 m ³ /ha	0.23 DH/ m ³	970 DH
Basin	6,907 m ³ /ha	0.23 DH/ m ³	1,590 DH
Fuel Charge for Pump			
Drip Irrigation	338 lit/ha	6.14 DH/lit	2,070 DH
Furrow with reservoir	159 lit/ha	6.14 DH/lit	970 DH
Furrow without reservoir	- lit/ha	6.14 DH/lit	0 DH
Basin	- lit/ha	6.14 DH/lit	0 DH
Depreciation Cost Per Crop Season			
Drip Irrigation			8,425 DH
Furrow with reservoir			695 DH
Furrow without reservoir			0 DH
Basin			0 DH
Total Irrigation Cost per ha			
Drip Irrigation			11,195 DH
Furrow with reservoir			2,755 DH
Furrow without reservoir			970 DH
Basin			1,590 DH

Total Cultivation Cost per ha			
Drip Irrigation			30,615 DH
Furrow with reservoir			22,175 DH
Furrow without reservoir			20,390 DH
Basin			21,010 DH

Figures

*Khettara Ait Ben Omar
Canal Rehabilitation Plan*



Legend	
Mark	Name
	Khettara
	Concrete canal
	Culvert canal
	Earth canal
	Secondary canal
	Outlet
	Washing space
	Sond trap
	Manhole
	Livestock water outlet

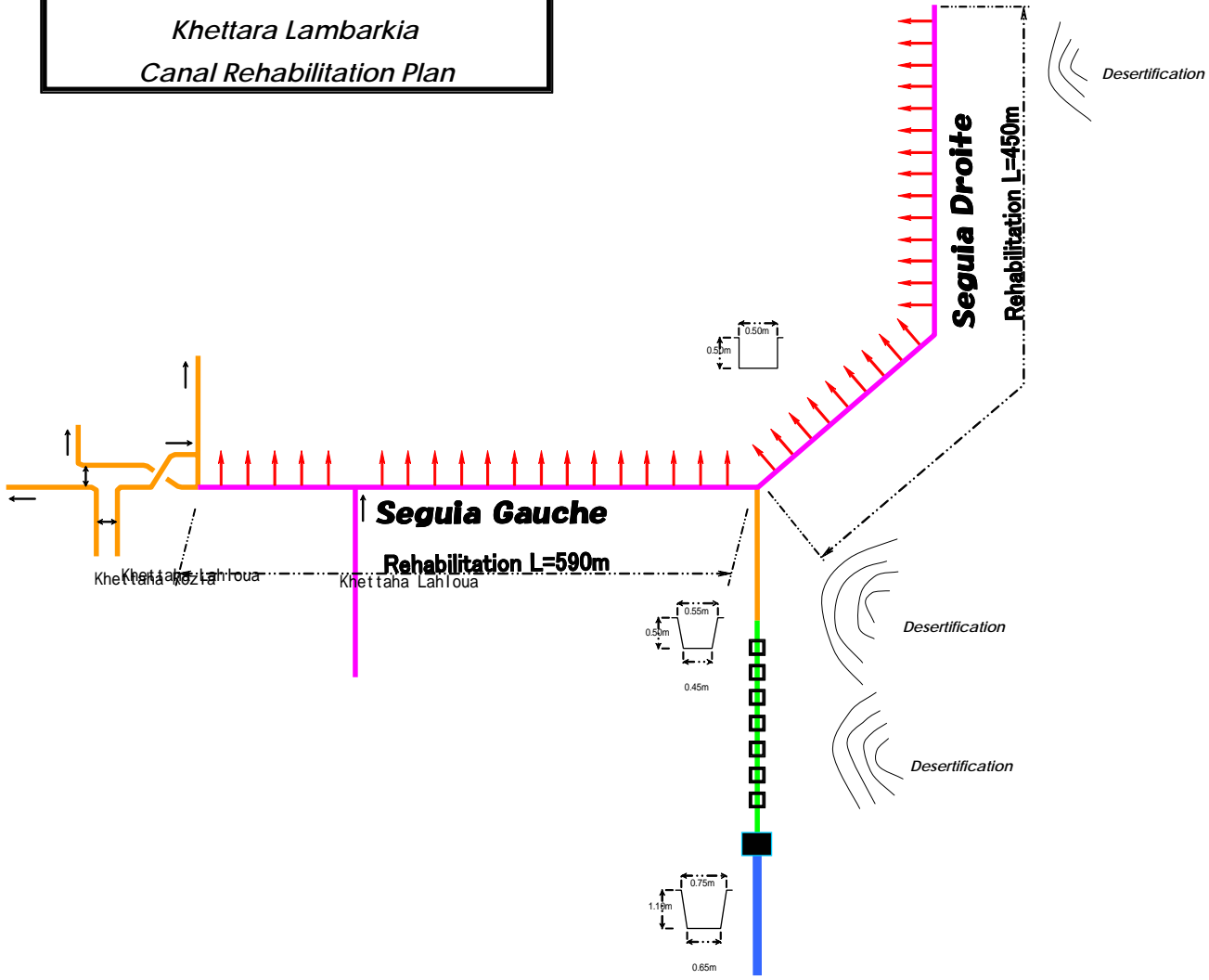
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Figure K.2.3.1
Irrigation Canal Rehabilitation Plan
(Ait Ben Omar)

**Khettara Lambarkia
Canal Rehabilitation Plan**



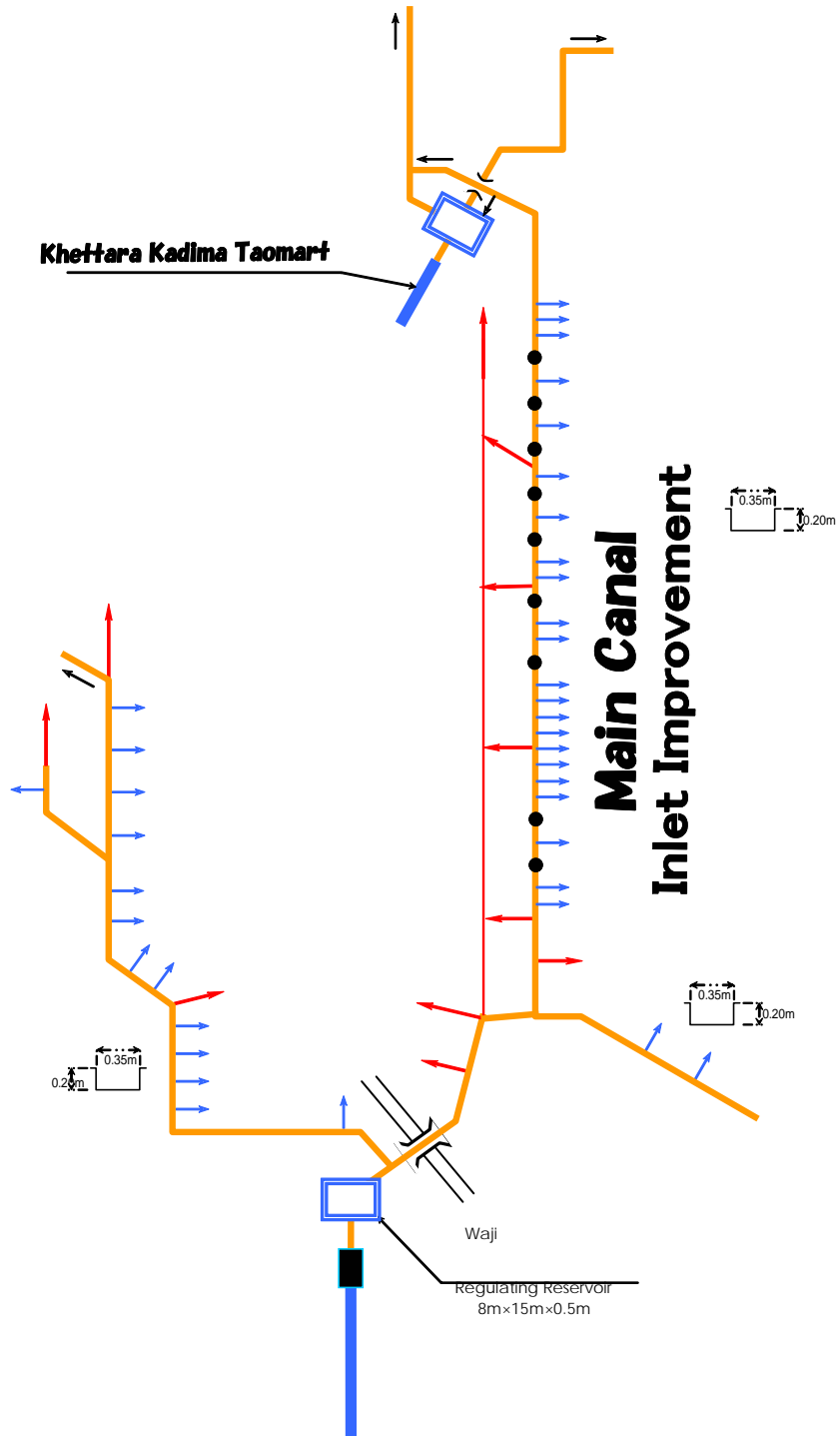
KF - 2

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Figure K.2.3.2
Irrigation Canal Rehabilitation Plan
(Lambarkia)

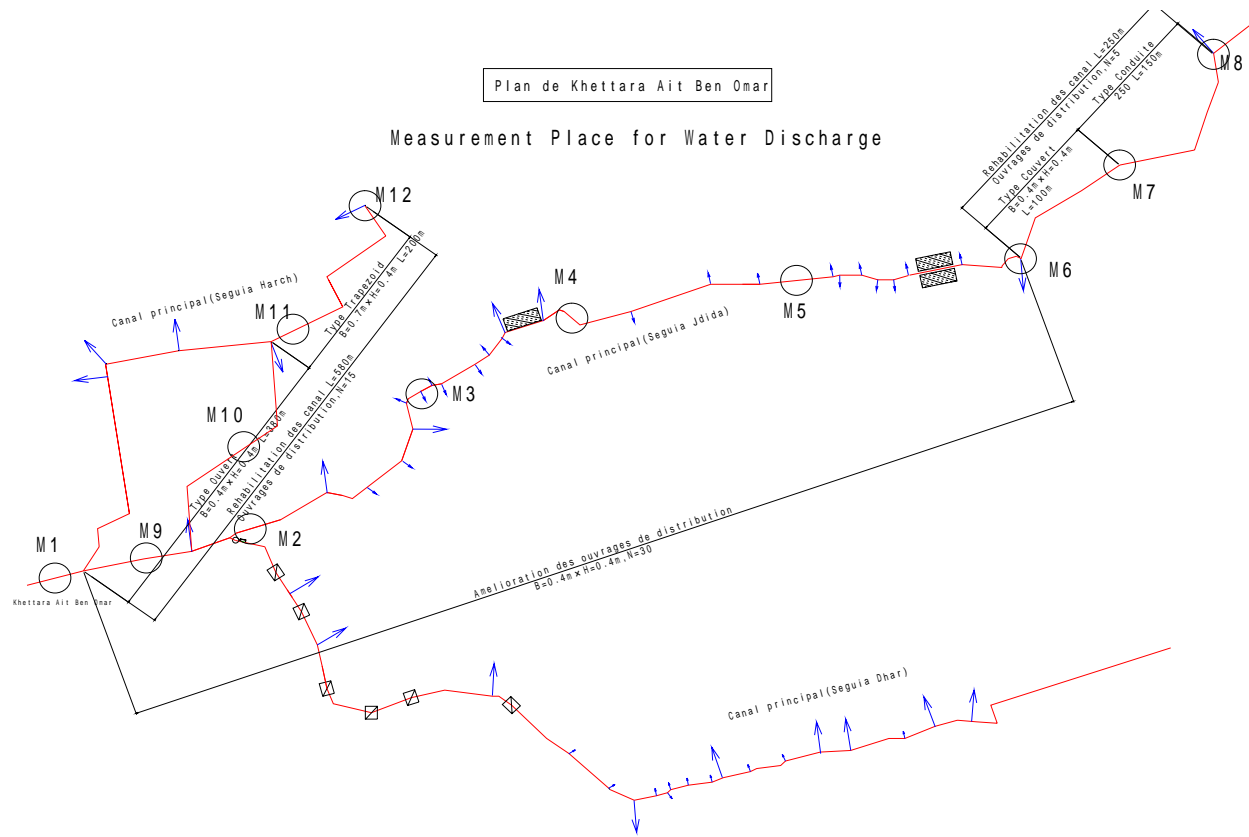
Khettara Jadid Taoumart
Canal Rehabilitation Canal



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Figure K.2.3.3
 Irrigation Canal Rehabilitation Plan
 (Taoumart)

