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ANNEX II-1

REGION OF SAFA SOURCE

CHAPTER 1

SOCIO-ECONOMIC ASPECTS

1. SOCIO-ECONOMIC ASPECTS

1.1 OVERVIEW

The Safa scheme covers eight villages located in the Mohafazat of Mount Lebanon, caza Chouf at an altitude varying between 600 m and 1050 m.

1.2 SOCIO-DEMOGRAPHIC SITUATION

1.2.1 Population

The scheme accounts for a total number of 48,350 members covering 3,710 households with an average family size of five persons (result that confirms the SES survey where the average family size is 5 persons in Deir el Qamar and El Fouara and 6 persons in Maaser Beit ed Dine). The sample covers 70 families with a total number of 343 members.

1.2.1.1 Family size

In the sample, the average family size is five persons. 21.4% of the families account for six members and 18.6% account for six members.

Table 1.1: Distribution of families per family size.

Family size	Frequency	Percent
1	2	2.9
2	5	7.1
3	10	14.3
4	11	15.7
5	13	18.6
6	15	21.4
7	10	14.3
8	2	2.9
10	1	1.4
12	1	1.4
Total	**70**	**100.0**

1.2.1.2 Sex

In the sample, there is almost an equal distribution of males (51%) and females (49%).

1.2.1.3 Age

Farmers' age

In the sample, 60% of farmers are 60 years old and above.

Table 1.2: Distribution of farmers per age group.

Age group (year)	Frequency	Percent
30 - 39	8	11.4
40 - 49	7	10.0
50 - 59	13	18.6
≥ 60	42	60.0
Total	**70**	**100.0**

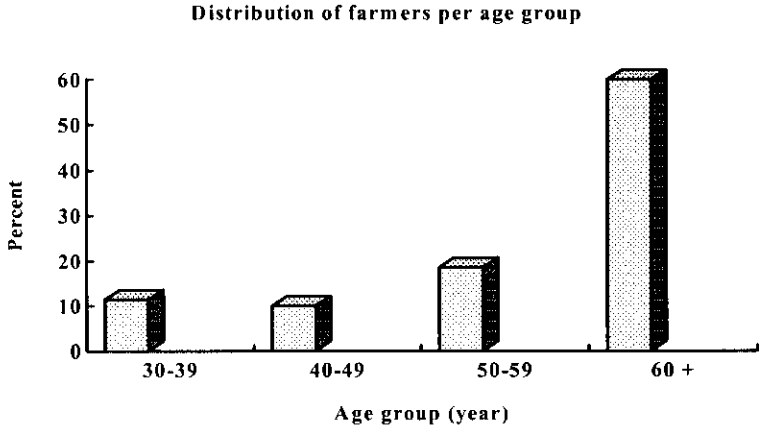

Figure 1.1: Distribution of farmers per age group.

Family members' age

In the sample, the distribution of family members per age gave the following results:

- 37.7% of members are below 20 years old;
- 39.1% of members are between 29 and 39 years old;
- 23.2% of members are 40 years old or above.

As in all rural areas in Lebanon, the distribution of family members per age group indicates a young population as well as a high percentage of people in the working age.

Table 1.3: Distribution of family members per age group.

Age group (year)	Frequency	Percent
≤ 9	41	15.0
10 - 19	62	22.7
20 - 29	64	23.4
30 - 39	43	15.7
40 - 49	22	8.2
50 - 59	21	7.7
≥ 60	20	7.3
Total	**273**	**100.0**

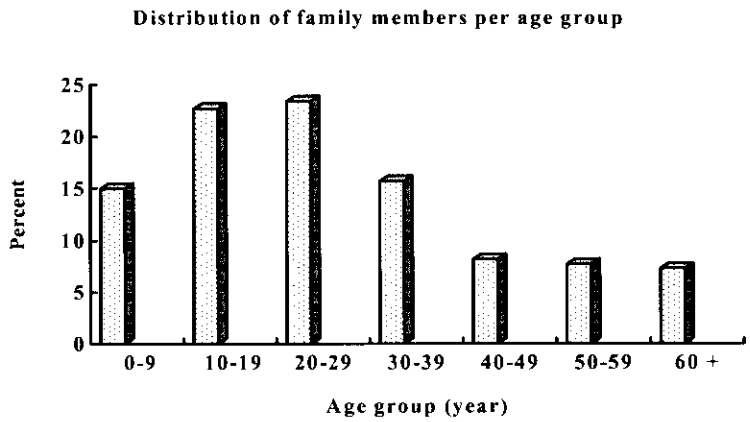

Figure 1.2: Distribution of family members per age group.

1.2.1.4 Farmers' educational level

In the sample, 14.4% of farmers are illiterate and 85.6% have received an education. Among those, 66.7% are elementary level, 20% are intermediate level, 5% are secondary level, 6.7% have completed university and 1.6% have completed technical school.

Table 1.4: Distribution of farmers per educational level.

Educational level	Frequency	Percent
Illiterate	10	14.4
Elementary	40	57.1
Intermediate	12	17.1
Secondary	3	4.3
University	4	5.7
Technical school	1	1.4
Total	**70**	**100.0**

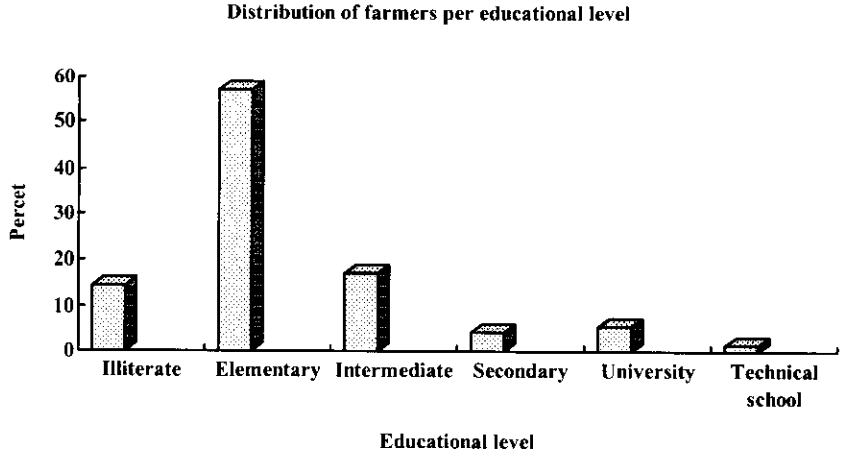

Figure 1.3: Distribution of farmers per educational level.

1.2.1.5 Farmers' marital status

The marital status of the 70 farmers was assessed and gave the following results: 94.3 % of them are married, 4.3 % are single and 1.4 % are widowed.

1.2.2 Occupations

In average, 45% of the total population are involved in agriculture.
54 % work as employees and 19% have their own business.

1.2.2.1 Present occupation

In the sample, the information concerning the present occupation of 7.3% of family members is missing. The remaining 92.7% are divided in three groups:

1. the paid workers represent 36.8% of total members and are distributed as follows :
   - agriculture (41.8%);
   - employment (41.8%);
   - free business (12.9%);
   - daily Laborers (3.5%).
2. the unpaid workers (unpaid family worker and housewife) represent 17.9% of total members.
3. the non workers (student, too young and no occupation) represent 45.3% of total members.

Table 1.5: Distribution of family members per type of occupation.

Type of occupation	Frequency	Percent
No occupation	52	15.2
Housewife	55	16.0
Farmer	49	14.3
Public sector	29	8.5
Private sector	20	5.8
Own business	15	4.4
Daily laborer	4	1.2
Unpaid family worker	2	0.6
Too young	45	13.1
Student	47	13.6
Missing	25	7.3
Total	**343**	**100.0**

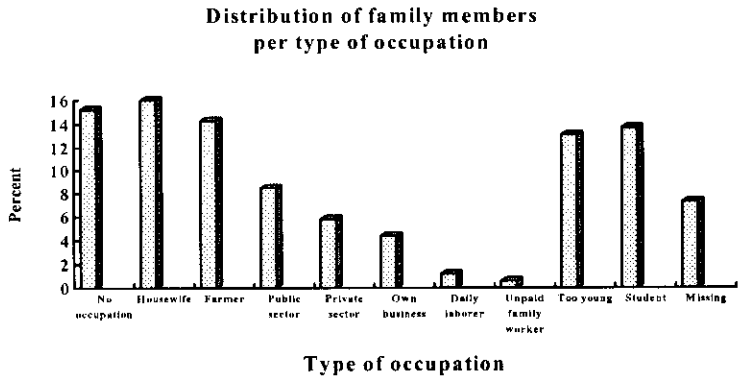

Figure 1.4: Distribution of family members per type of occupations.

1.2.2.2 Second occupation

In the sample, 89.7% of family members do not have a second occupation. Among 117 members that have a paid one, 42 have a second one (35.9%). Among all farmers (n = 70), 21 have farming activities as a second occupation (30% of farmers) and represent 60% of those who have a second activity.

Table 1.6: Distribution of family members per type of occupation.

Type of occupation	Frequency	Percent
Farmer	21	60.0
Public sector	5	14.2
Private sector	1	2.9
Own business	1	2.9
Daily laborer	1	2.9
Unpaid family worker	6	17.1
Total	**35**	**100.0**

1.2.3 Migrations

The total winter residents accounts for 10,765 members i.e. 18.6% of the total population.

8.6%, 8.7% and 10% respectively in Majdel Méouch, El Fouara and Maaser Beit ed Dine are winter residents. This is due to the low number of returnees to those villages which were displaced during the war. 25% and 40% of El Bire and Ouadi Es Sitt's population remains in winter in their villages. The 15% of winter residents in Deir el Qamar could be explained by the high percentage of people who move in winter to the urban areas for work and schools purposes. The villages of Ain Zhalta and Brih account for 50% and 40% respectively of winter residents only. Although in those villages few displaced returned, the remaining population was already accounting for those percentages. The SES survey states 20% of permanent residents in Maaser Beit ed Dine and El Fouara respectively and 60% in Deir el Qamar.

In the sample, 91.4% do not have male emigrants and 75.8% do not have urbanised males. The total number of emigrants in the sample is nine while the urbanised account for thirty five.

Table 1.7: Distribution of residents per village.

Villages	Population	Residents	Percent
Ouadi Es Sitt	1,500	60	40.0
El Fouara	1,150	100	8.7
Brih	3,700	1,480	40.0
Ain Zhalta	3,000	1,500	50.0
Majdel Méouch	3,500	300	8.6
Maaser Beit ed Dine	2,000	200	10.0
El Bire	3,500	875	25.0
Deir el Qamar	30,000	4,500	15.0
Total	**48,350**	**9,015**	**18.6**

1.3 SERVICES

1.3.1 Schools

There are five private schools in the scheme from which three are closed located in El Fouara, Brih and Maaser Beit ed Dine (intermediate, primary and elementary levels respectively). The remaining two are located in Deir el Qamar; one is secondary and the other one is intermediate level.

There are also eight public schools from which two are closed, a primary one in El Fouara and an intermediate one in Ouadi Es Sitt. From the remainig six schools, two of intermediate level are found in Ain Zhalta, one in Brih, one in Majdel Méouch and two in Deir el Qamar (one intermediate and one secondary).