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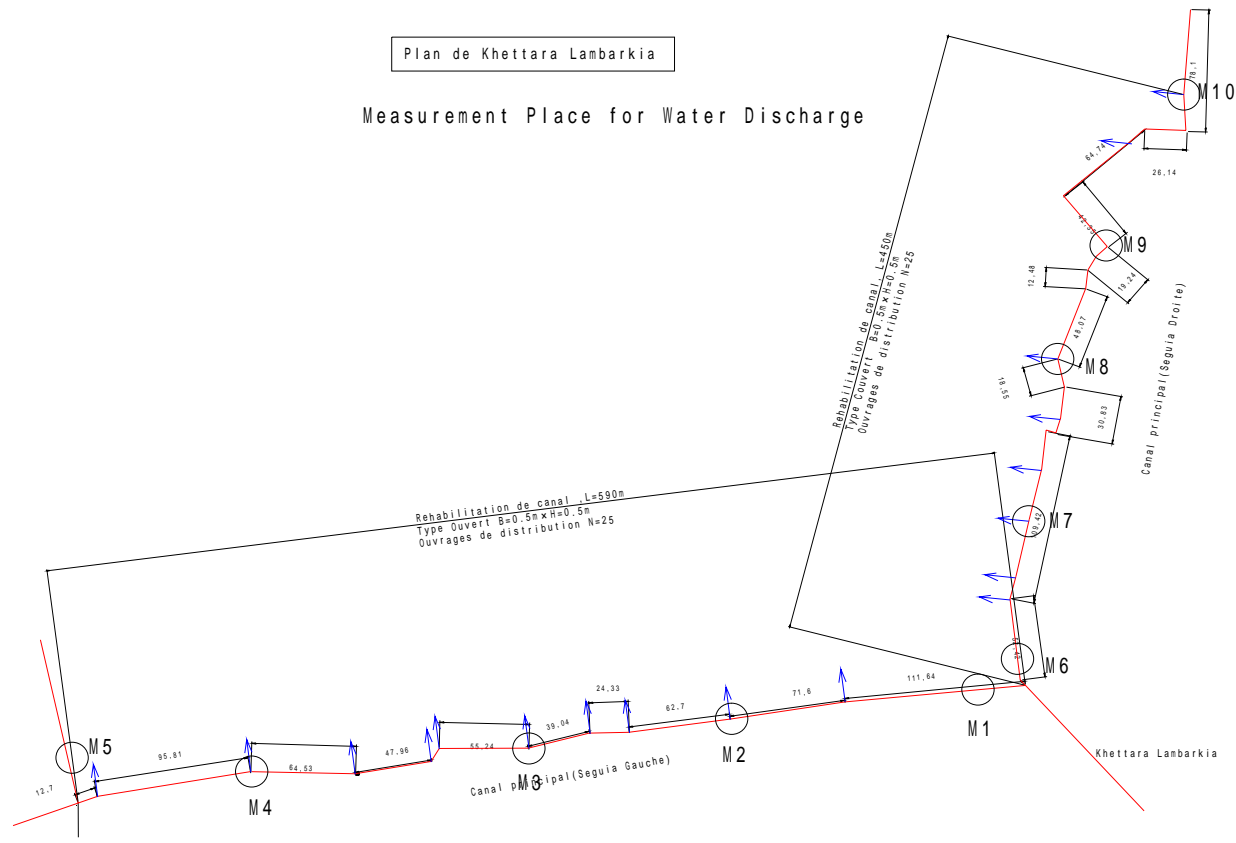
Water discharge (lit/sec)

Measurement point	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
Before rehabilitation	7.8	7.1	6.9	7.1	6.7	4.5	0.0	0.0	7.2	6.5	6.0	6.4
After rehabilitation	5.4/7.3	5.8	4.9	5.0	5.5	5.3	5.0	5.1	5.5	-	6.6	6.6

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Figure K.2.3.4
Irrigation Canal Water Discharge
(Ait Ben Omar)



Water discharge(lit/sec)

Measurement point	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10		
Before rehabilitation	16.6	14.5	15.9	12.9	-	17.4	18.8	16.9	12.9	14.3		
After rehabilitation	19.9	18.4	19.6	18.2	18.5	18.5	19.1	17.6	17.3	17.4		

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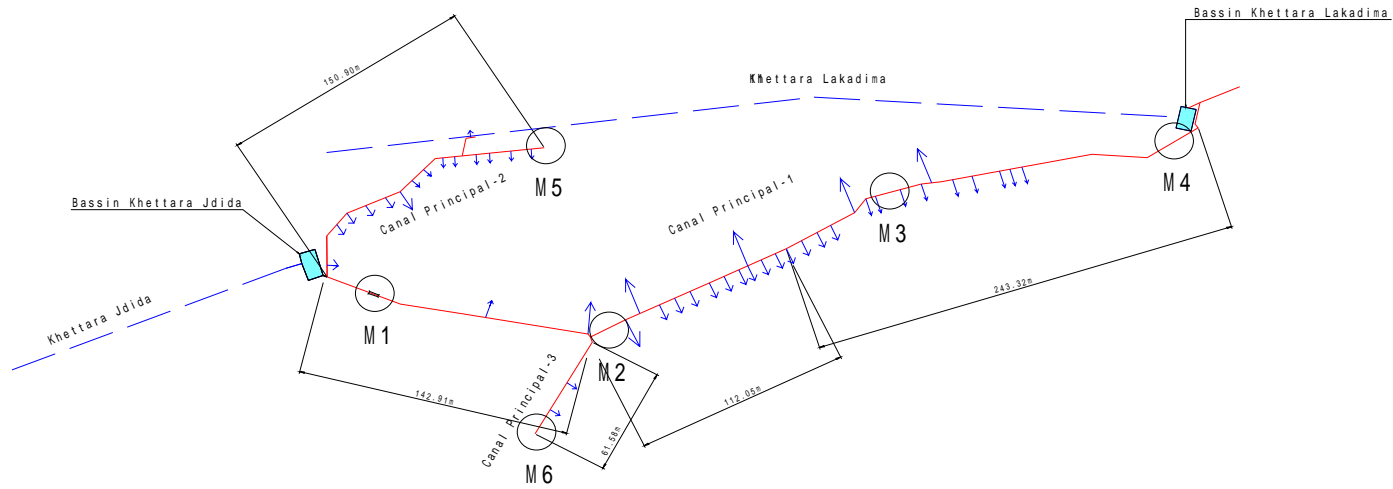
Figure K.2.3.5

Irrigation Canal Water Discharge
(Lambarkia)

Plan des Khezzara Taoumart

Measurement Place for Water Discharge

Amelioration des ouvrages de distribution
 Canal Principal -1,2,3
 B=0.35m x H=0.20m, N=50



Water discharge(lit/sec)

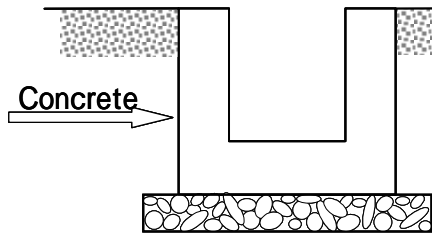
Measurement point	M1	M2	M3	M4	M5	M6						
Before rehabilitation	3.4	2.6	1.8	1.5	-	-						
After rehabilitation	1.7	1.8	1.5	1.8	-	-						

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 in Semi-Arid East Atlas Regions with Khezzara Rehabilitation
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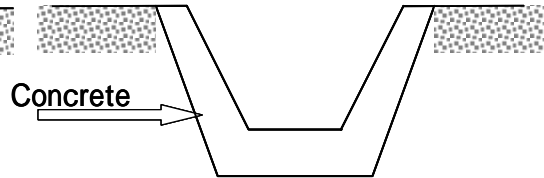
Figure K.2.3.6
 Irrigation Canal Water Discharge
 (Taoumart)

Ait Ben Omar

W=400mm × H=400mm

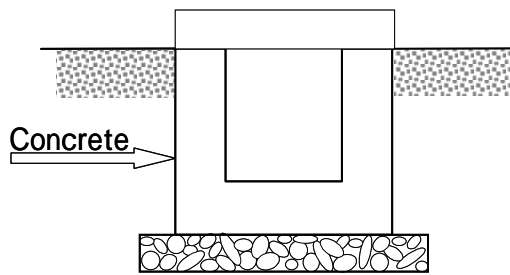
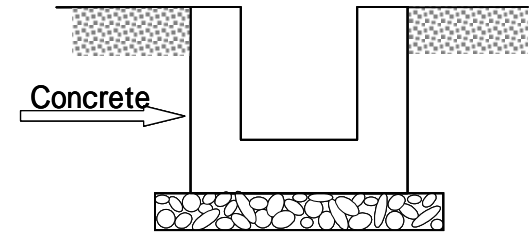


W=200-700mm
× H=400mm

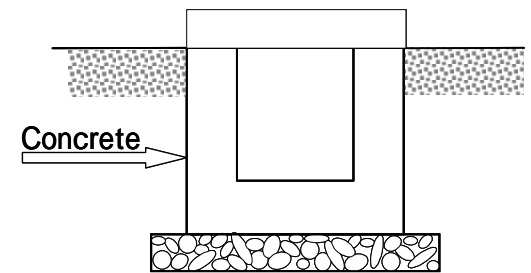
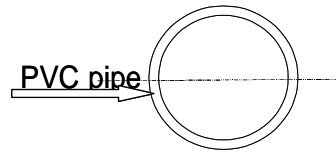


Lambarkia

W=500mm × H=500mm



D=250mm

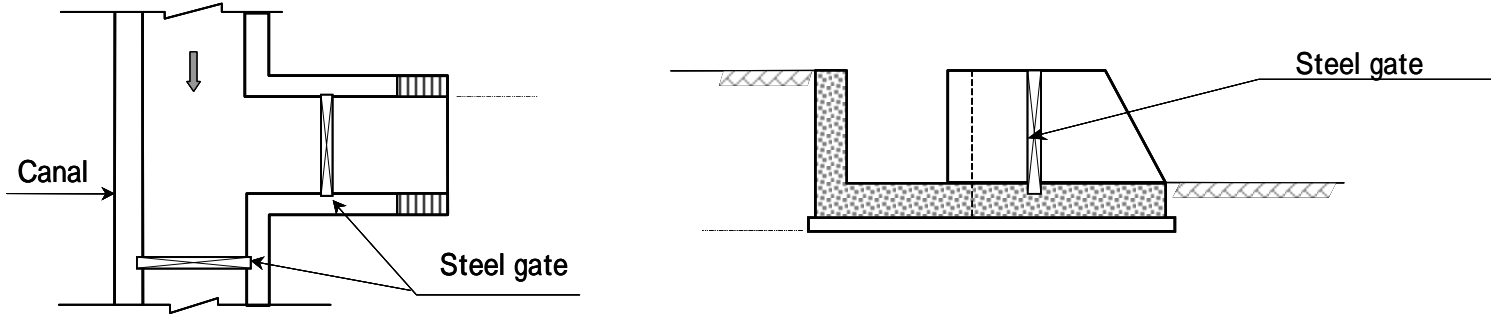


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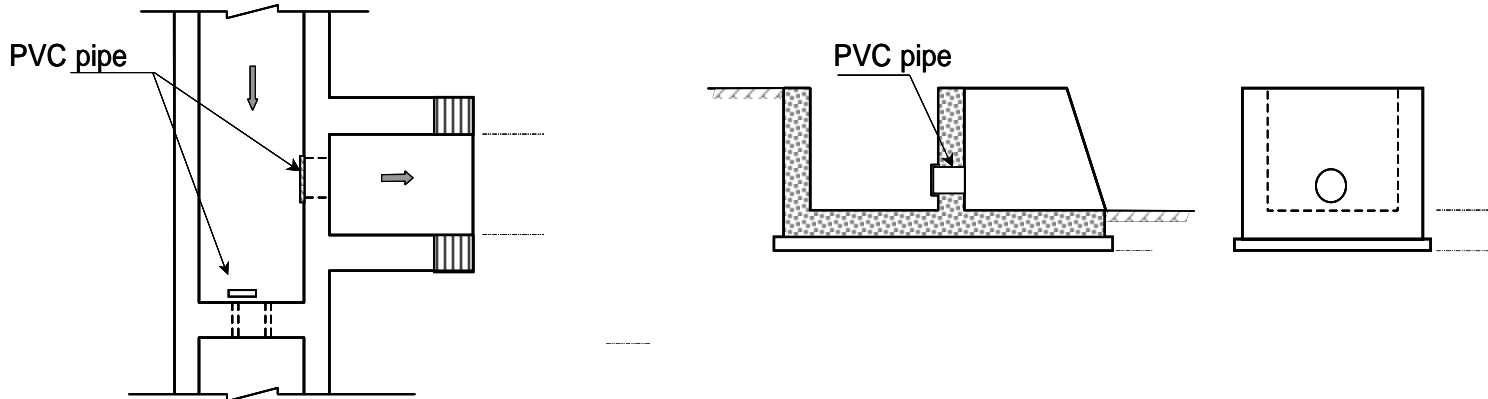
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Figure K.2.3.7
Irrigation Canal Rehabilitation

Q 5lit/sec (Ait Ben Omar, Lambarkia)



Q < 5lit/sec (Taoumart)