In addition to those schools, two technical ones exist in Deir el Qamar from which one of them is working only. There are also in Deir el Qamar an agricultural school under rehabilitation and a section of the Lebanese University for Sciences.

The SES survey states four private schools (three in Deir el Qamar and one in El Fouara) and a public one in El Fouara.

1.3.2 Dispensaries

There is a private dispensary in Ain Zhalta and two in Majdel Méouch; one for the Social Welfare and an ambulant one for the "Ordre de Malte" for the villages of Ras El Harf. Maaser Beit ed Dine accounts for a public dispensary closed nowadays. There are two hospitals, a private one "Boueiz Hospital" and "Deir El Salib"(for the elderly).

1.3.3 Cooperatives

Two agricultural cooperatives are found in the scheme, one in Brih and one in Ain Zhalta. Their work has been limited after the war.

1.3.4 Municipality

There are seven municipalities in the scheme from which the one in Brih is closed. Majdel Méouch is the only village which does not have a municipality. The SES survey states the existence of a municipality in El Fouara.

1.3.5 Non Governmental Organisations (NGO's)

The Pontifical Mission, the Young Men Christians Association, the World Vision, the UNICEF and Caritas are working in the scheme especially in the villages of the displaced. The Pontifical Mission as

well as the Young Men Christians Association are working mainly in agriculture and irrigation sectors.

1.4 BASIC INFRASTRUCTURE

1.4.1 Drinking water

The main source of drinking water is the Barouk that supply five villages in the scheme. Nabaa El Safa is the source of potable water for Ouadi Es Sitt and Ain Zhalta. Maaser Beit ed Dine drinks from an artesian public well. Deir el Qamar has three sources of potable water: Nabaa El Safa, Nabaa El Barouk and an artesian well (dug bu the Unicef).

1.4.2 Waste water disposal

Almost all villages rely on septic tanks that collect the waste water. Deir el Qamar rely on a network system; waste water is disposed in "El Ouadi" outside the village.

1.4.3 Solid wastes

In six villages of the scheme, the municipality deals with the solid waste either disposing it outside the village or burning it. In Deir el Qamar as well in El Fouara, solid wastes are collected and burned by a private company for M. Walid Joumblat.

1.5 LIVESTOCK

Maaser Beit ed Dine: there is no livestock in the village for market demand except three goats that belong to one person.

Deir el Qamar: each house has one or two cows given by Caritas as a help for the farmers. In the village, there are 350 heads of sheep, 600 heads of goats added to several chickens for home consumption. In addition to this, there are four chicken farms, two cow farms and one pig farm for market demand that are taken care by "Arab" people.

Majdel Méouch: only 5% of residents have livestock for home consumption (mainly for milk).

Ouadi es Sitt: there is no livestock in the village.

El Fouara: there are five heads of cows for home consumption.

Brih: there are two cow farms and one chicken farm for market demand. All houses own cows for home consumption.

El Biré: 5% of people own goats for the market. In the village, there are also four chicken farms.

Ain Zhalta: there is no livestock for market demand.

1.6 AGRICULTURE

1.6.1 Land surface

In several villages, the total agricultural area is unknown for two reasons:

- no topography;
- information not known by the Mukhtar.

Table 1.8: Distribution of agricultural land per village.

Villages	Total agricultural area (ha)	Irrigated area (ha)	Rainfed area (ha)	Non cultivated area (ha)
Ouadi es Sitt	Unknown	50% of agricultural area	50% of agricultural area	-
El Fouara	24	8	0	16
Brih	Unknown	16	Unknown	56
Ain Zhalta	Unknown	42.8	Unknown	-
Majdel Méouch	2000	200	0	1800
Maaser Beit ed Dine	100	20	10	70
El Biré	Unknown	Unknown	Unknown	Unknown
Deir el Qamar	40% of total area	25% of agricultural area	75% of agricultural area	-

N.B: Information from Mukhtars.

1.6.2 Land ownership

Land is mainly owned by farmers by inheritance. In the sample, 91.5% of parcels are owned by farmers, 7.8% are rented and 0.7% are shared.

1.6.3 Farm size

1.6.3.1 Farm sizes per Hectares

72.8% of the farms are less than one hectare while 27.2% are one hectare or more.

Table 1.9: Distribution of farms per size.

Total hectares	Frequency	Percent
< 1	51	72.8
1 - 2	10	14.3
2 - 3	4	5.8
≥ 3	5	7.1
Total	**70**	**100.0**

10 % of farms have non irrigated parcels. Among the remaining 90 %, 78,3 % have irrigated parcels less than one hectare, 10 % have irrigated parcels between one and two hectares, 11, 7% have irrigated parcels of two hectares or more.

Table 1.10: Distribution of farms per irrigated hectares.

Irrigated hectares	Frequency	Percent
< 1	47	78,3
1 - 2	6	10,0
2 - 3	4	6,7
≥ 3	3	5,0
Total	**60**	**100.0**

74,3 % of farms do not have rainfed parcels. Among the remaining 25,7 %, 61,1 % have rainfed parcels less than one hectare, and 38,9 % have rainfed parcels of one hectare or more.

Table 1.11: Distribution of farms per non irrigated hectares.

Non irrigated hectares	Frequency	Percent
< 1	11	61.1
1 - 2	3	16.7
2 - 3	1	5.5
≥ 3	3	16.7
Total	**18**	**100.0**

1.6.3.2 Farms' distribution per parcels

The total number of parcels account for 152 . Almost half the farms (48.5%) has one parcel and 51.5% have two parcels or more.

Table 1.12: Distribution of farms per parcels.

Parcels	Frequency	Percent
1	34	48.5
2	15	21.5
3	9	13.0
4	8	11.4
5	1	1.4
6	1	1.4
8	1	1.4
10	1	1.4
Total	**70**	**100.0**

1.6.3.3 Land use

In the sample, 97.4% of parcels are field cultivated whereas 2.6% are cultivated under green houses. The distribution of parcels per crop is as follows:

- 53.6% of parcels are planted with irrigated trees (mainlyapples, apricots and pears),
- 28.8% of parcels are cultivated with vegetables (mainly tomatoes),
- 16.3% of parcels are planted with non-irrigated trees (mainly olives),
- 0.7% of parcels are cultivated with cereals,
- 0.7% of parcels are cultivated with grapes.

Table 1.13: Distribution of parcels per type of crops.

Type of crops	Frequency	Percent
Cereals	1	0.7
Vegetables	44	28.7
Irrigated trees	82	53.6
Non - Irrigated trees	25	16.3
Other ...	1	0.7
Total	**153**	**100.0**

The production of 30.7 % of parcels are used for home consumption while the remaining 69.3 % are marketed.

The SES survey states that the agricultural land is divided between legumes, irrigated and non-irrigated trees and animal feed.

1.6.3.4 Cultural practices

Land preparation

Answers were obtained for 139 parcels. Land preparation of 71.9 % of them is mechanised whereas its is manual for the remaining 28.1%. Land preparation of ervil and tomato is mechanised whereas squash is

only manual. 50% of the parcels with grapes, prunes or cucumbers are prepared manually.

Planting

Answers were obtained for 66 parcels. Planting is done manually for all parcels regardless the type of crops cultivated.

Weeding

Answers were obtained for 61 parcels. All parcels are weeded manually.

Disease control

Answers were obtained for 139 parcels. 66.2% of parcels are sprayed manually and 33.8% are sprayed mechanically. Grape is the only crop sprayed almost equally manually (54.5% of the parcels) and mechanically (45.5% of the parcels).

Irrigation

Answers were obtained for 123 parcels. 95.1% of parcels are irrigated manually whereas the remaining 4.9% are irrigated mechanically. Parcels of squash, apple, prune and apricots are irrigated manually only.

Pruning

Answers were obtained for 121 parcels. Pruning is manual for all trees.

Harvesting

Answers were obtained for 142 parcels. Harvesting is manual for 97.9% of parcels and mechanised for the remainig 2.1%.

1.7 LABORERS IN AGRICULTURE

Foreign laborers are working in all villages of the scheme. Their participation vary from a village to another. In El Fouara, Majdel Méouch, Maaser Beit ed Dine and El Bire, the work is done only by foreign laborers. In Brih and Ain Zhalta, Lebanese participation is higher than foreigner one. In Deir el Qamar, foreigner input is greater than Lebanese one.

The wages of the foreigners vary from 15,000 to 20,000 LL. per day whereas the Lebanese wages vary from 15,000 to 25,000 LL. per day.

1.7.1 Without project

Foreign laborers represent 83.9% of the total workers. In all activities, foreign laborers are more involved than other laborers.

The difference between Lebanese workers and unpaid family workers can be measured as follows: land preparation, pruning and harvesting are mainly done by Lebanese workers while planting is an unpaid family worker task mainly. The involvement of Lebanese workers and unpaid family workers is equal for weeding, spraying and irrigating.

Table 1.14: Average number of Laborers per type activity.

Agricultural activity	Lebanese		Foreign		Unpaid family laborers		Total	
	No	%	No	%	No	%	No	%
Land preparation	3	20.0	11	73.3	1	6.4	15	100.0
Planting	1	2.8	32	91.4	2	5.8	35	100.0
Weeding	2	15.4	9	69.2	2	15.4	13	100.0
Disease control	1	9.1	9	81.8	1	9.1	11	100.0
Irrigation	1	12.5	6	75.0	1	12.5	8	100.0
Pruning	3	27.3	6	54.5	2	18.2	11	100.0
Harvesting	3	4.8	57	91.9	2	3.3	62	100.0
Total	**14**	**9.0**	**130**	**83.9**	**11**	**7.1**	**155**	**100.0**

1.7.2 With project

As the result of rehabilitation the demand on hired laborers will increase by 33%. In the same time, the rehabilitation will increase the productivity by 45% resulting in average incremental benefits increase of 48% per holdings (labor cost included). So, the farmers are able to cover the increase in labor cost.

1.8 IRRIGATION

1.8.1 Sources

The main source of water is Nabaa El Safa. It irrigates the villages of Ouadi Es Sitt (100% of the irrigated area), Brih (16 hectares), Ain Zhalta (42.8 hectares), Majdel Méouch (200 hectares), Maaser Beit ed Dine (20 hectares), Deir el Qamar (70% of the agricultural area) and El Bire (surface unknown).

In Maaser Beit ed Dine, there is also a local spring that is used also for irrigation. In Deir el Qamar, a 6" well dug by the Unicef is used for irrigation (20% of the irrigated area) as well as six private wells from 1" to 2" (10% of the irrigated area). El Fouara relies on nine small springs that irrigate 8 hectares.

In the sample, 5.2% of parcels are rainfed. Among the irrigated parcels, 92.4% are irrigated from springs, 4.1% from private wells, 2.8% from concrete reservoirs and 0.7% from earth reservoirs.

83.9% of farmers are owners of water, 10.7% are users and 3.6% are users and owners . The users are distributed as follows: 7.1% use private wells and 3.6% concrete reservoirs.

Table 1.15: Distribution of parcels per irrigation source.

Irrigation source	Frequency	Percent
Private well	6	3.9
Spring	134	87.6
Earth reservoir	1	0.7
Concrete reservoir	4	2.6
Rainfed	8	5.2
Total	**153**	**100.0**

1.8.2 Methods and Frequencies

The number of irrigations per season was assessed and gave the following results:

- vegetables are irrigated 25 to 26 times per season;
- trees are irrigated 10 to 11 times per season.