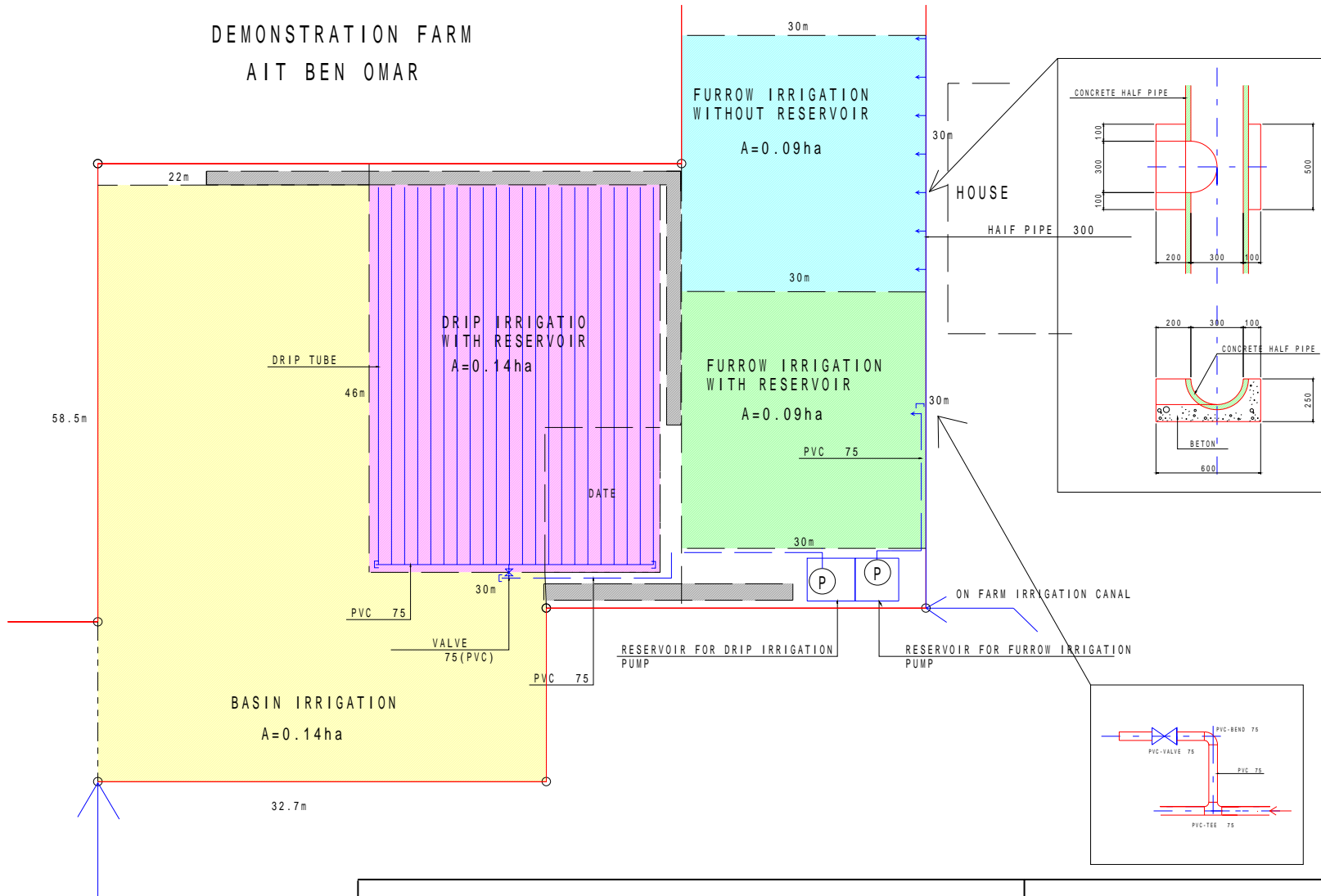


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in Semi-Arid East Atlas Regions with Kheffara Rehabilitation

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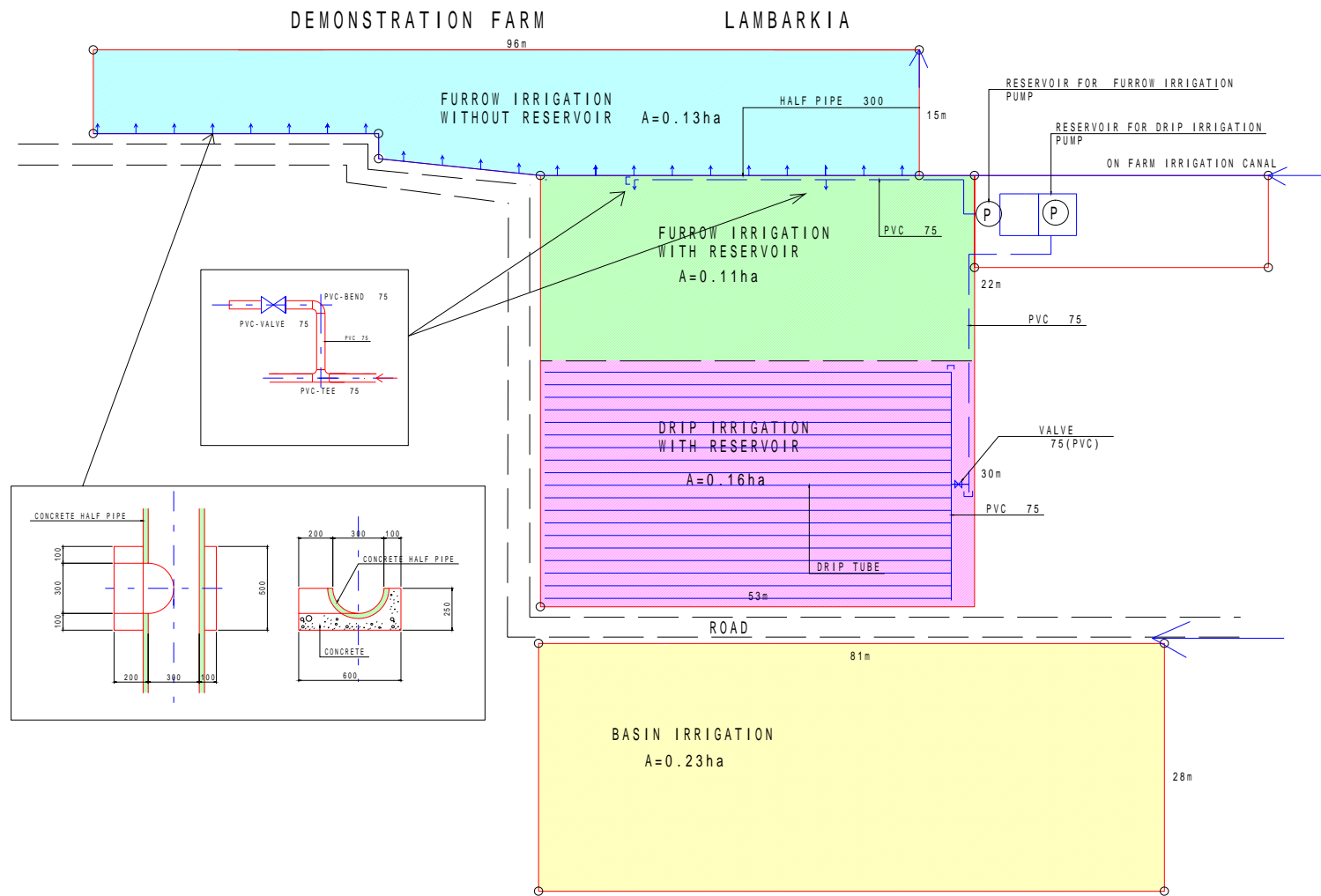
Figure K.2.3.8

Inlet Improvement



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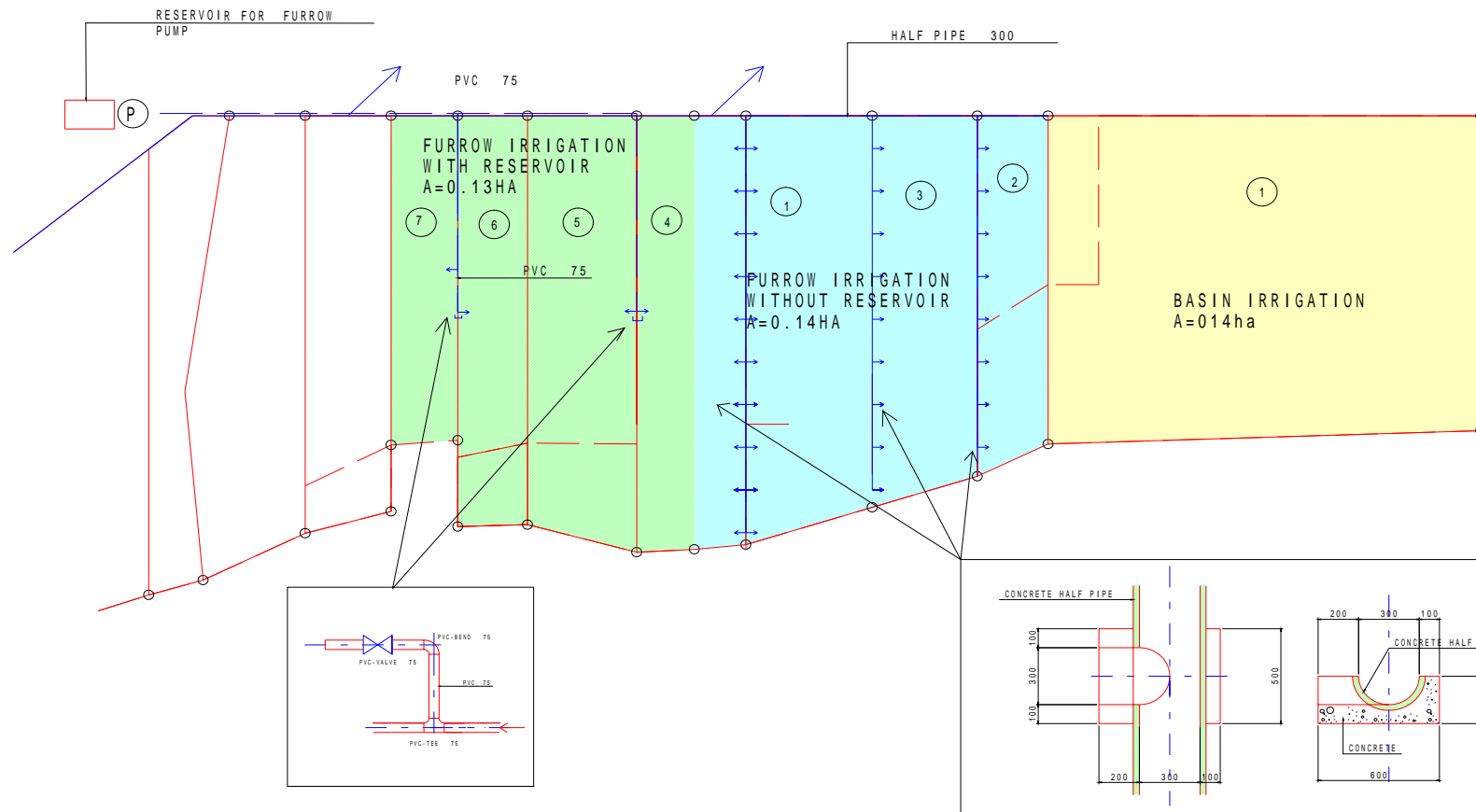
Figure K.2.3.9
Demonstration Farm Plan
(Ait Ben Omar)



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in Semi-Arid East Atlas Regions with Kheffara Rehabilitation

Figure K.2.3.10
Demonstration Farm Plan
(Lambarkia)

DEMONSTRATION FARM
TAOUMART

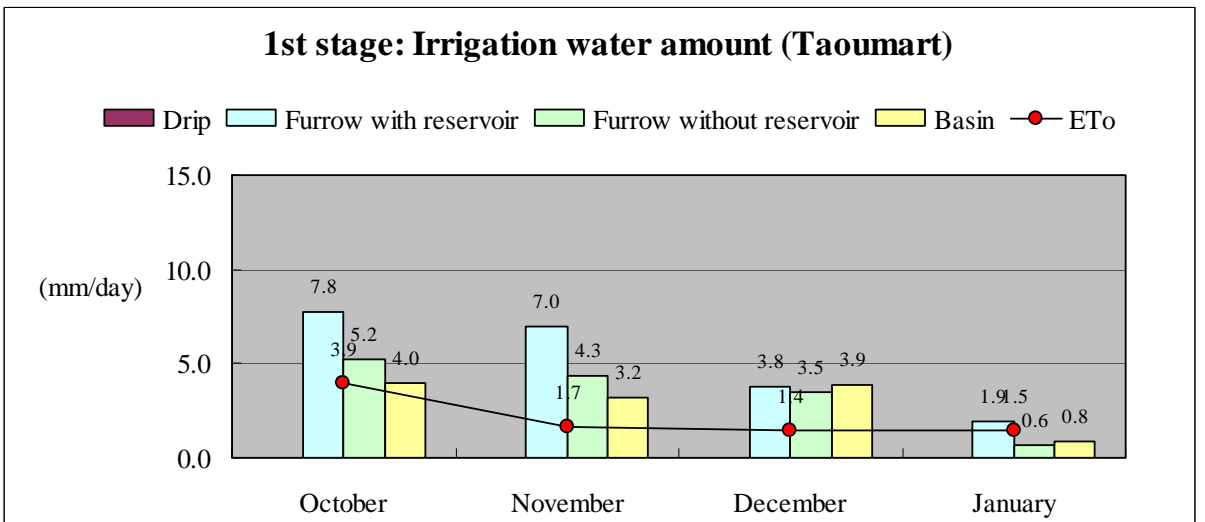
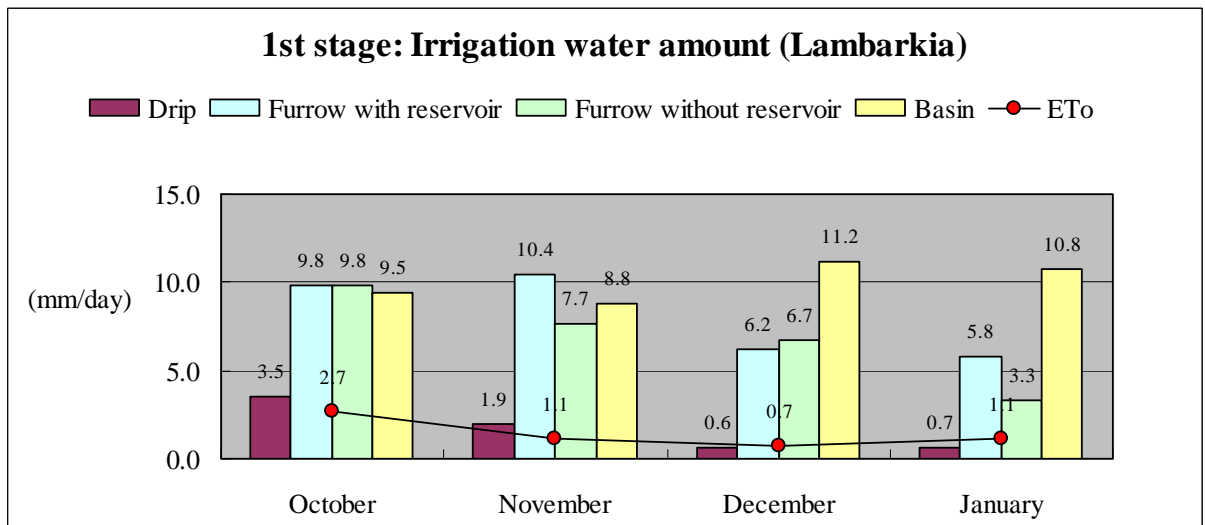
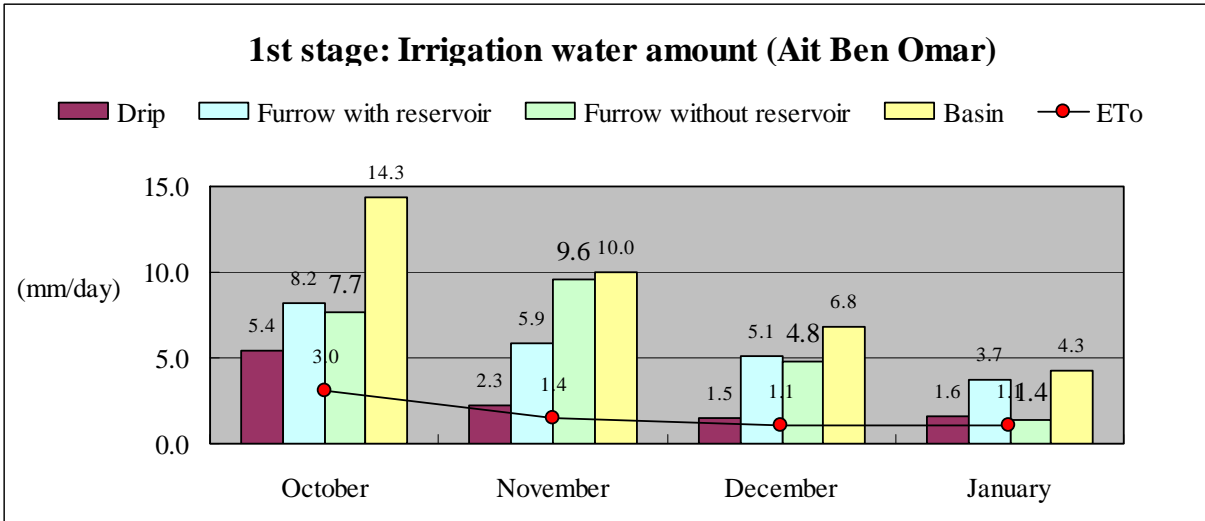


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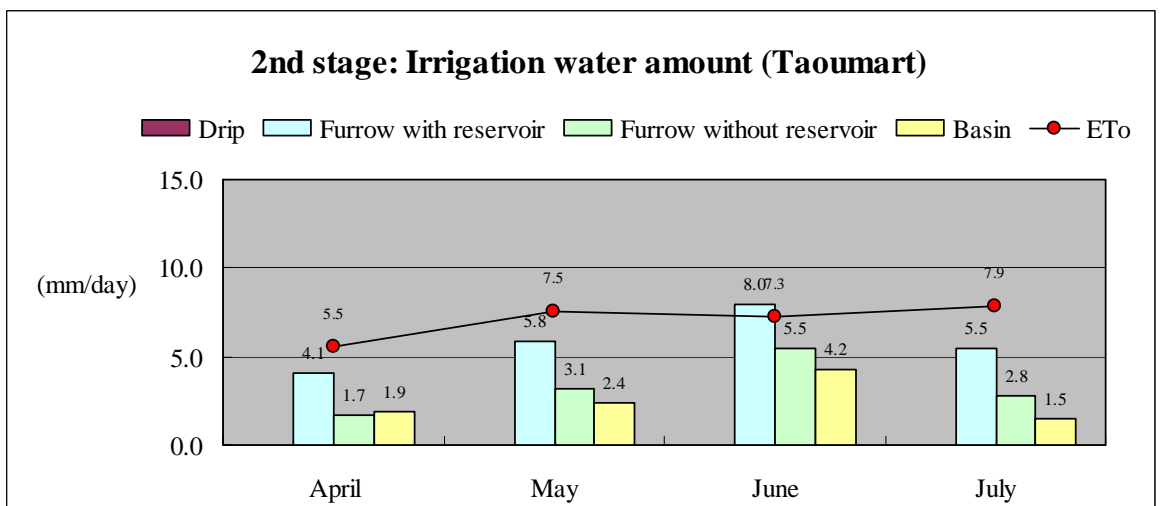
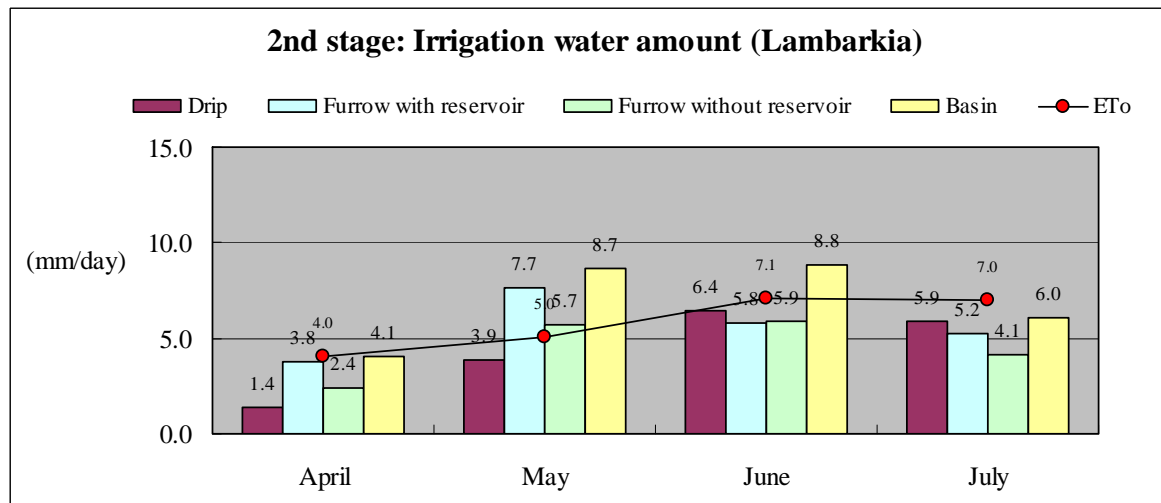
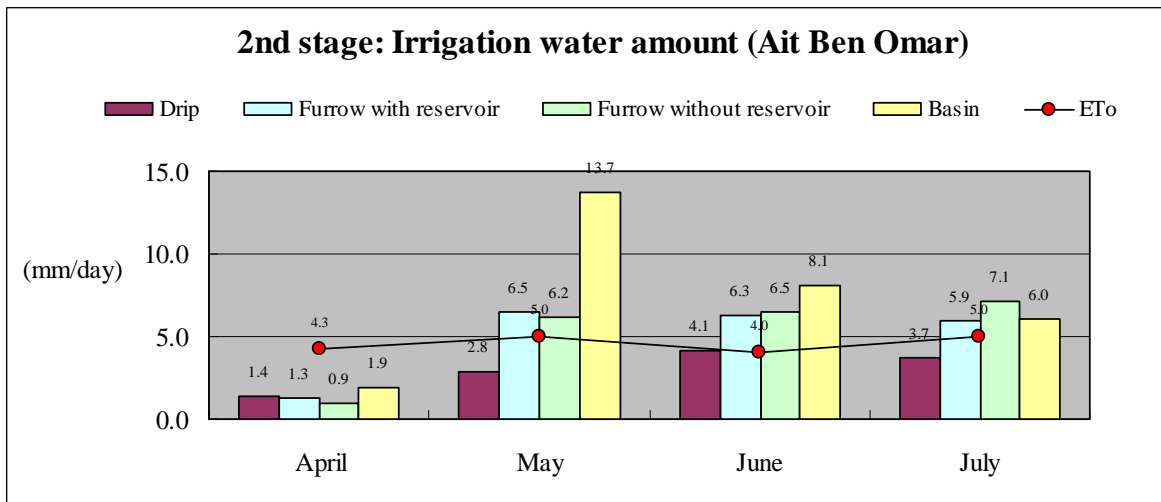
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Figure K.2.3.11
Demonstration Farm Plan
(Taoumart)



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in Semi-Arid East Atlas Regions with Khezzara Rehabilitation

Figure K.2.3.12
Water Consumption (1st Stage)



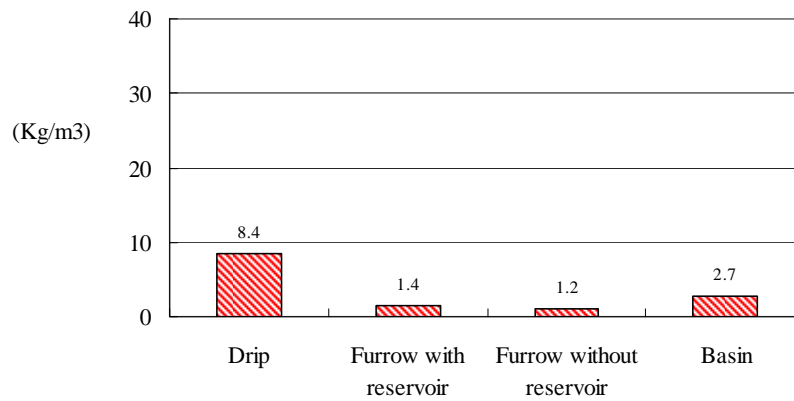
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in Semi-Arid East Atlas Regions with Kheffara Rehabilitation

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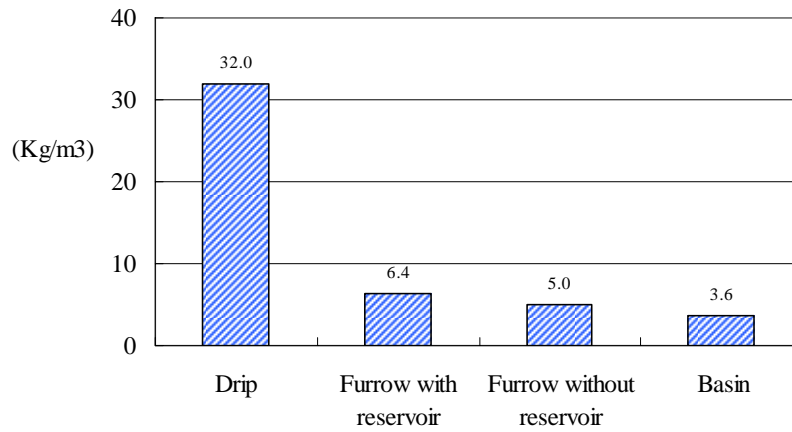
Figure K.2.3.13

Water Consumption (2nd Stage)