In the sample, 5.2% of parcels are rainfed. Among the remaining 94.8%:

- 92.4% are furrow irrigated;
- 7.6% are drip irrigated

Table 1.16: Distribution of parcels per irrigation system.

Irrigation system	Frequency	Percent
Drip	11	7.2
Furrow	134	87.6
Rainfed	8	5.2
Total	**153**	**100.0**

1.8.3 Distribution of water

Maaser Beit ed Dine:

On the local spring of the village, there is no committee responsible of water distribution but farmers agree among each other. There are only ten beneficiaries on this source of water, all people did not return to the village permanently. Each Feddan (Feddan = 1 dunum) receives the water each eight days.

Nabaa es Safa,

The local authority of El Barouk is responsible of water distribution. It has appointed a Shawi for the water distribution. Farmers pay 10,000 LL. per hour for the whole season and 600 LL. per hour for each irrigation of trees. This situation is the same for Brih and Ain Zhalta where there are two Shawis and one respectively. Shawis are seasonal; they work six month and are paid 250,000 LL. per month.

Deir el Qamar:

On Nabaa es Safa, two Shawis are appointed from the municipality to be responsible of the water distribution. They are employees in the municipality and are paid on monthly basis. No fees are collected from the farmers.

On the UNICEF well, five Shawis from the municipality are responsible for water distribution but no fees are collected from farmers.

Majdel Méouch:

The local irrigation committee of Majdel Méouch is responsible for the distribution of Nabaa es Safa's water. Water rights are predetermined. Water is distributed among users according to a pre-set schedule. Water rights are buyed at $3,000 per hour. The local irrigation committee accounts for twelve members (one from each family). This committee designates a Shawi each year who is paid 25,000 LL. per hour. Each farmer pays according to the numbers of hours of water he owns.

Ouadi es Sitt:

The local irrigation committee of Ouadi es Sitt accounts for four members. Usually, the municipality appoints a Shawi to distribute water among users but nowadays water is sufficient for all users that are in the village so there is no need for a Shawi. No fees are paid by the users.

El Fouara:

Users agree among themselves to distribute water.

El Biré:

The local irrigation committee of El Biré appoints a Shawi that is paid on salary basis. This salary is divided on the total number of irrigated hours and each beneficiary pay according to the number of water hours he owns.

1.8.4 Operation, maintenance and rehabilitation

The operation, maintenance and rehabilitation of the irrigation system is the responsibility of the local authority of El Barouk for the villages of Ain Zhalta, Brih, El Bire as well as for Maaser Beited Dine. In Maaser Beit ed Dine, the farmers are responsible of the local spring's water.

In Deir el Qamar, Ouadi es Sitt and El Fouara, the operation, maintenance and rehabilitation is the responsibility of the municipality. In Majdel Méouch, the farmers are totally responsible of the operation, maintenance and rehabilitation of the irrigation system. In El Fouara, farmers participate in the operation, maintenance and rehabilitation of the irrigation system.

Farmer's participation was measured and gave the following results :

Brih: 80% of farmers are involved in the operation, maintenance and rehabilitation of the irrigation system and 20% do not participate totally. Those who participate are divided as follows: 40% pay on all canals, 30% work and 10% pay for primary canals and work on secondary and tertiary.

Ain Zhalta: farmers stated that the operation, maintenance and rehabilitation of the irrigation system are done by the:

* farmers (60% of the answers);

* local authority of El Barouk (20% of the answers);

* municipality (20% of the answers).

Their participatence was measured and gave the following results:

- 40% do not participate at all;

- 40% participate by their work;

- 20% participate by their payments.

Maaser Beit ed Dine: 70% of farmers stated that the operation, maintenance and rehabilitation of the irrigation system are done by the committee while 30% did not answer.

40% of farmers participate in the operation, maintenance and rehabilitation of the system by paying while the remaining 60% do not at all.

El Biré: 67% of farmers stated that the operation, maintenance and rehabilitation of the irrigation system are done by the committee while 33% did not answer.

75% of farmers do not participate in the operation, maintenance and rehabilitation of the system while the remaining 25% did not answer.

Deir el Qamar: 40% of farmers stated that the operation, maintenance and rehabilitation of the irrigation system are done by the municipality, 30% said that it is done by the farmers while 30% did not answer.

40% of farmers do not participate in the operation, maintenance and rehabilitation of the system while the remaining 30% participate on all canals by paying.

Majd el Méouch: 62.5% of farmers stated that the operation, maintenance and rehabilitation of the irrigation system are done by the committee, 12.5% said that it is done by the municipality while 25% did not answer.

All farmers participate in the operation, maintenance and rehabilitation of the system by paying.

El Fouara: 80% of farmers stated that the operation, maintenance and rehabilitation of the irrigation system are done by themselves. They participate by paying on all canals. The remainig 20% do not participate at all.

Ouadi es Sitt: All farmers stated that the operation, maintenance and rehabilitation are done by the committee. 75% of them do not participate and the remainig 25% participate by paying.

The SES survey states that in Deir el Qamar, the operation, maintenance and rehabilitation are done by the Shawi, in Maaser Beit ed Dine by the municipality and in El Fouara by the municipality and the committee.

1.8.5 Farmers opinions

Brih: 50% of farmers are satisfied with the present situation while the remaining 50% want the Ministry of Hydraulics and Electrical Resources to be responsible.

The willingness of farmers to participate in future operation, maintenance and rehabilitation was measured and gave the following results:

- 30% of farmers are willing to pay,
- 30% of farmers are willing to work,
- 40% of farmers are not willing to participate.

Ain Zhalta: 70% of farmers are satisfied with the present situation while the remaining 30% are divided as follows: 20% want the Ministry of Hydraulics and Electrical Resources to be responsible and 10% the municipality.

The willingness of farmers to participate in future operation, maintenance and rehabilitation was measured and gave the following results:

- 30% of farmers are willing to participate (not specified how),
- 20% of farmers are willing to pay,
- 20% of farmers are willing to work,
- 30% of farmers are not willing to participate.

Maaser Beit ed Dine: All farmers are satisfied with the present situation.

The willingness of farmers to participate in future operation, maintenance and rehabilitation was measured and gave the following results:

- 20% of farmers are willing to participate (not specified how),
- 40% of farmers are willing to work,
- 40% of farmers are not willing to participate.

El Biré: 60% of farmers are satisfied with the present situation while the remaining 40% want a change but did not specified the way.

The willingness of farmers to participate in future operation, maintenance and rehabilitation was measured and gave the following results:

- 25% of farmers are willing to participate (not specified how),
- 75% of farmers are not willing to participate.

Deir el Qamar: 90% of farmers are satisfied with the present situation while the remaining 10% want the Ministry of Hydraulics and Electrical Resources to be responsible.

The willingness of farmers to participate in future operation, maintenance and rehabilitation was measured and gave the following results:

- 10% of farmers are willing to participate (not specified how),
- 10% of farmers are willing to pay,
- 20% of farmers are willing to work,
- 60% of farmers are not willing to participate.

Majdel Méouch: 62.5% of farmers are satisfied with the present situation while the remaining 37.5% are divided as follows: 12.5% want the Ministry of Hydraulics and Electrical Resources to be responsible and 25% want a change but did not specify the way.

The willingness of farmers to participate in future operation, maintenance and rehabilitation was measured and gave the following results:

- 62.5% of farmers are willing to participate (not specified how),
- 12.5% of farmers are willing to pay,
- 12.5% of farmers are willing to work and to pay,
- 12.5% of farmers are not willing to participate.

El Fouara: 40% of farmers are satisfied with the present situation while the remaining 60% are divided as follows: 40% want the Ministry of Hydraulics and Electrical Resources to be responsible and 20% want a change but did not specify the way.

The willingness of farmers to participate in future operation, maintenance and rehabilitation was measured and gave the following results:

- 30% of farmers are willing to participate (not specified how),
- 40% of farmers are willing to work,
- 30% of farmers are not willing to participate.

Ouadi es Sitt: All farmers are satisfied with the present situation.

The willingness of farmers to participate in future operation, maintenance and rehabilitation was measured and gave the following results:

- 37.5% of farmers are willing to participate (not specified how);
- 12.5% of farmers are willing to pay,
- 12.5% of farmers are willing to work,
- 37.5% of farmers are not willing to participate.

The SES survey states that the farmers of Deir el Qamar, El Fouara and Maaser Beit ed Dine want the operation, maintenance and rehabilitation to be done by the municipality.

1.9 FAMILY INCOME AND EXPENDITURES

1.9.1 Family income (LL./month)

1.9.1.1 Present income

In the sample, 65.8% of family members do not earn any income, 3.3% are loosing (farming activities) and 5.8% did not answer. The income of the paid workers who are making profit is divided as follows:

- 37.3% of workers earn less than 250,000 LL per month;
- 25.6% of workers earn between 250,000 to 500,000 LL per month;

- 19.7% of workers earn between 500,000 and 750,000 LL per month;
- 5.8% of workers earn between 750,000 and 1,000,000 LL per month;
- 11.6% of workers earn 1,000,000 LL or more per month.

Table 1.17: Distribution of family members per monthly income.

Monthly income (LL.)	Frequency	Percent
< 250,000	32	37.3
250,000 - 500,000	22	25.6
500,000 - 750,000	17	19.7
750,000 - 1,000,000	5	5.8
≥ 1,000,000	10	11.6
Total	**86**	**100.0**

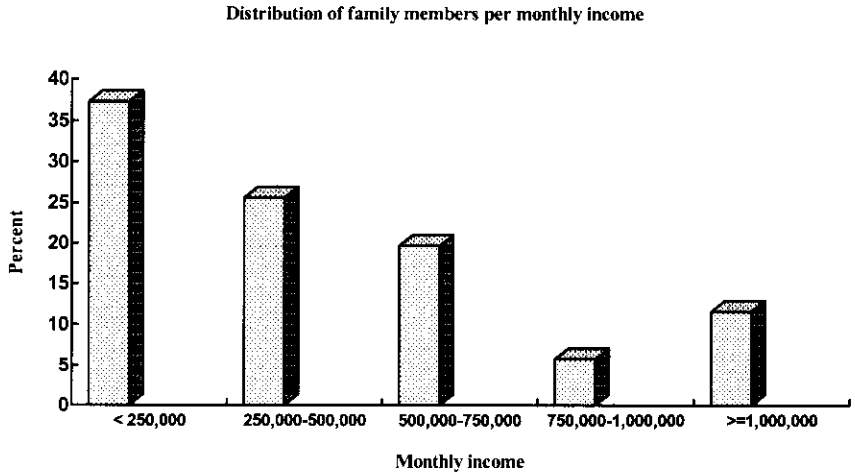

Figure 1.5: Distribution of family members per monthly income.

76.5% of farmers earn less than 500,000 LL per month while 23.5 % earn 1000,000 LL per month and above.17.9% of employees in public sector earn less than 250,000 LL per month, 63.4 % earn between 250,000 and 750,000 LL per month, and 17.8 % earn 750,000 LL and above per month. 27.8 % of employees in private sector earn less than 250,000 LL per month while the remaining 72.2 % earn more or equal 250,000 LL per month
(44.4 % earn between 250,000 and 500,000 LL per month). 61.5 % of those having free business are earning less than 250,000 LL per month and 38.5% earn 250,000 LL and above per month.

1.9.1.2 Second income

In the sample, 89.8% of family members do not have a second source of income and 5.6% did not answer. Among those who answered:

- 43.7% of workers earn less than 250,000 LL per month;

- 18.8% of workers earn between 250,000 to 500,000 LL per month;
- 6.2% of workers earn between 500,000 and 750,000 LL per month;
- 12.5% of workers earn between 750,000 and 1,000,000 LL per month;
- 18.8% of workers earn 1,000,000 LL or more per month.

Table 1.18: Distribution of family members per monthly income.

Monthly income (LL.)	Frequency	Percent
< 250,000	7	43.7
250,000 - 500,000	3	18.8
500,000 - 750,000	1	6.2
750,000 - 1,000,000	2	12.5
≥ 1,000,000	3	18.8
Total	**16**	**100.0**

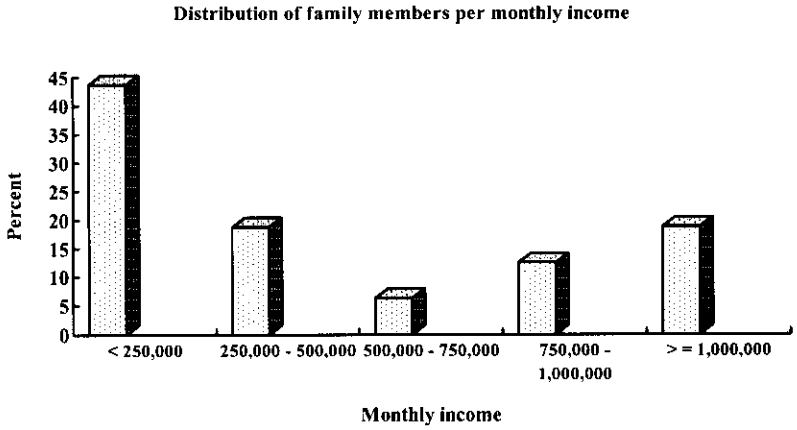

Figure 1.6: Distribution of family members per monthly income.

76.9% of farmers earn less than 500,000 LL while the 23.1% earn 750,000 L L and above per month.

1.9.2 Family annual expenditures

1.9.2.1 Off-farm expenditures

Schools

50% (n=35) of farms do not pay annual schools' expenses (do not have children at schools).

The remaining farms have annual schools' expenditures as follows:

- 11.4% of them pay less than 2,000,000 LL per year;

- 34.3% of them pay between 2,000,000 and 4,000,000 LL per year;
- 31.4% of them pay between 4,000,000 and 6,000,000 LL per year;
- 22.9% of them pay 6,000,000 LL or above per year;

The average schools expenditures per year is about 4,460,571 LL.

Table 1.19: Distribution of schools expenditures per family.

Expenditures (x 1,000,000 LL.)	Frequency	Percent
< 2	4	11.4
2 - 4	12	34.3
4 - 6	11	31.4
≥ 6	8	22.9
Total	**35**	**100.0**

Food

65.7% (n=46) of total farms refused to answer this question. From the remaining %:

- 33.3% pay less than 10,000,000 LL. per year,
- 66.7% pay 10,000,000 LL. or more per year.

The average food expenditures per year is about 8,484,792 LL.

Table 1.20: Distribution of food expenditures per family.

Expenditures (x 1,000,000 LL.)	Frequency	Percent
≥ 6	5	20.8
6 - 10	3	12.5
10 - 14	14	58.4
≥ 14	2	8.3
Total	**24**	**100.0**

Medication

58.6% of interviewed families did not answer and 21.4% reported that they do not have annual medical expenditures. Among those who reported their medical expenditures, 71.4% pay less than 2,000,000 LL. per year. The average medical expenditures per year is 1,691,714 LL.

Table 1.21: Distribution of medication expenditures per family.

Expenditures (x 1,000,000 LL.)	Frequency	Percent
< 2	10	71.4
2 - 4	2	14.2
4 - 6	1	7.2
≥ 6	1	7.2
Total	**14**	**100.0**

Other

54.3% of families did not answer and 37.1% reported not to have other type of expenses. On average, families pay around 2,036,667 LL per year.

Table 1.22: Average expenditures per category in the scheme.

Expenditures	Average (LL/year)	Percent
Schools	4,460,571	26.7
Food	8,484,792	50.9
Medication	1,691,714	10.1
Others	2,036,667	12.3
Total	**16,673,744**	**100.0**

1.9.3 On-farm expenditures

Per farm size

The interviewed farmers have mainly less than one hectare. The number of cases for the other farm size groups (i.e., more than one hectare) were very few to be considered. The net revenue per hectare for farmers cultivating less than one hectare is $ 3,471,156.

Table 1.23: Mean on-farm expenditures per farm size in L.L./ha/yr.

Mean Cost	< 1
Land rental	1,300,000
Land preparation	1,284,416
Planting	1,038,008
Seeds/Seedlings	1,677,945
Weeding	1,403,718
Fertilisers, insecticides, pesticides	2,305,798
Pruning	553,698
Irrigation cost	367,289
Fuel & electricity	595,000
Harvesting	1,065,632
Packaging	2,825,783
Transportation	941,797
Total Input cost	**15,359,084**
Total Revenue	**18,830,240**
Net Revenue	**3,471,156**

1.10 GENERAL OVERVIEW ON PROBLEMS

1.10.1 Main agricultural problems

In the sample, 10% of farmers stated not to have agricultural problems. Among those who have:

- 41.3% of farmers declared that the diseases as well as the neglect from the authorities are their main agricultural problems;
- 23.8% of farmers declared that high cost of inputs is their main agricultural problem;
- 15.9% of farmers declared that the insufficient income from agriculture is their main agricultural problem;
- 9.5% of farmers declared that the undesirable effects of pesticides is their main agricultural problem;
- 9.5% of farmers declared that the limited market is their main agricultural problem.

Table 1.24: Distribution of main agricultural problem per family.

Main agricultural problem	Frequency	Percent
Insufficient income	10	14.3
Limited market	6	8.6
High cost	15	21.4
Undesirable effect of pesticides	6	8.6
Other	26	37.1
No problem	7	10.0
Total	**70**	**100.0**

1.10.2 Main irrigation problem

In the sample, 64.3% of families declared not to have irrigation problems while 35.7% stated their main irrigation problem. Among those, the main irrigation problem is the:

- water shortage (52% of the answers);
- bad quality of canals (44% of the answers);
- bad location of land (4% of the answers).

Table 1.25: Distribution of main irrigation problem per family.

Main irrigation problem	Frequency	Percent
Water shortage	13	18.6
Bad location of land	1	1.4
Other	11	15.7
No problem	45	64.3
Total	**70**	**100.0**

1.11 AFFORDABILITY OF WATER CHARGES

The extra farm income received by farmers, is on the average. L.L.5,256,000 (US$ 3,369) per year during the steady stage. This extra income already takes into consideration water charges, which amount to LL 110,000 per farm or US$ 70. Water charges account for approximately 2% of the extra income earned in irrigated agriculture. This percentage is lower than the upper limit of 5% generally used in studies, and thus it means that the farmers would probably be willing to pay the preset water charges.

1.12 SOCIO-ECONOMIC CRITERIA FOR SCHEME SELECTION

Table 1.26: Socio-economic ranking criteria.

Socio-economic criteria	Rank (%)
Highest annual present income (20%)	50
Highest annual second income (20%)	50
Unpaid family workers (15%)	14
Farmers percentage (15%)	26
Annual residency (10%)	10
Lebanese workers (10%)	10
Willingness to participate in future O&M (10%)	10
Score	**170**

ANNEX II-1

REGION OF SAFA SOURCE

CHAPTER 2

SOIL AND LAND CLASSIFICATION

2. SOIL AND LAND CLASSIFICATION

2.1 TERRAIN-SOIL CLASSIFICATION

2.1.1 Landform

The topography of the project area is typical of the mountainous regions in Lebanon, where the norm is rough broken land, stony and/or rocky, sometimes steeply dissected, cut by escarpments and traversed by deep ouadi stream channels.

The main Ouadi Safa runs in the direction from northeast to southwest. The highest point, in the northeast, is almost 1200 m, where as the lowest point in the southwest is nearly 450 m.

The cultivated irrigated lands are all terraced. They are located on slopes perpendicular to the ouadi ranging from moderately steep (15-30 %) to strongly sloping (8-15 %) with very few undulating slopes (5-8 %). In some areas along the ouadi bed, the slope becomes nearly level.

2.1.2 Parent material

In the northeastern part of the scheme, mainly in Ain Zhalta area, the parent material is from cretaceous sandstone. Also few areas, along Ouadi Safa are of cretaceous sandstone origin.

Most of the slopes that run towards Ouadi Safa, are from unconsolidated debris material (alluvial-colluvial deposits) of limestone origin. In the Majd el Meouch and El Biré areas, the parent material is mainly of detritic limestone, where as in Kfar Nabrakh, Maaser Beit Eddine and Deir El Qamar regions, detritic to hard limestone is the origin of their parent materials.

2.1.3 Soils

The soils of the Safa region are in general medium textured soils ranging from loam to clay loam. Their depth varies from moderately to very deep, depending mostly on the slope gradient. The calcium carbonate content is generally low, but moderate in few cases. The stoniness is mostly slight to moderate.

No problem of drainage is visible in the area.

They are all developed on limestone and colluvium deposits.

In the Ain Zhalta area and in few places along the Ouadi Safa, light textured soils are found. Their texture is sandy loam, with depth

varying from very deep to moderately deep. They are non calcareous, not stony and excessively well drained.

These soils are developed on cretaceous sandstone.

Table 2.1 shows the different soil mapping units (SMU) and their description in the scheme. Drg. No. II-1/101-102 show their location and distribution.

Table 2.1: Explanatory notes on the soil mapping units.