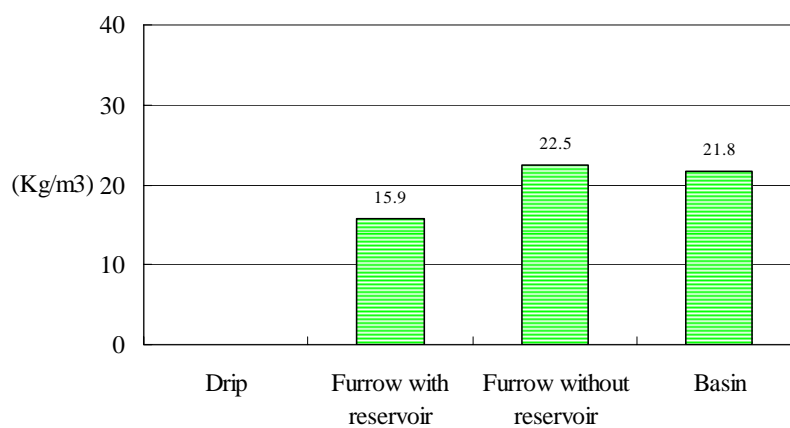
**Quantity of harvest per water consumption
(Ait Ben Omar)**



**Quantity of harvest per water consumption
(Lambarkia)**



**Quantity of harvest per water consumption
(Taoumart)**



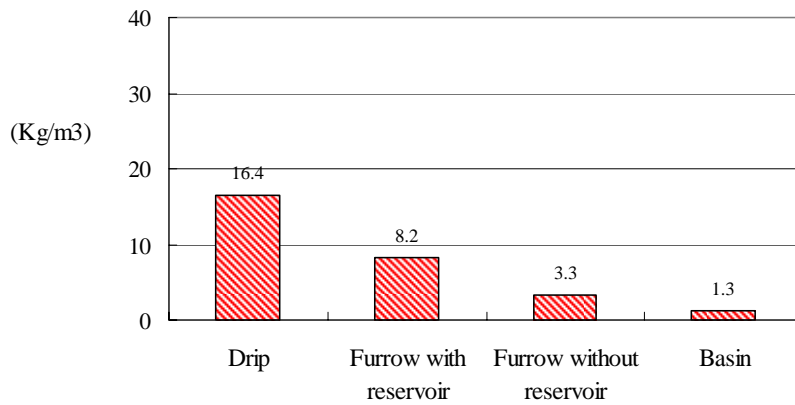
The Development Study on Rural Community Development Project
in Semi-Arid East Atlas Regions with Kheffara Rehabilitation

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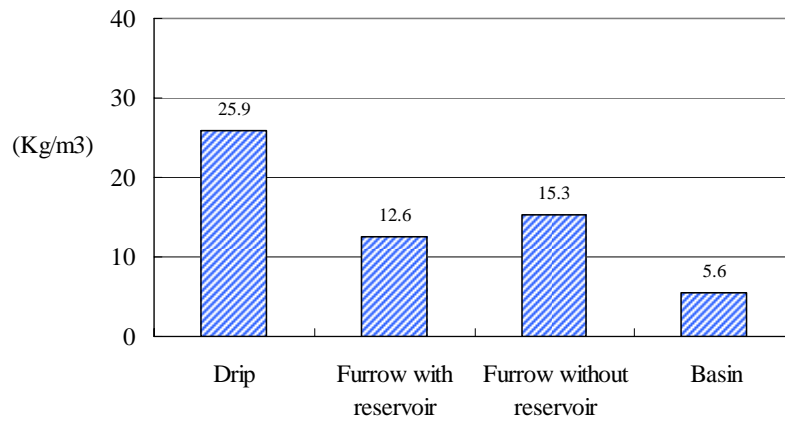
Figure K.2.3.14

Crop Yield per One Cubic Meter of
Water Consumption (1st Stage)

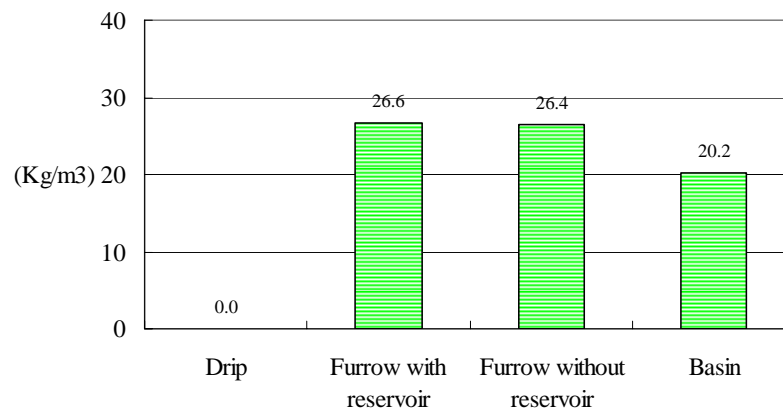
**Quantity of harvest per water consumption
(Ait Ben omar)**



**Quantity of harvest per water consumption
(Lambarkia)**



**Quantity of harvest per water consumption
(Taoumart)**

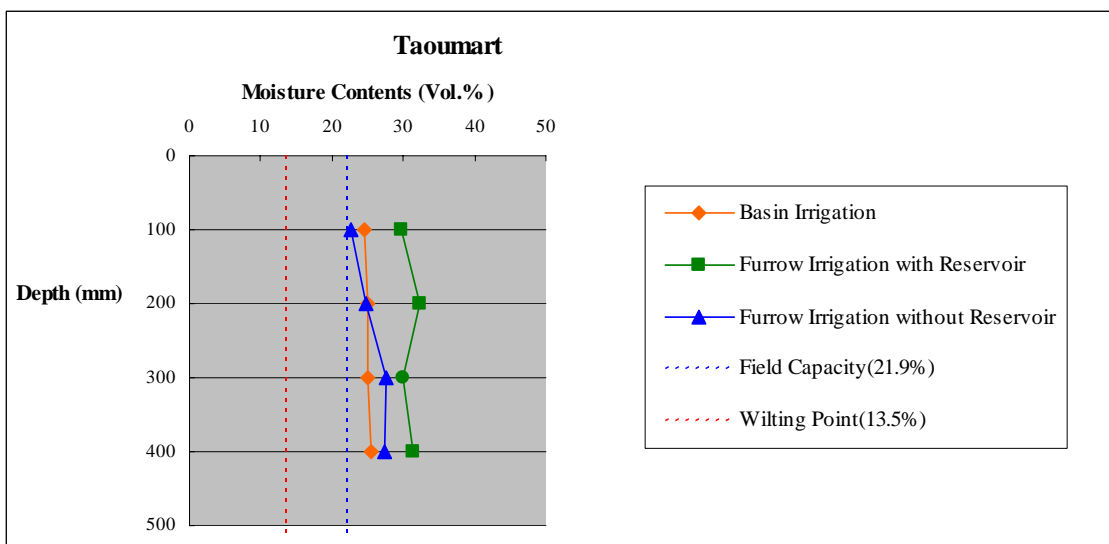
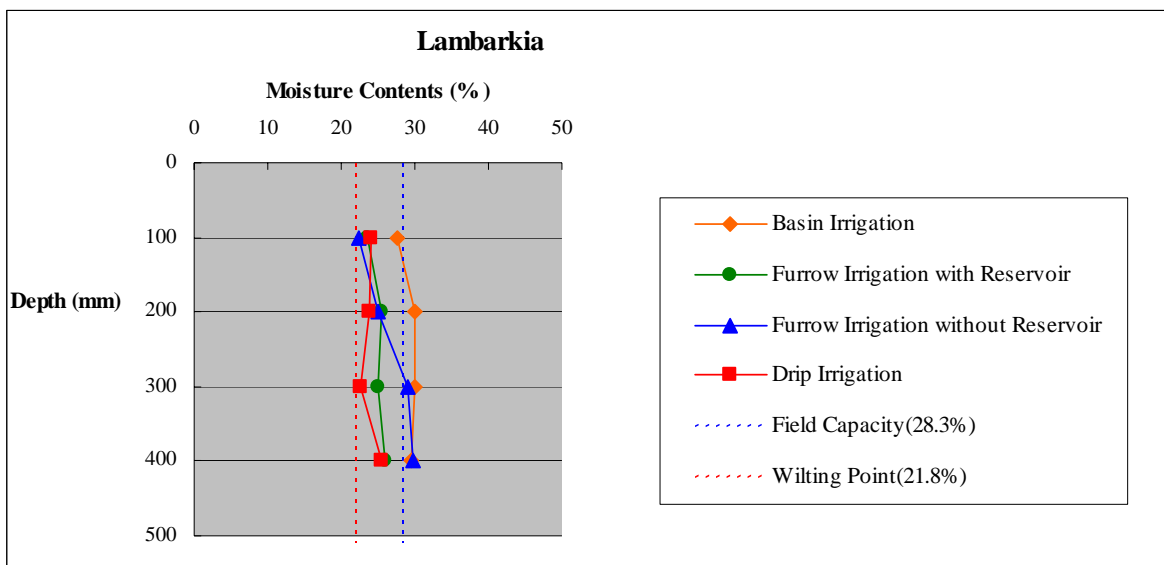
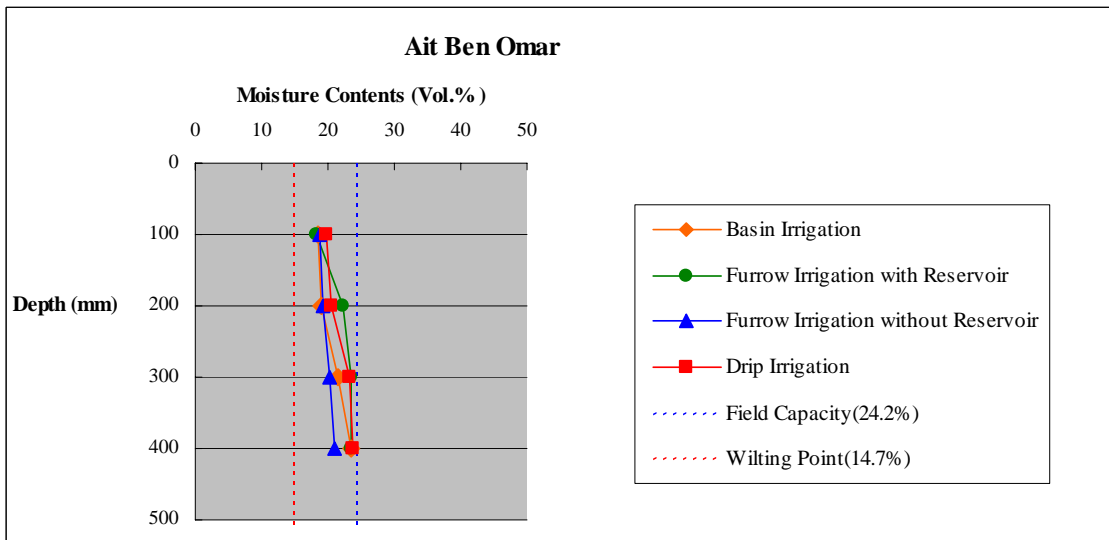


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Figure K.2.3.15

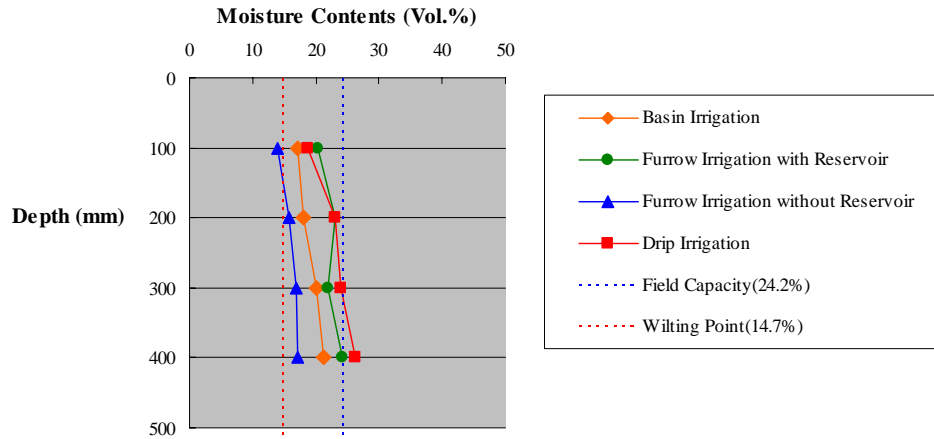
Crop Yield per One Cubic Meter of
Water Consumption (2nd Stage)



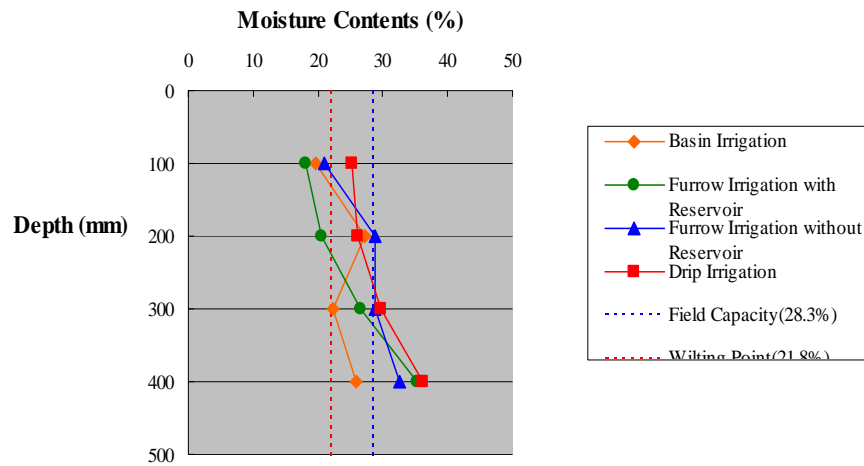
The Development Study on Rural Community Development Project
in Semi-Arid East Atlas Regions with Khettara Rehabilitation