Soil mapping unit	Description
$M_4\ T_3\ t_1\ d_1\ c_1\ s_1$	Mountainside, moderately steep, terraced, moderately wide, medium textured, very deep, slightly calcareous, slightly stony.
$M_4\ T_3\ t_1\ d_1\ c_1\ s_2$	i d. except moderately stony.
$M_4\ T_3\ t_1\ d_2\ c_1\ s_2$	i d. except deep, moderately stony.
$M_4\ T_3\ t_1\ d_1 c_2\ s_2$	i d. except calcareous, moderately stony.
$M_4\ T_3\ t_2\ d_1$	i d. except light textured, non calcareous, non stony.
$M_3 T_2\ t_1\ d_1\ c_1\ s_1$	i d. except strongly sloping, terraced, wide.
$M_3 T_2\ t_1\ d_2\ c_2\ s_2$	i d. except strongly sloping, terraced, wide, deep, calcareous, moderately stony.
$M_3\ T_2\ t_2\ d_1$	i d. except strongly sloping, terraced, wide, light textured, non calcareous, non stony.
$M_5\ T_4\ t_1\ d_3\ c_2\ s_2$	i d. except steep, terraced narrow, moderately deep, calcareous, moderately stony.
$M_5\ T_4\ t_1 d_2\ c_1\ s_2$	i d. except steep, terraced, narrow, deep, moderately stony.
$M_5\ T_4\ t_1\ d_3\ c_1\ s_2$	i d. except steep, terraced, narrow, moderately deep, moderately stony.
$M_3\ T_6\ t_1\ d_1\ c_1\ s_1$	i d. except strongly slopping, terraced, wide, non irrigated
$M_4\ T_6\ t_1\ d_1\ c_1\ s_1$	i d. except terraced, non irrigated.
$M_4\ T_6\ t_1\ d_2\ c_1\ s_2$	i d. except terraced, non irrigated, deep, moderately stony.
$M_5\ T_6\ t_1 d_2\ c_1\ s_2$	i d. except steep, terraced, narrow, non irrigated, deep, moderately stony.
$M_5\ T_6\ t_1 d_3\ c_1\ s_2$	i d. except steep, terraced, narrow, non irrigated, moderately deep, moderately stony.
$M_5\ T_6\ t_2 d_2$	i d. except steep, terraced, narrow, non irrigated, light textured, deep, non calcareous, non stony.
$M_3\ T_5\ t_2\ d_1$	i d. except strongly sloping, terraced, wide, abandoned, light textured, non calcareous, non stony.
$M_4\ T_5\ t_2\ d_1$	i d. except terraced, abandoned, light textured, non calcareous, non stony.
$M_4\ T_5\ t_1\ d_1\ c_1\ s_1$	i d. except terraced, abandoned.
$M_4\ T_5\ t_1\ d_1\ c_1\ s_2$	i d. except terraced, abandoned, moderately stony.
$M_4\ T_5\ t_1\ d_1\ c_2\ s_2$	i d. except terraced, abandoned, calcareous, moderately stony.
$M_4\ T_5\ t_1\ d_2\ c_1\ s_2$	i d. except terraced abandoned, deep, moderately stony.
$M_5 T_5\ t_1\ d_2\ c_1\ s_2$	i d. except steep, terraced, narrow, abandoned, deep, moderately stony.
$M_5 T_5\ t_2\ d_2$	i d. except steep, terraced, narrow, abandoned, light textured, deep, non calcareous, non stony.
$H_2\ T_1\ t_1\ d_1\ c_1\ s_1$	Foothill, sloping, terraced, very wide, medium textured, very deep, slightly calcareous, slightly stony.
$V_2\ T_1\ t_1\ d_1$	Valley bottom, sloping, terraced, very wide, medium textured, very deep, non calcareous, non stony.
$M_3\ t_1\ d_2\ c_1\ s_2$	Mountainous, strongly, sloping, medium textured, deep, slightly calcareous, moderately stony.
$M_4\ t_1\ d_2\ c_1\ s_2$	i d. except moderately steep.
$M_3\ t_2\ d_2$	i d. except light textured.
$M_5\ t_2\ d_3$	i d. except steep, light textured, moderately deep.

2.2 SOIL CAPABILITY CLASSES

Three classes were determined for irrigated lands in general.

In the following sections a general description is given of these three classes, with a summary of those factors which are limiting.

2.2.1 Class I

Flat to very gently sloping land or terraces over 5 meters wide, medium textured, very deep, non calcareous to slightly calcareous, not stony to slightly stony, ground water depth more than 2 meters, no ponding or flooding hazards.

2.2.2 Class II

Gently sloping land or terraces 3-5 meters wide, light or heavy textured, deep, moderately calcareous, moderately stony, slightly rocky ground water dept 1-2 meters, slight ponding and flooding hazards.

2.2.3 Class III

Sloping land or terraces less than 3 meters, coarse light or very heavy textured, moderately deep, calcareous, stony and rocky, ground water depth less than 1 meter, severe ponding and flooding hazards.

2.2.4 Potential Classes

a) Class i - Depending on the limitation, becomes irrigated land after securing water.

b) Class d - Depending on the limitation, becomes irrigated land after development - i.e. levelling, clearance of stones, rocks etc, and construction of retaining walls.

2.3 LAND CLASSES FOR THE PROJECT AREA

Table 2.2 shows the land classes and subclasses as sorted out by the different soil mapping units. Drg No. II-1/201-202 show the location and distribution of the land classes and subclasses.

Table 2.2: Land classes and subclasses distribution.

Class/Subclass	Soil mapping unit
I	$M_4 T_3 t_1 d_1 c_1 s_1$, $M_3 T_2 t_1 d_1 c_1 s_1$, $H_2 T_1 t_1 d_1 c_1 s_1$, $V_2 T_1 t_1 d_1$,
I - i	$M_4 T_6 t_1 d_1 c_1 s_1$, $M_3 T_6 t_1 d_1 c_1 s_1$
I - d	$M_4 T_5 t_1 d_1 c_1 s_1$
II st	$M_4 T_3 t_2 d_1$, $M_3 T_2 t_2 d_1$
II sst	$M_4 T_3 t_1 d_1 c_1 s_2$
II sd, sst	$M_4 T_3 t_1 d_2 c_1 s_2$
II sc, sst	$M_4 T_3 t_1 d_1 c_2 s_2$
II sd, sst, sc	$M_3 T_2 t_1 d_2 c_2 s_2$
II sd, sst, t	$M_5 T_4 t_1 d_2 c_1 s_2$
II sd, sst-i	$M_4 T_6 t_1 d_2 c_1 s_2$
II sd, sst, t-i	$M_5 T_6 t_1 d_2 c_1 s_2$
II sd, st, t-i	$M_5 T_6 t_2 d_2$
II st-d	$M_3 T_5 t_2 d_1$, $M_4 T_5 t_2 d_1$
II sst-d	$M_4 T_5 t_1 d_1 c_1 s_2$
II sd, sst, t-d	$M_5 T_5 t_1 d_2 c_1 s_2$
II sd, st, t-d	$M_5 T_5 t_2 d_2$
II sc, sst-d	$M_4 T_5 t_1 d_1 c_2 s_2$
II sd,sst-d	$M_4 T_5 t_1 d_2 c_1 s_2$, $M_3\ t_1 d_2 c_1 s_2$, $M_4 t_1 d_2 c_1 s_2$
II sd, st-d	$M_3 t_2 d_2$
III sd-i	$M_5 T_6 t_1 d_3 c_1 s_2$
III sd	$M_5 T_4 t_1 d_3 c_1 s_2$, $M_5 T_4 t_1\ d_3 c_2 s_2$
III sd-d	$M_5 T_2 d_3$

ANNEX II-1

REGION OF SAFA SOURCE

CHAPTER 3

WATER RESOURCES

3. WATER RESOURCES

3.1 CHARACTERISTICS OF PROJECT AREA

3.1.1 Location

The project area, Scheme II-1 is around 50 kilometers south east of Beirut and is accessible on the road passing through Hazmieh - Bhamdoun - Sofar - Mdairej - Es Safa.

The project area is in Mohafazat Mount Lebanon, Caza El Chouf. The project area appears on Drg. Nos. II-1/301 and II-1/302.

The project area is bounded on the south by Scheme II-2, Region of Barouk.

3.1.2 Physiography

The topography of the project area is typical of the mountainous areas in Lebanon, where the norm is rugged rocky ridges traversed by deep ouadi stream channels.

The elevation at the north eastern extremity of the scheme is around 975 m and drops to 775 m at the south western extremity with the two point being 13 kilometers apart. Note that the ground slope reaches 20% in several points.

3.1.3 Climate

The climate of the project area is characterized by a cold winter and a pleasant summer. The mean annual rainfall is around 1200 mm with a mean annual temperature around 13°C ranging from an average low of 5°C in January to an average high of 21°C in August.

3.2 HYDROLOGICAL CONSIDERATIONS

3.2.1 Water Source

The project area is irrigated by a group of 3 sources called Es Safa Springs. These springs are: Nabaa Es Safa, Nabaa Er Rouyane and Nabaa El Qaa.

Faouara village and its environs does not have water rights on Es Safa Springs and is irrigated from several local springs: Ain El Haoura, Ain Ez Zaitoune, Ain Et Tine, Ain El Khasfe, and Nabaa Zouaiya. According to the local committee and to local farmers, a natural underground channel,

downstream of Nabaa El Barouk, is diverting water from Nahr El Barouk to Nabaa Zouaiya.

3.2.2 Spring Flows

Table 3.1 presents the measurements carried out by the Consultants in 1996 and Table 3.2 presents the Consultants flow estimates for springs in Faouara. The MHER figures on Es Safa Springs are presented in Table 3.3.

According to the Final Report on "Identification of Source Protection Works" prepared by Howard Humphreys for the CDR, 1995, (HH/CDR), the total yield of Safa springs is around 69,000 m^3/day.

Table 3.4 gives the annual rainfall for the years in which discharge measurements were recorded. The data was extracted from the Main Report, Chapter 6. Inclusion of rainfall data in this section was done for correlation purposes to help in the assessment of the spring flow data.

The rainfall data used was based on the records (1876-1984) of the American University of Beirut (AUB) Weather Station. The rainfall data for Safa Region was estimated from AUB data by adjusting the rainfall figures proportionally, based on the mean annual rainfall.

Table 3.1: Nabaa Es Safa Flow Measurement Jouzy - Haskoning 1996

Discharge in m^3/day		
June	**July**	**August**
83,705	62,040	52,300

Table 3.2: Consultants Field Investigations on Spring Flows in Faouara July 1996

Spring Name	Discharge in m^3/day
Ain El Haoura and Ain Ez Zaitoune	3,500
Ain Et Tine	9,500
Ain El Khasfe	2,500
Nabaa Zouaiya	3,300
Total	**18,800**

Table 3.3: Discharge of Es Safa Springs from MHER Records

Spring Name	Year	Discharge in m³/day				
		May	June	July	Aug.	Sept.
Nabaa Es Safa	1960	39,398		53,222		
	1975			23,587		
Nabaa Er Rouyane	1968			14,999	16,243	
	1971			15,984		
	1973					13,306
	1975	17,021	15,725	18,576		
	1979	15,811			15,638	
Nabaa El Qaa	1972				32,141	
	1975	24,970	37,152			
	1977	53,568	42,163			
	1979				25,448	

Table 3.4: Annual Rainfall for Safa Region.

Year	Rainfall mm
1959 - 1960	972
1967 - 1968	1727
1970 - 1971	1053
1971 - 1972	760
1972 - 1973	814
1974 - 1975	1476
1976 - 1977	1183

3.2.3 Assessment of Spring Flows

Assessment of the spring flow data leads to the following comments :

- Referring to Table 3.1, it is seen that the reduction of flow with time follows a consistent pattern.

- With respect to Es Safa Springs, referring to Table 3.3, it is seen that where there are more than one reading in a single year, i.e, 1960, 1968, 1975, 1977 and 1979 the increasing flow in the dry period is inconsistent for recession curves in such hydrogeological formations, and sheds doubt on the reliability of the data. For the year 1975, with regards to Nabaa Er Rouyane, the reduction of flow from May to August i.e. (15811 to 15638) is consistent. For the year 1977, with regards to Nabaa El Qaa, the reduction of flow from May to June is consistent.

- In an attempt to correlate between flow figures in Table 3.3 and rainfall data in Table 3.4, inconsistencies are evident:

  As regards to Nabaa Es Safa, its flow figures for July are 53,222 m^3/day and 23,587 m^3/day, the corresponding annual rainfall figures from Table 3.4 are : 972 mm and 1476 mm.