Figure K.2.3.16
Soil Moisture Monitoring Result
(1st Stage)

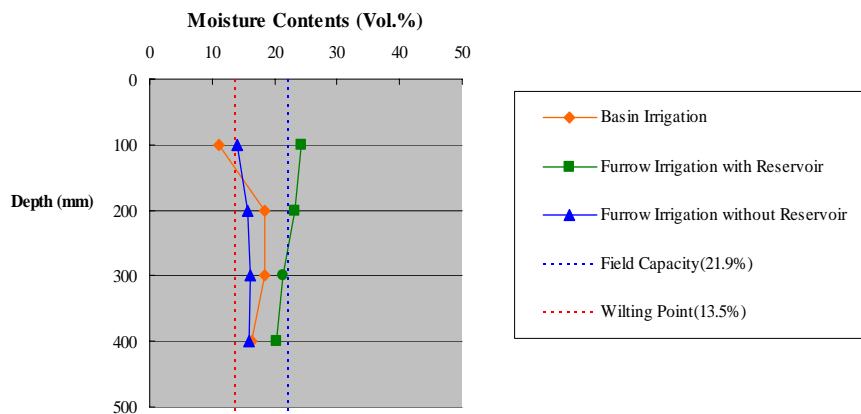
Ait Ben Omar



Lambarkia

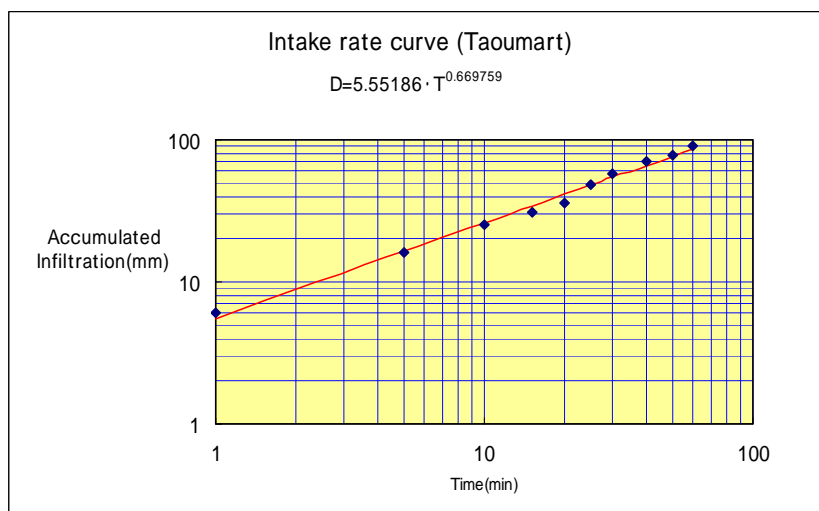
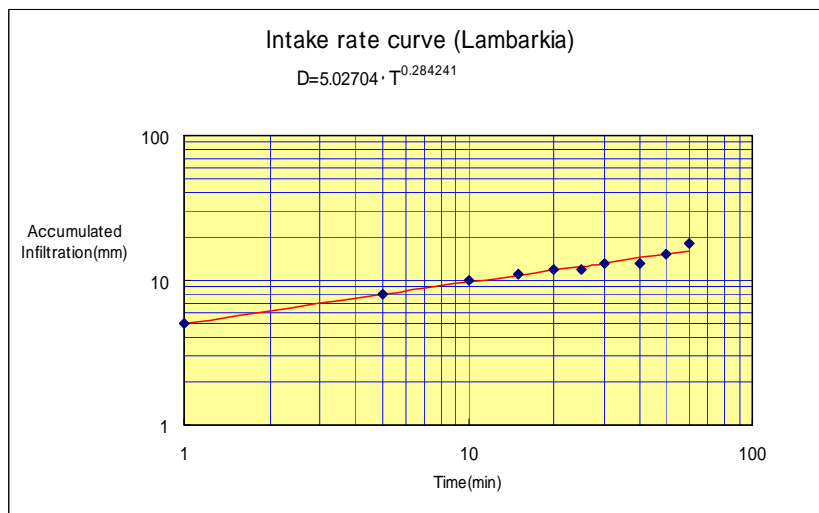
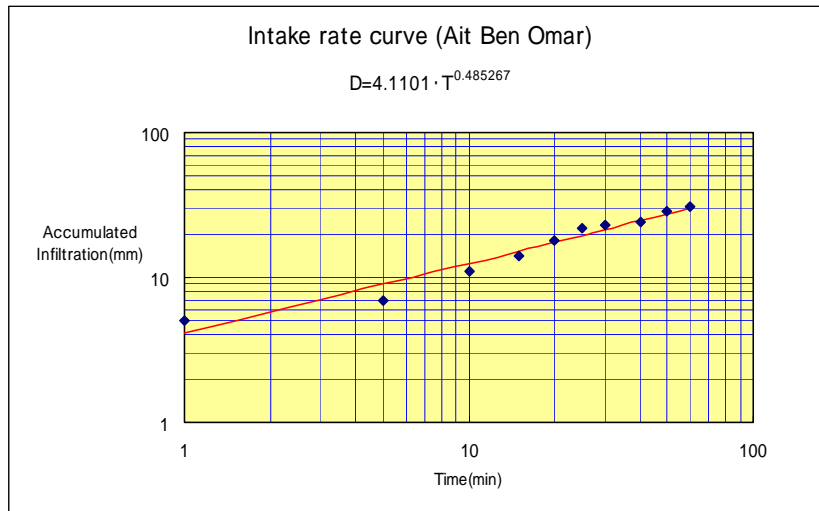


Taoumart



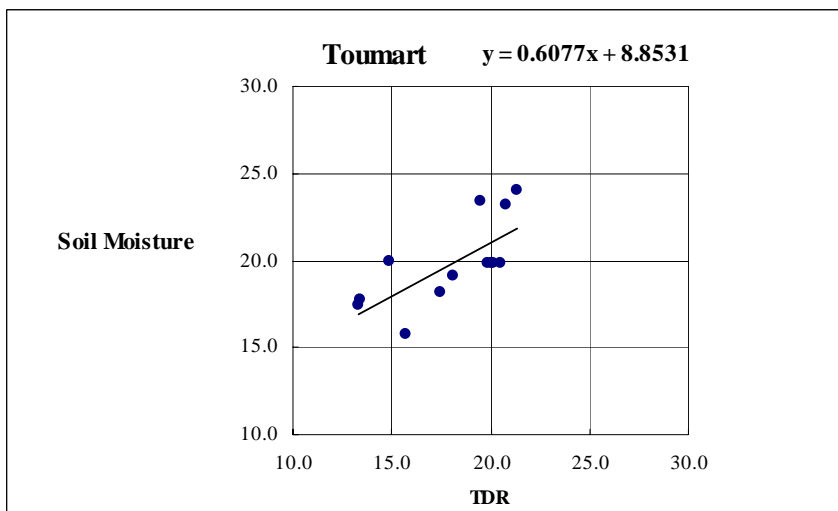
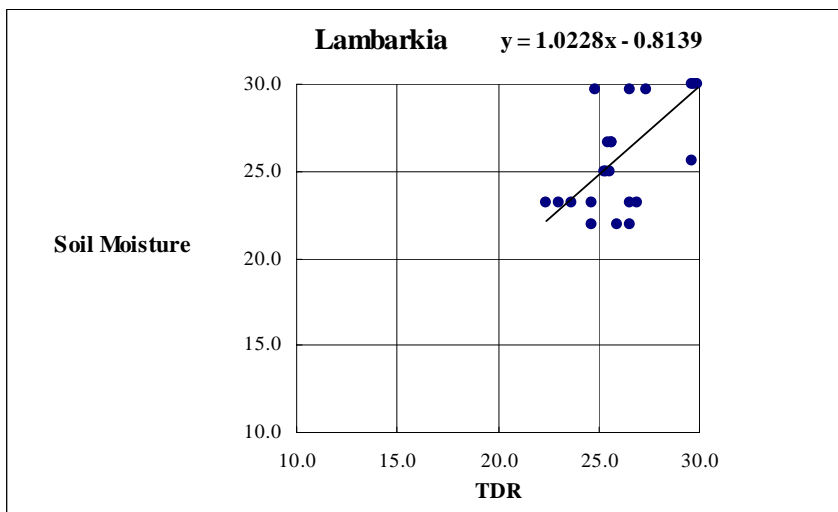
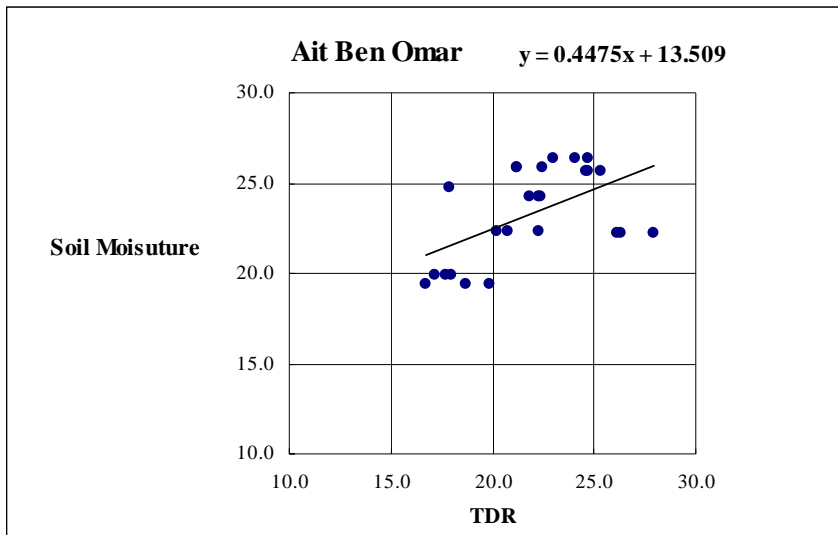
The Development Study on Rural Community Development Project
in Semi-Arid East Atlas Regions with Khettara Rehabilitation

Figure K.2.3.17
Soil Moisture Monitoring Result
(2nd Stage)



The Development Study on Rural Community Development Project
in Semi-Arid East Atlas Regions with Khettara Rehabilitation

Figure K.2.3.18
Intake Rate of the Demonstration Farm



The Development Study on Rural Community Development Project
in Semi-Arid East Atlas Regions with Khetarra Rehabilitation

Figure K.2.3.19
Calibration Curve for Soil Moisture
(TDR)

Attachment

Attachement - 1.1.1 Organization Structure and Division of Roles for Implementation

1. Capacity Building for ORMVA/TF

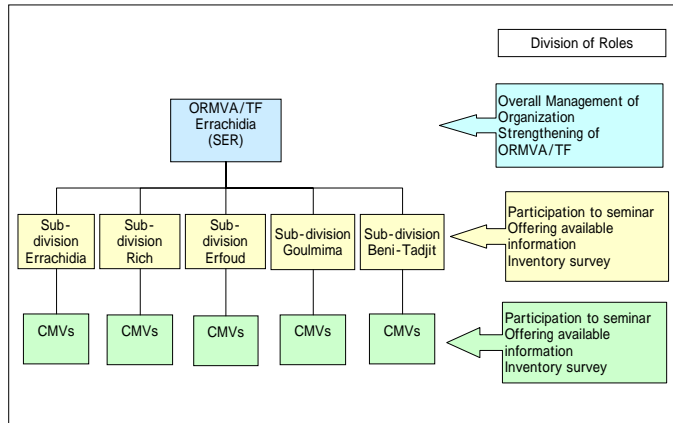


Figure 1-1 Organization Structure and Division of Roles for Implementation of Organization Strengthening for ORMVA/TF

Table 1-1 Tasks for Each Sub-component

No.	1-1	1-2	1-3	1-4	1-5
Sub-component	Establishing network between ORMVA/TF and farmers' organizations by medium of inventory data	Update of inventory data GIS data distribution	Data collection and information sharing on agricultural development scheme	Strengthening of project evaluation and monitoring	Technical seminar on project evaluation and monitoring related to V/S
Target Area	ORMVA/TF				
ORMVA/TF Errachidia (SER*)	- Planning of network establishment - Supervision of inventory mother data - Update of inventory data and data analysis		- Planning of data collection and sharing methods	- Preparation of monitoring sheets	- Participation to seminar - Coordination of seminar opening
Sub-division	- Installation of inventory data to computer - Presentation to beneficiaries		- Collecting and offering available information	- Summarizing monitoring data/information	- Participation to seminar
CMV	- Hearing of farmers' opinions	- Updating inventory data	- Collecting and offering available information	- Collection of monitoring data/information	- Participation to seminar
JICA Study Team	- Delivery of inventory data and GIS map		- Supporting programs	- Support of monitoring and evaluation activities	- Organizing seminar