  As regards Nabaa Er Rouyane, the flow figures for July are 14,999 m^3/day, 15,984 m^3/day and 18,576 m^3/day, the corresponding annual rainfall figures are 1727 mm, 1053 mm and 1476 mm.

  The flow figures of Nabaa El Qaa are 24,970 m^3/day and 53,568 m^3/day in May, and 37,152 m^3/day and 42,163 m^3/day in June. The corresponding annual rainfall figures are 1476 mm and 1183 mm

From the above the yield of Es Safa Springs will be based on the Consultants flow measurements. In the absence of any other data on the springs in Faouara, the Consultants Field Investigations figures will be retained.

As a comment on the accuracy of the above estimates, the rainfall in the water year 1995-96 was close to the long term average and it is expected that spring flows in 1995-96 are also close to the average. The subject of correlation between precipitation and spring flow date is discussed within the Main Report, Chapter 6, Section 6.3.

3.2.4 Hill Lakes

A site to construct a hill lake near Ain el Qotn was investigated (see Drg. No. II-1/402 and Figure 3.1) and found suitable.

Physical Characteristics

- Approximate altitude: 1,060 meters
- Shape: almost rectangular
- Average Depth: 4 meters
- Watershed area: 0,7 square kilometer

Storage Capacity

- Total volume: 104,000 cubic meters per year
- Total losses (evaporation and infiltration): 37,000 cubic meters per year
- Total available water for irrigation: 67,000 cubic meters per year

Assuming the irrigation period around 100 days, the daily flow is around 670 m^3/day or 7,7 l/s.

Another site to construct a small dam in a Ouadi just south of Beit Ed Dine was investigated and found suitable too (see Figure 3.2).

Physical Characteristics

- Approximate altitude: 870 meters
- Shape: "square"
- Average depth: 7 meters
- Dam height: 15 meters
- Dam length: 200 meters
- Watershed area: 80 hectars.

Storage Capacity

- Total volume: 210,000 cubic meters
- Total losses: 70,000 cubic meters
- Total water available for irrigation: 140,000 cubic meters per year

Assuming the irrigation period around 100 days, the daily.flow is approximately 140,000 cubic meters per day or 16 l/s.

The water from the reservoir can irrigate an area west of Beit Ed Dine, a conveyance pipeline of about 4 km will be needed.

Note that the water available from the proposed hill lake and dam will not be included in the water balance analysis.

Figure 3.1: Proposed Hill Lake Location Plan

Figure 3.2: Proposed Dam Location Plan

3.3 WATER BALANCE

3.3.1 Main Yield

The irrigation scheme is fed mainly by Es Safa Springs that provide also domestic water for many villages.

Faouara Region is fed by the following springs: Ain El Haouara, Ain Ez Zaitoune, Ain Et Tine, Ain El Khasfe and Nabaa Zouaiya.

3.3.2 Subsidiary Yield

There is no local inflow to the stream of the main sources.

3.3.3 Domestic Water Supply Demand

A large number of villages: Aley, El Bire, Majdel Maouch, Baaqline Chouairit, Rachaya, Baisour, Beit Ed Dine, Al Mecherfeh, Badghan, Baalchmay, Ain Dara, Kfarnis, Iqlim El Kharoub, Ain Zhalta, Es Safa... , get their domestic water supply from Es Safa Springs.

According to (HH/CDR), the present population served by Nabaa Es Safa, Nabaa Er Rouyane and Nabaa El Qaa is around 185000 inhabitants.

At a water consumption rate of 100 l/p/d, the domestic water supply demand is around 18,500 m^3/day. Information obtained from Barouk water authority indicates that the daily domestic water supply demand is about 15,000 m^3/day and this is the figure used for the water balance analysis.

3.3.4 Water Requirements Downstream of the Scheme

There are no evident water rights on Es Safa Springs.

3.3.5 Water Budget

The water budget for Es Safa Springs is presented in Table 3.5.

As regards the springs in Faouara, since there are no subsidiary yields, no domestic water supply demand and no water requirement downstream of any of the springs, their yields are all available for irrigation. The water availability is listed in Table 3.6.

Table 3.5: Nabaa Es Safa Water Budget

Item	Discharge in m³/day		
	June	July	August
Yield	83,705	62,040	52,300
Subsidiary	---	---	---
Domestic Water Supply	15,000	15,000	15,000
Downstream Requirements	---	---	---
Water Available for Irrigation	68,705	47,040	37,300

Table 3.6: Irrigation Water Availability in Faouara

Spring	Dry Period Average Flow in m³/day
Ain El Haoura and Ain Ez Zaitoune	3,500
Ain Et Tine	9,500
Ain El Khasfe	2,500
Nabaa Zouaiya	3,300
Total	**18,800**

3.4 FLOOD PROTECTION

According to local farmers and authorities, no flooding problem was reported in the scheme area.

ANNEX II-1

REGION OF SAFA SOURCE & SURROUNDING

CHAPTER 4

AGRONOMIC ASPECTS

4. AGRONOMIC ASPECTS

4.1 INTRODUCTION

Safa and surrounding areas are tourism resorts. The fruits and vegetables produced in this region may be considered as an integral part of the general attractions. Apples and peaches have a very good quality. Brih, a village in this area is very popular for its round, white, sweet onions. Under these conditions local agricultural production becomes more valuable and economic.

Animal husbandry is quite important. The number of dairy cattle (600 to 800 heads) and goats (300 to 400 heads) is relatively high. Bees are kept in about 300 hives.

At the altitude of Safa (about 850 m a.s.l.) winter and summer crops have opportunities to produce a good yield especially where improved production practices are applied.

Farm roads are in a very poor shape or non-existent and transport from the farms to the fields (and vice versa) is cumbersome.

4.2 PRESENT SITUATION

Tomatoes are drip irrigated and the yields of the local cultivar are very high. Cucumbers are grown under greenhouse conditions. Their yield is double the yield that can be obtained in open fields. The present cropping pattern is presented in Figure 4.1.

Annual winter crops cover small areas. Irrigated fruit trees and summer vegetables cover most of the presently cultivated land.

Apparently Safa agriculture is doing well. Major farmer complaints are on the badly maintained farm roads. No complaints have been noted about produce price and marketing.

There is full awareness of the need to establish farmer's associations that can help in increasing production and improving marketing conditions.

4.3 CROPPING SYSTEMS

Single cropping of summer vegetables is the rule. Crop rotation is practised among these summer vegetables. Small areas are used for onion and garlic cultivation in winter time in rotation with summer vegetables. Mainly cucumbers are produced in greenhouses in rotation with summer vegetables.

Figure 4.1: Present and suggested cropping patterns for the Safa Source Scheme.

4.4 PRODUCTION CONSTRAINTS

4.4.1 Biotic

Aphids and mites infest apples and peaches. Zuzera attacks apples. Olive is a host for pheasant's eye and olive flies (Mediterranean fruit fly ??). Tomatoes host aphids and mites while squash is attacked by leaf miners. Fungal pathogens as mildew and scab infect apples, monilia infects peaches, mildew and anthracnose attack tomatoes and cucumber. Cucumber also succumbs to a virus infection.

4.4.2 Land suitability

Land has been classified according to its suitability for irrigated crop production. The methodology adopted is developed in the Appendix on Land Suitability of the main report. Factors taken into account in this classification are climate, landscape and soils. The classified units are those that are also depicted on the Soil Class Map (capability for irrigation).

Land suitability is classified according to a calculated index. Actual land suitability is calculated in the without project conditions and is indicated by the Land Index (LI). Potential land suitability reflects the situation in the with project conditions, this situation is indicated by the Potentiality Index (PI). The land suitability classification distinguishes four classes as indicated in Table 4.1.

Table 4.1: Land suitability classification.

Class	Description	Index (LI or PI)
S1	Very suitable land, no physical factors limiting production, highly productive and high profits can be expected	100-65
S2	Moderately suitable land, some limiting factors, moderate high productivity , moderately high profits can be expected	64-35
S3	Marginally suitable land, limiting factors are important, moderately low productivity for most agricultural uses, profits cannot be expected in all years	34-20
N	Unsuitable but sometimes suitable after improvements are carried out, low productivity for most agricultural uses, no profits can be made under normal farming conditions	19-0

The major agro-climatological features and a selection of temperature adaptable crops are presented in Figure 4.2.

The Safa Scheme is on the fringe between two temperature zones. The limit is situated at about 850 m altitude. The upper, colder parts of the Scheme are particularly suited to cultivate deciduous fruit trees, whereas the most adaptable crops of the lower parts are olives, grapes.

Other climatically adaptable (but not necessarily environmentally suited and economically viable) crops are also indicated in Figure 4.2.

In Safa moisture deficit occurs from the first week of April to the first week of November. The temperature regime allows for the cultivation of vegetables in winter time only below 850 m elevation. Cold greenhouses are a necessity for winter cultivation of vegetables from the second half of December until end February, at least in the upper parts of the Scheme. Because of high rainfall and low temperature risks, summer vegetables can be prepared in nurseries in April for transplantation to the field only in May.

Strong wind damages apples in September before the harvest time. Peaches are sensitive to low temperatures at flowering time. The frequency of risky frosts is not high at the lower elevations of the Safa Scheme, but increase with altitude.

Without and with project land suitability classifications are shown in Table 4.2.

4.4.3 Economic aspects

The complaint about high cost of production is heard everywhere in Lebanon and Safa is no exemption, especially when one considers produce transport from the field with animal power in the absence of acceptable farm roads.

Less complaints are heard about selling prices even though farm prices are only one third of the retail price. Input costs are high and co-operation is thought off as a way to reduce production costs, and at the same time, increasing farm gate prices.

4.5 THREATS IN AGRICULTURE

In the Safa area agricultural activities are well-set and the threats to farming are not numerous. Urbanisation is modestly expanding on the account of farm land.

4.6 TRENDS IN AGRICULTURE

Greenhouse cropping and drip irrigation are on the front page of the intensification of the agri-system. They are the signs of willingness to improve agricultural production.

4.7 FUTURE PROSPECTS

The farmer builds high expectations on improved support services, agro-industry, credit, infrastructure rehabilitation and development and the establishment of a proper marketing system.

Agro-industry development and quality control organised by the public sector with an increase of cold storage capacity would help in alleviating major constraints to increase production.

4.8 PROPOSED CROPPING PATTERN

Suggested changes take into account principles of sustainable agriculture and rural development.

A discussion of existing agricultural support services and proposals to increase their impact on the agricultural sector are presented in the main report.

The proposed cropping pattern and its characteristics are presented in Figure 1b. Irrigation periods indicated in the suggested cropping pattern

Figure 4.2: Major agro-climatic featres of the Safa Scheme and crop adaptability.

Table 4.2: Actual and potential suitability classification for irrigated agriculture in the Safa Scheme.

الجمهورية اللبنانية
مكتب وزير الدولة لشؤون التنمية الإدارية
مركز مشاريع ودراسات القطاع العام

solely reflect the agronomists' viewpoint. According to water availability and socio-economic considerations (traditional water rights, etc...) irrigation priorities might change.

Being an efficient centre of production for apples and peaches, it is logical to concentrate activities on those crops. Safa is one of the centres of excellence in these fruits. Suggestions are based on the following premises:

- improvement of farm roads,
- establishment of farmer's associations,
- introduction of an agro-industry able to store and to transform the major local produce,
- crop diversification (almonds and grapes have excellent production and marketing potentials),
- improvement of the marketing system.

4.9 LAND USE PLANNING

Optimal land use after scheme rehabilitation is presented in Table 4.3. Land capability classes in Table 4.3 correspond to the mapping units of the 'Soil Class Map' of the Scheme.

The table suggests in the 'with project' condition, for each 'Capability Class', the best use(s) that can be made of the land, repeats the suitability class (see Table 4.2) of the best land use and indicates for each of the land capability classes of the Scheme the suggested priority ranking for rehabilitation.

4.10 SUMMARY AND CONCLUSIONS

The Safa agricultural system is typical for the mountain irrigated areas, with few crops. Crops are dominated by fruit trees, some summer vegetables are also grown. Yields are high and quality is good. Modern technologies as greenhouse agriculture and drip irrigation are accepted.

Poor farm roads and high production costs are set-backs to a potentially successful production system.

Irrigation rehabilitation should be accompanied by rehabilitation of rural road infrastructure, introduction of agro-industry and improvements on the marketing system.

Table 4.3: Optimal land use after irrigation rehabilitation in the Safa Scheme.

ANNEX II-1

REGION OF SAFA SOURCE

CHAPTER 5

IRRIGATION

5. IRRIGATION

5.1 INTRODUCTION

This scheme is located in Mohafazat Mount Lebanon. The Safa scheme lies in a climatic zone 1100 m above sea level, in the south-mount Lebanon region. This scheme irrigates areas in eight villages.The main sources of irrigation water are Nabaa es Safa , Ain et Tine and other springs as presented in the water resources annex. The gross area presently irrigated in 1085 hectares. With an additional gross area that potentially could be irrigated equal to 350 hectares, the total gross irrigable area is equal to 1435 hectares. The net irrigated area is equal to 868 hectares at present, and the net potential area is equal to 280 hectares, adding to a total net irrigable area equal to 1148 hectares.

5.2 PRESENT SITUATION

The main irrigation system used in this scheme is surface or gravity irrigation. In addition, some crops are irrigated by trickle irrigation systems. It is worth mentioning that the land of the irrigated land in the project is terraced and not properly leveled or graded, which renders the on farm -irrigation efficiency to be low and not adequate, and therefore the overall scheme irrigation efficiency is estimated to the less than 40%.

The field survey of the scheme area, showed that fruit crops grown under irrigation are apples, peaches, and olives. The area of these crops constitutes 82 % of the total irrigated area. The main field vegetable crops that are grown under irrigation are tomatoes, squash, cuccumber eggplant, garlic and onion, covering the remaining 18 % of the irrigated area. The farmers preference in case of extension of the irrigable area is to extend irrigation for already existing crops.

5.3 DATA

The basic climatic data that is used for the scheme evapotranspiration calculation is shown in Table 5 1 below.

Table 5.1 : Climatic data of Safa plain

Month	Av.Temp ^0C	Humidity RH%	Wind km/day	Sunshine hrs	Rainfall mm/mth
January	6.9	74	337	4.6	304
February	7.5	72	512	5.1	273
March	9.7	67	531	5.8	213
April	13.5	61	506	6.4	159
May	17.2	57	402	9.5	41
June	20.5	55	436	11.9	1.0
July	22.4	56	501	11.6	0.2
August	22.9	56	370	11.3	0.0
September	20.3	58	317	10.1	3.0
October	7.8	64	256	8.1	46
November	13.3	65	274	5.8	129
December	9.3	72	407	4.4	235
AV./ Total	**15.1**	**63**	**404**	**7.9**	**1404**

5.4 IRRIGATION WATER REQUIREMENTS

5.4.1 Potential Evapotranspiration

The potential evapotranspiration (ETo) , was calculated from the climatic data presented in Table 5.1, using the FAO-CROPWAT computer program. The effective rainfall was calculated using the United States Bureau of Reclamation method. The FAO-CROPWAT model utilizes the Penman - Monteith model. The results of the calculation are presented in Table 5.2 .

Table 5.2 : Potential evapotranspiration, total and effective rainfall as calculated by the FAO- CROPWAT:

Month	Eto mm/day	Total Rainfall mm/month	Effective Rainfall mm/month
January	1.5	304	155.4
February	1.9	273	152.3
March	2.7	213	140.4
April	3.8	159	118.6
May	5.0	41	38.3
June	6.2	1.0	1.0
July	6.7	0.2	0.2
August	6.1	0.0	0.0
September	4.8	3.0	3.0
October	3.2	46	42.6
November	2.3	129	102.4
December	1.7	235	146.6
Year Total	1401	1404.2	900.8

5.4.2 Crop Water Requirement

Based on the intensity and the actual cropping pattern, followed at present in the scheme area and the climatic data as presented in Table 5.1, the actual crop water requirement was calculated and presented in Table 5.3. Table 5 3 presents a bar chart for irrigation starting and ending dates of the crops, presently irrigated in the scheme area, and the daily crop water requirement per month for each crop. The seasonal actual water requirement and the required volume of water per hectare per season for the scheme was calculated .

Table 5.4 shows the results of calculations for the actual crop evapotranspiration, effective precipitation, and net seasonal water requirement in mm/hectare per season and cubic meter per hectare per season, for each crop planted in the project area. It also presents the starting and ending irrigation date, as well as the percentage area grown for each crop in the scheme.

Table 5.3 : Irrigation starting and ending dates bar chart and daily crop water requirement (mm/day) for each crop grown in the scheme area.

Crops	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Vegetables												
Tomato						4.2	5.5	6.4	5.1	1.4		
Cucomber						4.8	7.0	6.4				
Squash						4.8	7.0	6.4				
Eggplant						3.6	5.9	6.3	4.4			
garlic				0.2	3.3							
Onion				0.2	3.3							
Fruits												
Apples						5.0	6.5	5.7				
Peaches						3.9	6.5	5.7				
Olives						3.8	5.1	4.7				

Table 5.4 : Cropping pattern and actual net irrigation requirement for the crops in the scheme area .

Actual water requirement							
Crops	**%**	**Irr.startDate**	**Irr. end Date**	**ETc mm**	**Pe mm**	**NIR mm**	**NIR m^3/ha**
Vegetables							
Tomato	7	June 1	Nov 1	736.6	52.9	684	6840
Cucumber	5	June 1	Sep 1	548.8	3.7	545	5450
Squash	2	June 1	Sep 1	548.8	3.7	545	5450
Eggplant	2	June 1	Oct 1	612.3	8.4	604	6040
Garlic	1	Apr 1	June 1	227.2	155.8	71	710
Onion	1	Apr 1	June 1	227.2	155.8	71	710
Sub Total	18						
Fruits							
Apples	48	June 1	Sep 1	517.8	3.7	514	5140
Peaches	24	June 1	Sep 1	480.7	3.7	477	4770
Olives	10	June 1	Sep 1	412.1	3.7	408	4080
Sub Total	82						
Total	**100**						**5010**

The net water requirement per hectare for the present cropping pattern and cropping intensity is 5,010 m^3 and the gross water requirement per hectare assuming an overall scheme irrigation efficiency of 40 %, is 12,525 m^3. The data on net and gross irrigation requirement per hectare

is presented in Table 5.5. Table 5.5 also presents the net flow required in liters per second per hectare for the present actual cropping pattern for each month of the year and the gross flow at the estimated efficiency of the whole scheme which is equivalent to 40%. The maximum net flow did occur during the month of July, and is equal to 0.72 l/s while the gross required flow is equal to 1.8 l/s .

Table 5.5 : Net and Gross Irrigation requirement per hectare :

	Unit	Jan	Feb.	Mar	Apr	May	June	July	Aug.	Sep	Oct	Nov.	Dec.
NIR[1]	mm/m	0.0	0.0	0.0	0.0	2	132	183	168	13	3.0	0.0	0.0
NWR[2]	m^3/ha	0.0	0.0	0.0	0.0	20	1320	1830	1680	130	30	0.0	0.0
IRarea[3]	%	0.0	0.0	0.0	0.7	2.0	98	98	98	9.0	4.7	0.0	0.0
Nflow[4]	l/s	0.0	0.0	0.0	0.0	0.38	0.52	0.72	0.66	0.57	0.24	0.0	0.0
Grflow[5]	l/s	0.0	0.0	0.0	0.0	0.95	1.3	1.8	1.65	1.43	0.6	0.0	0.0
Gwr[6]	m^3/ha	0.0	0.0	0.0	0.0	50	3300	4575	4200	325	75	0.0	0.0
Eff	%	40	40	40	40	40	40	40	40	40	40	40	40

[1] NIR: Net irrigation requirement in mm per month
[2] NWR: Volume of water required per month per hectare
[3] IR. area: Area irrigated in %
[4] N.flow: Net flow required per hectare on continuos basis
[5] Gr. flow: Gross flow per hectare per month on continuos basis
[6] Gwr: Gross water required per hectare per month on continuos basis

At present, the available water flow in the scheme area is detailed under water resources section in the same Annex. As mentioned before, the total available flow is high at the beginning of the growing season and decreases when the peak water requirement is reached, i.e. during the months of July and August. The available flow and the area that can be adequately irrigated each month are presented in Table 5.6. The area that can be irrigated each month was calculated by dividing the available flow each month by the gross flow required each month . The net required flow was calculated using the FAO-CROPWAT Software, and the required gross flow is calculated by dividing the net flow by the Scheme irrigation efficiency. Three efficiencies were used: 40%, 50%, and 60%, in order to estimate the maximum acreage the available can irrigate, and to compare the results with the presently irrigated area in order to determine if the scheme can be extended or not.

Table 5.6 : Available flow (l/sec), net and required flow at different efficiencies, and area that can be irrigated each month under this scheme.

	Unit	Jan	Feb.	Mar	Apr	May	June	July	Aug.	Sep	Oct	Nov.	Dec.
Av.Flow	l/sec	-	-	-	-	-	1013	762	650	-	-	-	-
N.flo/ha	l/sec	0.0	0.0	0.0	0.0	0.38	0.52	0.72	0.66	0.57	0.24	0.0	0.0
G.flo/ha[1]	l/sec	0.0	0.0	0.0	0.0	0.95	1.3	1.8	1.65	1.43	0.6	0.0	0.0
Area	ha						779	434	394				
G.Flo/ha[3]	l/sec	0.0	0.0	0.0	0.0	0.76	1.04	1.44	1.32	1.14	0.48	0.0	0.0
Area	ha						974	529	492				
G.flo/ha[2]	l/sec	0.0	0.0	0.0	0.0	0.63	0.87	1.2	1.1	0.95	0.4	0.0	0.0
Area	ha						1164	635	591				

[1] The overall irrigation efficiency is assumed to be equal to 40%.
[2] The overall irrigation efficiency is assumed to be equal to 50%.
[3] The overall irrigation efficiency is assumed to be equal to 60%.