SER* Mme Moumen Bouchra Mr. Saada Mohamed

2. Rehabilitation of Khettaras

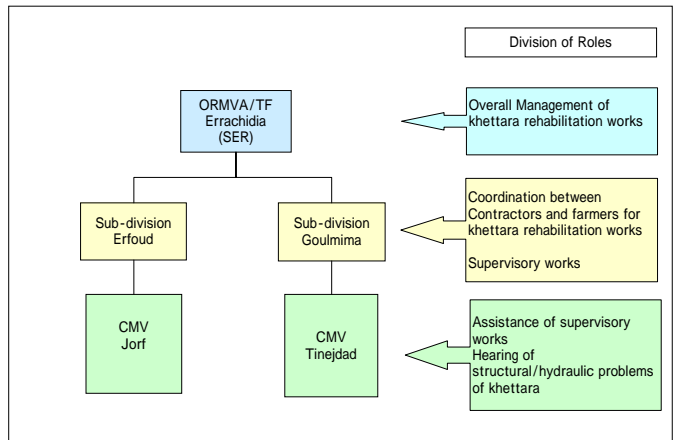


Figure 2-1 Organization Structure and Division of Roles for Implementation of Khettara Rehabilitation Plan

Table 2-1 Tasks for Each Sub-component

No.	2-1	2-2	2-3	2-4	2-5	2-6	2-6
Sub-component	Evaluation and feedback on khettara rehabilitation Master Plan	Verification of benefits by khettara rehabilitation (Water loss)	Verification of benefits by khettara rehabilitation (Labor for maintenance)	Preparation of standard design for khettara rehabilitation works	Preparation of material supply plan (Masonry, concrete aggregates, etc.)	Reconstruction plan for decrepit structures of khettara	Supervision of rehabilitation works
Target Area	(not specified)	Jorf, Tinejdad including 6 grant-aid project		(not specified)	Jorf, Tinejdad	Jorf	Jorf, Tinejdad
ORMVA/TF Errachidia (SER*)	- Review of Master Plan - Planning of data collection (discharge of khettara, maintenance condition, rehabilitation progress related to inventory survey)	- Preparation of monitoring plan, monitoring sheets		- Standardization of khettara design, construction method - Preparation of reference drawings	- Collection of quarry site information - Preparation of instruction manual to local contractor	- Preparation of reconstruction plan (inspection of structural, hydraulic problems of decrepit structures)	- Overall supervisory works including inspection
Sub-division	- Supervision of data collection mentioned above	- Summarizing monitoring data/information		(not specified)	- Supply of information such as quarry sites	- Collection of structural, hydraulic problems of decrepit structures	- Supervision including inspection (learning supervisory works)
CMV	- Data collection mentioned above	- Collection of monitoring data/information		(not specified)	(not specified)	- Hearing of structural, hydraulic problems of decrepit structures from beneficiaries	- Supervision (learning supervisory works)
JICA Study Team	- Collaborating above study items with ORMVA/TF - Review and updating Master plan			- Preparation of rehabilitation manual - Preparation of standard drawings, design criteria, construction planning			- Supervision

SER* Mr. Sossey My Lhassan Mr. Saada Mohamed Mr. Hachimi S. Lahbib Mr. Skourane Moha

3. Water Saving for Irrigation Water

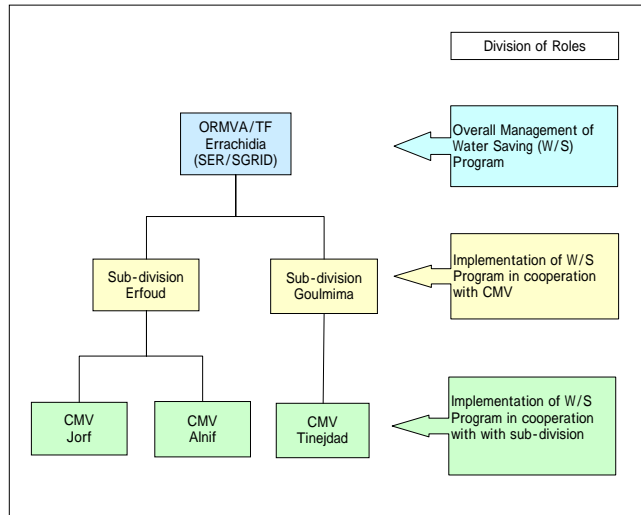


Figure 3-1 Organization Structure and Division of Roles for Implementation of Water Saving Program

Table 3-1 Tasks for Each Sub-component

No.		3-1	3-2	3-3	3-4
	Sub-component	Minimizing water conveyance loss on irrigation canal and inlet (through rehabilitation works)	Preparation of design manual for irrigation canal rehabilitation	Construction of demonstration farm for evaluation of water saving irrigation	Demonstration and Comparison of each water saving irrigation
	Target Khetterra	Ait Ben Omar (Tinejdad), Lambarkia (Jorf), Taoumart (Alnif)			
	ORMVA/TF Errachidia	Mr. Sossey My Lhassan (SER) Mr. Saada Mohamed(SER) Mr. Hachimi S.Lahbib(SER) Mr. Skourane Moha(SER)	- Supervision of rehabilitation works in cooperation with Sub-division. - Evaluation of monitoring data in collaboration with JICA study team.	- Preparation of design manual in collaboration with JICA study team.	
		Mr.Meftah Abdelhafid(SER) Mr.Ait Ihaj Ahmed(SGRID) Mr.EL Hindi Abderrahmane(SGRID)		- Supervision for construction of demonstration farm in cooperation with Sub-division.	- Evaluation of monitoring data/information in collaboration with JICA study team.
	Sub-division (Gourmima)	- Supervision of rehabilitation works	- Summarizing questionnaires.	- Supervision for construction of demonstration farm	- Summarizing monitoring data/information
	Sub-division (Jorf)				
	CMV (Tinejdad)	- Monitoring water discharge before rehabilitation works and after rehabilitation works.	- Collection of questionnaires for the result of rehabilitation works.		- Collection of monitoring data/information in cooperation with farmer's association. (recording watering time, amount of irrigation water, and measuring daily evaporation and rainfall)
	CMV (Jorf)				
	CMV (Alnif)				
	JICA Study Team	- Preparation of monitoring sheets. - Evaluation of monitoring data.	- Preparation for draft of design manual.	- Technical assistance for construction of demonstration farm.	- Preparation of monitoring sheets. - Evaluation of monitoring data.
		- Preparation of implementation plan in cooperation with ORMVA/TF - Bearing cost for implementation. - Technical advise for implementation of W/S program and for monitoring and evaluation activity			

4. Farming Improvement

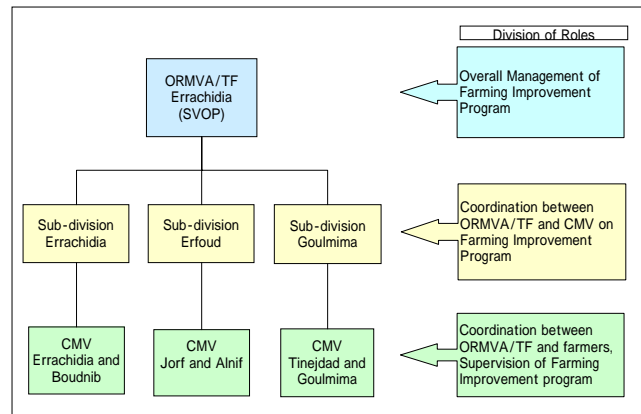


Figure 4-1 Organization Structure and Division of Roles for Implementation of Farming Improvement Program

Table 4-1 Tasks for Each Sub-component

No.	4-1& 4-2 & 4-4 & 4-5	4-3	4-6	4-7
Sub-component	Essai d application de l irrigation à économie d eau et de démonstration de culture	Triage, transformation et conservation des légumes	Triage et transformation des dattes	Study trips to demonstration plots and processing demonstration
Target Area	Jorf, Tinejdad, Alnif	Errachidia (for zumbo), Alnif (for henne)	Boudnib, Goulmina	
ORMVA/TF Errachidia (SVOP)	- Preparation of programs - Selection of demonstration plot - Arrangement of contract with farmers - Arrangement of necessary equipment and materials - Preparation of monitoring sheet - Technical guidance for implementation of demonstration plot - Extension of outputs and outcomes to be made in demonstration plots	- Preparation of programs - Selection of location and groups - Arrangement of necessary equipment and materials - Arrangement of contract with association - Preparation of monitoring sheet - Technical guidance - Arrangement of study tour (for Henna only) - Extension of outputs and outcomes to be made in demonstration plots	- Preparation of programs - Selection of location and groups - Arrangement of necessary equipment and materials - Arrangement of contract with association - Preparation of monitoring sheet - Technical guidance - Extension of outputs and outcomes to be made in demonstration plots	- Preparation of programs - Arrangement of bus and materials - Preparation of monitoring sheet
Sub-division	- Selection of demonstration plot - Technical guidance for implementation of demonstration plot	- Technical guidance - Monitoring of activities and outputs		- Monitoring of activities and outputs
CMV	- Monitoring of activities and outputs - Selection of demonstration plot - Supervision of demonstration plot - Monitoring of activities and outputs	- Technical guidance - Monitoring of activities and outputs - Supervision of machinery and equipment		- Monitoring of activities and outputs
JICA Study Team	- Preparation of implementation plan and monitoring plan in cooperation with ORMVA/TF - Bearing cost for implementation as agreed with SVOP - Purchasing equipment and materials - Arrangement of Technical expert for caper cultivation, date processing and water saving irrigation for date palms, if necessary - Technical guidance for Selection of plots, implementation of demonstration plot and monitoring and evaluation activities			

* : SGRID and SER will cooperate with SVOP for implementation of sub-component 4-1, Essai d application de l irrigation à économie d eau et de démonstration de culture.

5. Organization Strengthening

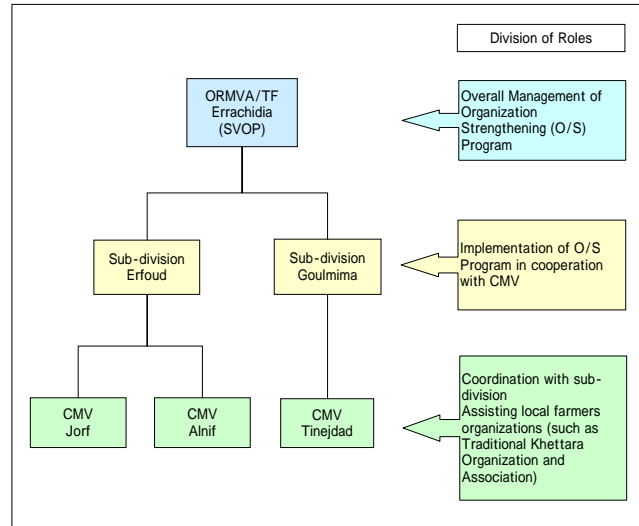


Figure 5-1 Organization Structure and Division of Roles for Implementation of Organization Strengthening Program

Table 5-1 Tasks for Each Sub-component

No.	5-1	5-2	5-3	5-4	5-5	5-6	5-7
Sub-component	Facilitating establishment of Association	Trainings for established Association for acquiring basic knowledge and skill	Publicity of governmental supports for Khetarra rehabilitation	Monitoring works in cooperation with Association	Establishment of partnership scheme on equipment rental including compressor and concrete breakers	Dissemination of knowledge on water saving irrigation	Exchange of experience among Associations
Target Area	Alnif	Jorf, Tinejdad, Alnif	All CMV	Jorf, Tinejdad, Alnif	Jorf, Tinejdad	Jorf, Tinejdad, Alnif	Jorf, Tinejdad, Alnif
ORMVA/TF Errachidia (SVOP)* (Mr. Alioui Abdelghani)	- Preparation of seminar programs - Coordination with outside organization (such as ODECO)		- Preparation of brochure, newsletter etc.	- Preparation of monitoring sheets	- Preparation for starting new equipment rental scheme (including preparation of agreement form with an Association, insurance policy and other paper works) - Repair of broken equipments	- Preparation of dissemination programs	- Preparation of study tour programs
Sub-division	- Arrangement for seminars/training (seminar hall, transportation, accommodation etc.)		- Distribution to CMVs	- Summarizing monitoring data/information	- Concluding rental agreement with Association - Regular maintenance of equipments - Technical advise to CMV (include safety control)	- Arrangement for dissemination program	- Arrangement for study tours (seminar hall, transportation, accommodation etc.)
CMV	- Giving advise to traditional Khetarra organization for establishing association	- Providing information to local organizations (such as traditional Khetarra organizations and Associations)		- Collection of monitoring data/information	- Assisting local organizations (including preparation of rehabilitation plan, application to the new equipment rental scheme, guidance on operation of equipment, technical advise on rehabilitation work etc.)	- Assisting local organizations (including collection of data, holding seminar, technical advise on water saving irrigation etc.)	- Providing information to local organizations (such as traditional Khetarra organizations and Associations)
JICA Study Team	- Preparation of implementation plan in cooperation with ORMVA/TF - Bearing cost for implementation (including purchase of one compressor and two concrete breakers for rental) - Technical advise for implementation of O/S program and for monitoring and evaluation activity						

*: SGRID and SER will cooperate with SVOP for implementation of sub-component 5-5, "Establishment of partnership scheme on equipment rental".

6. Life Improvement

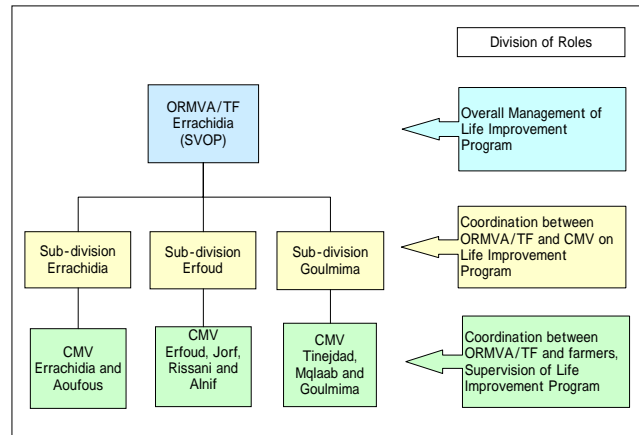


Figure 6-1 Organization Structure and Division of Roles for Implementation of Life Improvement Program

Table 6-1 Tasks for Each Sub-component

No.	6-1	6-2	6-3 (1)	6-3 (2)	6-4
Sub-component	Contrôle de l'hygiène des khetarras	Contrôle de l'hygiène des agglomérations	Méthodes d'aide pour améliorer et diversifier les revenus des agriculteurs (Lapins)	Méthodes d'aide pour améliorer et diversifier les revenus des agriculteurs (Pigeon)	Study trips to income generation activities
Target Area	Under consideration	Jorf, Goulmima, Alnif	Errachidia, Rissani, Malaab, Tinejdad,	Rissani and/or Aoufous	
ORMVA/TF Errachidia (SVOP)	- Preparation of programs - Selection of location and groups - Arrangement of necessary equipment and materials - Arrangement of contract with association - Preparation of monitoring sheet - Technical guidance		- Preparation of programs - Selection of location and groups - Arrangement of necessary materials etc. - Arrangement of contract with association - Preparation of monitoring sheet - Technical guidance - Extension of outputs and outcomes		- Preparation of programs - Arrangement of bus and materials - Preparation of monitoring sheet
Sub-division		- Technical guidance - Monitoring of activities and outputs			- Monitoring of activities and outputs
CMV		- Technical guidance - Monitoring of outputs - Supervision of activities including construction			- Monitoring of activities and outputs
JICA Study Team	- Preparation of implementation plan and monitoring plan in cooperation with ORMVA/TF - Bearing cost for implementation as agreed with SVOP - Arrangement of contract for construction works - Technical guidance for selection of plots, implementation of activities and monitoring and evaluation activities				

7. Planting by Double Sack Method

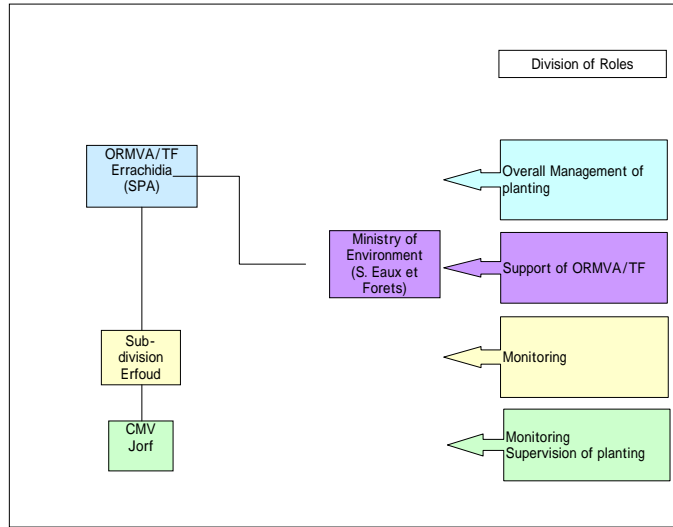


Figure 7-1 Organization Structure and Division of Roles for Implementation of Planting by Double Sack Method

Table 7-1 Tasks for Each Sub-component

No.	7-1
Sub-component	- Evaluation of planting by double sack method - Comparison of double sack and conventional methods
Target Area	Jorf
ORMVA/TF Errachidia (SPA*)	- Planning of planting - Preparation of monitoring sheets
Ministry of Environment (S. Eaux et Forets*)	- Selection of variety - Training of farmers for planting
Sub-division	- Summarizing monitoring data/information
CMV	- Supervision of planting by farmers - Collection of monitoring data/information
JICA Study Team	- Planning of planting - Monitoring and evaluation of planting

SPA* Mr. Benjira Mohamed Mr. Dribi Lhabib
S. Eaux et Forets* Mr. Ouabi Haddou

8. Data Collection for Recharge Facility Planning

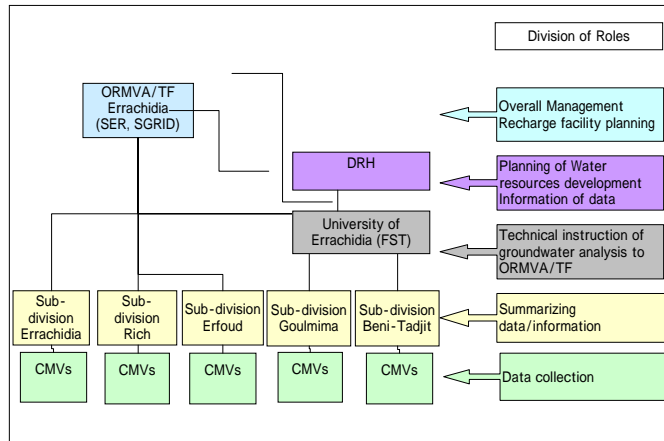


Figure 8-1 Organization Structure and Division of Roles for Data Collection of Recharge Facility Planning

Table 8-1 Tasks for Each Sub-component

No.	2-1	2-2
Sub-component	- Data collection of meteorological records - Data collection of groundwater level records	Survey for groundwater resources
Target Area	Whole area of ORMVA/TF precinct	(Proposed area: Jorf, Tinejdad)
ORMVA/TF Errachidia (SER*, SGRID*)	- Data processing and analysis - Coordination of data processing and analysis between ORMVA/TF, DRH and FST	- Planning of groundwater level record collection, processing and analysis - Groundwater analysis in collaboration with DRH, FST - Planning of recharge facilities (including surface water utilization)
DRH*	- Hydro-geological data collection, processing and analysis - Planning of water resources development, especially for groundwater recharge in collaboration of ORMVA/TF	- Data processing and analysis of groundwater level records
University of Errachidia (FST*)	- Technical instruction for hydro-geological data processing to ORMVA/TF and DRH	- Technical instruction for groundwater analysis to ORMVA/TF and DRH
Sub-division	- Supervision of data collection and measurement	- Collection of groundwater level records
CMV	- Data collection including measurement	- Hearing of structural, hydraulic problems of decrepit structures from beneficiaries
JICA Study Team	- Collaborating above study items with ORMVA/TF - Installation of automatic groundwater level recorders	

SER* Mr. Meftah Abdelhafid Mr. Saada Mohamed
SGRID* Mr. Ihaj Ahmed
DRH* Mr. El Mouquadem Kamal Mr. El Laouzi Said
FST* Mr. Eddahdy Lhou

**RECORD OF STUDY TOUR
FOR SHARING INFORMATION AND EXPERIENCE ON ASSOCIATION ACTIVITIES**

1. Date: July 14 and 15, 2005 (9:00 – 17:00)
2. Place: Day 1: Erfoud Areas
Day 2: Goulmima Area
3. Participants: Day 1: Representatives from Associations in Jorf, Rissani and Alnif areas
(61 people)
Day 2: Representatives from Associations in Tinejdad area (37 people)
4. Program:

Program for 2 nd Study Tour	
DAY 1 and DAY 2	
9:00 Opening remarks (Coordinator of ORMVA/TF SVOP, JICA Study Team)	
9:30 Presentation 1; Importance of application of water saving agriculture techniques (ORMVA/TF, SGRID)	
9:45 Presentation 2; Procedure and concept of governmental supports on localized irrigation system (ORMVA/TF, SGRID)	
10:00 Coffee break	
10:30 Presentation 3; Preparation of necessary documents for applying government subsidy on localized irrigation system (Credit Agricole, Errachidia)	
11:00 Discussion	
12:00 Presentation 4; Commercialization of agriculture products (ODECO, Meknes)	
Lunch Break	
14:30 Site visits to the following destinations.	
DAY 1	DAY 2
15:00 FIDA demonstration farm of drip irrigation system in Bouya, Jorf	15:00 FIDA demonstration farm of drip irrigation system in Tinejdad
16:00 JICA demonstration farm in Hannabou (Khattara Lambarkia), Jorf	17:00 End of the tour
17:00 End of the tour	

5. Contents:

< DAY1 >

1) Opening remark (ORMVA/TF SVOP and JICA Study Team)

- This study tour is a part of training sessions for newly established association leaders. Starting from last September, ORMVA/TF and JICA Study Team held sensitization seminar for association establishment, training seminar for association management and 1st study tour for observing several projects realized in good cooperation between associations and outside organizations such as ORMVA/TF, ADS, JICA and other international donors.
- This study tour is focused on application of water saving agriculture techniques especially on drip irrigation technique, since many association leaders showed strong interest on drip irrigation scheme during the 1st study tour held in February 2005.

- Making networks between association leaders is another objective of this study tour. Therefore, please exchange frank opinions and make a lot of friends during the tour.
- 2) Presentation 1; Importance of application of water saving agriculture techniques (ORMVA/TF, SGRID, Mr. Babakhouya)
- Importance and benefit of water saving agriculture techniques, i.e. safeguard of water resource, save input of manpower and fertilizer, increase production in quality and quantity and production of high marketable crops.
 - Explanation on several water saving irrigation systems.
 - Government and ORMVA/TF strategy for promoting water saving agriculture techniques.
- 3) Presentation 2; Procedure and concept of government supports on localized irrigation system (ORMVA/TF, SGRID, Mr. Ait Lhaj)
- Governmental support policy on localized irrigation system.
 - Procedure for applying localized irrigation system. (i) Carry out technical study, (ii) decided specification of equipments, (iii) prepare additional necessary documents such as certificate of land, (iv) Approval on technical study by ORMVA/TF, (v) submit documents to Agriculture Fund. (Credit Agricole deputizes the procedure.)
- 4) Presentation 3; Preparation of necessary documents for applying government subsidy on localized irrigation system (Credit Agricole Errachidia, Mr. Bouirig)
- Explanation on documents to be submitted, including results of technical study, specification of equipments installed, authorization of using pump (if it is used), land registration, by-law of cooperative (in case of application from cooperative).
 - 40% of total installation cost is subsidized when it is approved by the committee in Rabat. In case of drip irrigation, additional subsidy of DH2,000/ha is also available. Agriculture fund also can provide loan for the remaining portion if it is required.
 - Agriculture Fund is currently proposing the Ministry of Agriculture to simplify the procedure, i.e.) approval of technical study be processed by ORMVA in that area.
 - Subsidy is also applied for other purpose, such as fertilizer, agriculture machine like tractor, and so on.
- 5) Presentation 4; Commercialization of agriculture products (ODECO, Meknes, Mr. D. Latif)
- Farmers also need to acquire marketing knowledge and skills.
 - Where to sell, how to sell, to whom to sell, when to sell in order to maximize profit. Explanation on “Four Ps” in marketing, Production, Price, Position and Promotion.
- 6) Discussions

<Day 1>

- This area is suffering from serious water shortage. 12 khattaras in Jorf area were dried up. Pump stations are cause of the problem.

Drip irrigation should be applied not only on khattara but also on pump stations irrigation system since it dramatically reduces water consumption and consequently safeguards water resource in the area.

- Desertification is also big problem.

Khattara should be kept because it is a base for life and also hinders the progress of desertification. Selling palm trees to other areas should also be restricted.

- Many demonstration farms are located in Jorf and Tinejdad area. Alnif area only has one. More demonstration farms in Alnif area are needed for extending drip irrigation in that area.

Demonstration farm were installed to be functioned as a school for farmers. ORMVA/TF expects many farmers to visit and learn from experience on the farm. This study tour is also organized on this purpose.

<Day 2>

- Followings are constraints for applying government subsidy on drip irrigation on khattara. (i) Registration of farm land, (ii) Obtaining license for using pump.

In case of Ksar Aoufous, *Caidat* issues license for drip irrigation. Agriculture Fund accepted it as a proof of ownership of land and license of using pump. This kind of simple procedure is also possible to be applied.

- Dispersed lands and water rights are also constraints on applying drip irrigation on khattara agriculture fields.

We need to disseminate knowledge, as well as the benefits, of drip irrigation system to more farmers so that we can take collective action to modify these dispersed lands and water rights.

- Preparation of technical documents is difficult for farmers.

ORMVA/TF can help farmers to prepare technical documents upon their requests.

- LUNCH BREAK -

- FIELD VISITS-

- END OF THE DAY -