Table 5.6 shows clearly that the irrigated area under the scheme present water management and on-farm irrigation management is 394 hectares for the month of August. If the scheme irrigation efficiency is improved to reach 60%, the area that can be irrigated by the available flow during the month of August will be increased to 591 hectares, an increase of 50% in the irrigated area. Therefore, On-farm water management is necessary in order to improve the irrigation efficiency of the scheme. On the other hand, the cropping pattern of the scheme needs to be changed in order to include crops that can planted early in the season, around March-April and harvested in June-July in order to make better use of the available water during this period. One such cropping pattern and the water utilization is presented in Table 5.7 below. Table 5.7 shows the area percentage of the suggested crops to be grown under this scheme and the net available flow necessary in liters per second per hectare per month as a function of the cropping intensity and dates of planting and harvest.

Table 5.7 : Suggested cropping pattern, percentage area, and water needs and flow required each month of the growing season.

Crops	Area %	Jan	Feb	Mar	Apr	May	June	Jul.	Aug.	Sep	Oct	Nov.	Dec.
Vegetables													
Tomato	7					2.2	5.0	7.1	6.6	4.0			
Cucumber	4					2.6	6.0	7.3	6.4				
Squash	2						4.7	6.5	6.6	4.9			
Eggplant	2					1.4	4.0	6.6	6.3	3.8			
Garlic	2				0.2	3.3							
Onion	2				0.2	3.3							
Fruits													
Apples	46					2.7	5.1	6.5	6.0	4.1			
Peach	23					1.7	4.1	6.3	6.0	4.1			
Olives	12						3.8	5.1	4.7				
WATER REQUIREMENT AND PERCENT AREA IRRIGATED													
	unit	Jan	Feb	Mar	Apr	May	June	July	Aug.	Sep	Oct	Nov.	Dec.
NWR	m^3/ha	0.0	0.0	0.0	0.0	610	1350	1830	1700	980	0.0	0.0	0.0
IR AREA	%	0.0	0.0	0.0	1.3	86	96	96	96	80	0.0	0.0	0.0
N. FLOW	l/s	0.0	0.0	0.0	0.06	0.28	0.54	0.73	0.68	0.47	0.0	0.0	0.0
GR.FLOW[1]	l/s	0.0	0.0	0.0	0.0	0.47	0.9	1.22	1.13	0.78	0.0	0.0	0.0
GWR[1]	m^3/ha	0.0	0.0	0.0	0.0	1017	2250	3050	2833	1633	0.0	0.0	0.0

[1] The efficiency is assumed to be equal to 60%.

The area that can be irrigated in the month of August will be 575 hectares, an increase of 46% over the presently applied cropping pattern. This leads to the conclusion that it is not necessary to extend this scheme to irrigate new land, because there will not be enough water to irrigate and/or continue irrigation any crop that is planted in June or before, unless we cut irrigation on the fruit trees which will be in bad need for water, and any induced water stress will affect their quantity and quality of the fruits. It is worth mentioning that an efficiency of 60% on the scheme level means a high conveyance and distribution efficiency in the scheme network and adequate and moderate efficiency on the field level i.e. farmers should smoothen the surfaces of their land in order to have a uniform slope, and construct better water distribution network in their farms.

The area irrigated by some individual springs is presented in Table 5.8 below. Also Table 5.8 shows the area that can be actually irrigated with 40 % efficiency and the potential area that will be irrigated under the suggested future cropping pattern with a 60 % overall irrigation efficiency.

Table 5.8 : Minimum water available for irrigation by spring in each scheme the flow requirement for the present cropping pattern during this period, and the area presently irrigated by the spring.

			Present Cropping		Future Cropping		
Water Sources	**Q_{in} l/s**	**Ac.area [A] ha**	**Req. flow l/s**	**pr. area ha**	**Q_{req} l/s**	**ps. area [B] ha**	**Remarks**
Naaba el Safa	432	900 (720)	1.65	(262)	1.13	(382)	No extension
Ain El Khasfe	29	20 (16)	1.65	(18)	1.13	(26)	No extension
Nabaa Zouaiya	38	85 (68)	1.65	(23)	1.13	(34)	No extension
Ain ez Zaitoun, El Haoura & ain etTine	151	80 (64)	1.65	(92)	1.13	(134)	Extension
Total	650[C]	1085 (868)	1.65	(395)	1.13	(576)	

[A] Area in () is the net irrigated area and it is approximately 80 % of the gross area
[B] The potential area that could be irrigated
[C] This is the available measured flow.

5.5 REHABILITATION WORKS

5.5.1 Introduction

The existing scheme of Safa Source is being irrigated from several sources. The general state of the infrastructure is not too bad, although large sections of the existing concrete canals are in need of rehabilitation. Within the scheme, there are no reservoirs in existence, that need rehabilitation.

In the previous section on irrigation water-requirements, it was concluded that this scheme did not have enough water resources to make any extensions, when considering the scheme as one unit. In Table 5.8, it was indicated that a group of springs, Ain en Zaitoun, El Haoura & Ain et Tine, have enough water to consider an extension of the area presently deveoped. Unfortunately no extension is possible when irrigation is limited to gravity supply. Only with pumping water to a higher elevation is extension possible. This option was not considered.

Appendix A, Table A-1 presents a listing of the general state of the present conveyance system, subdivided over the different sources. Drawings II 1-301/302 present the existing lay-out, with Drawings II-1-401/402 giving the proposed lay-out.

The proposed lay-out for rehabilitation is based on the conservative option, i.e. the rehabilitation of existing canals and replacement of earthen channels by concrete channels.

5.5.2 Areas for Rehabilitation

The following table presents the gross and net areas available for irrigation:

Table 5.9: Areas identified for irrigation

Area	Gross Area Developed ha	Net Area Developed ha	Rehabilitated Net Area ha
Nabaa El Safa	900	720	382
Ain El Kkhasfe	20	16	16
Nabaa Zouaiya	85	68	34
Ain ez Zaitoun, El Haoura & Ain etTine	80	64	64
Present Developed Areas	1085	868	-
Potential Areas for Development	228	182	-
Proposed Rehabilitated Area	**620**	**496**	**496**

From the above table it can be seen that of the present developed area of 1085 ha, an area of 496 ha net (620 ha gross) is proposed for rehabilitation.

5.6 COST OF REHABILITATION WORKS

5.6.1 Headworks

Of the different sources for this scheme, one is in need of rehabilitation of its headworks, at a total cost of US$ 600. Table 2b of Appendix A is giving some details.

5.6.2 Storage Reservoirs

Night Storage Reservoirs

For a more efrficient use of the available water, the Consultants propose to construct night-storage reservoirs on 3 springs, at a total cost of US$ 417,780, as detailed in Table 2b of Appendix A.

Hill Lake

In the Chapter on Water Resources, it was mentioned that an appropriate site for an Hill-Lake is existing. This reservoir, with a net capacity of 67,000 m^3 can irrigate an area of 6.2 ha., using part of the existing infrastructure commanded by Nabaa el Qaah. Construction of the Hill Lake amounts to US$ 1,248,000 .

5.6.3 Conveyance System

The total length of the conveyance system is 71,255 meters. Table 5.1 gives a breakdown of the total length divided over earthen channels, concrete canals and pipes.

Table 5.10: Present Conveyance System

Type of Conveyance	Length [mtr]
Earthen Channels	52,450
Concrete Canals	8,785
Pipes	10,020
Total Length	**71,255**

Of the total length, 29% is in need of rehabilitation, or 20,919.m. Appendix A, Table A-1 gives details of the proposed rehabilitation, at a total cost of US$ 583,227.

5.6.4 Canal Structures

Diversion Structures

The Safa Source irrigation scheme is characterised by its lack of control structures. In accordance with the rehabilitation methodology adopted, the Consultants have introduced diversion structures for this scheme at each junction in a (rehabilitated) canal. In total 32 Distributory Turnouts have been included in the rehabilitation works, at a cost of US$ 1,344.

Field Turnouts

In order to make water distribution more efficient and to avoid demolishing of canals by farmers who want to facilitate their irrigation, Field Turnouts have been included in the rehabilitation design. In total 124 FTO's have been included in the design, at a cost of US$ 744

5.6.5 Conventional Rehabilitation

The total cost of rehabilitation for the Safa Source irrigation scheme equals US$ 1,003,695 or US$ 4,431,965 per ha. Table 5.11 summarises the expenditures:

Table 5.11: Summary of Cost of Conventional Rehabilitation

Description	Cost in US$	Forex Component
Canal (Re)construction	583,227	16,525
Head Works	600	84
Night Storage Reservoirs	417,780	58,489
Distributory Turnouts	1,344	215
Field Turnouts	744	74
Total Cost of Rehabilitation	**1,003,695**	**75,387**
Cost of Rehabilitation per ha	**2,024**	

Hill Lake

The proposed Hill Lake can irrigate an area of 6.2 ha. Taken as a rehabilitation project isolated from the rest, this means an additional investment of US$ 1,248,000 or US$ 201,290 per ha for the additional 6.2 ha which can be irrigated. This investment comes on top of the -average- investment of US$ 4,540 per hectare for the rehabilitation of the existing infrastructure, thus totalling US$ 203,314 per hectare.

5.6.6 Cost of Alternative Rehabilitation

In Appendix A, Tables A3 and A4, the alternative rehabilitation is presented, using gravity flow pipes.

A summary of the rehabilitation cost using pipes is presented in Table 5.12:

Table 5.12: Summary of Cost of Alternative Rehabilitation

Description	Cost in US$	Forex Component
Pipe-laying (including existing reservoirs)	3,866,885	657,370
Head Works	600	84
Night Storage Reservoirs	417,780	58,489
Total Cost of Rehabilitation	**4,285,265**	**715,943**
Cost of Alternative Rehabilitation per ha	**8,640**	

The cost of rehabilitation using gravity flow pipes results in a investment of US$ 4,285,265 or US$ 8,640 per ha.

Hill Lake

The proposed Hill Lake can irrigate an area of 6.2 ha. Taken as a rehabilitation project isolated from the rest, this means an additional investment of US$ 1,248,000 or US$ 201,290 per ha for the additional 6.2 ha which can be irrigated. This investment comes on top of the -average- investment of US$ 8,640 per hectare for the rehabilitation of the existing infrastructure, thus totalling US$ 209,930 per hectare.

5.6.7 Full Rehabilitation

As an alternative to the rehabilitation proposed in the previous section the complete rehabilitation of the scheme could be considered. As a compete rehabilitation will not increase the benefits, but only increase the costs of rehabilitation, this solution will have a negative effect on the B/C ration and on the Rates of Return.

5.6.7.1 Full Conventional Rehabilitation

The total cost of full rehabilitation for the Qartaba irrigation scheme equals US$ 1,127,442 or US$ 2,273 per ha. Table 5.13 summarises the expenditures. Appendix A, Tables A5 and A6 give details of this rehabilitation.

Table 5.13: Summary of Cost of Full Conventional Rehabilitation.

Description	Cost in US$	Forex Component
Canal (Re)construction	706,290	18,986
Rehabilitation of existing Reservoirs	0	0
Head Works	600	84
Night Storage Reservoirs	417,780	58,489
Distributory Turnouts	1,470	235
Field Turnouts	1,302	130
Total Cost of Full Rehabilitation	**1,127,442**	**77,925**
Cost of Full Rehabilitation per ha	**2,273**	

5.6.7.2 Cost of Full Alternative Rehabilitation

In Appendix A, Tables A7 and A8, the alternative rehabilitation is presented, using gravity flow pipes.

A summary of the rehabilitation cost using pipes is presented in Table 5.14:

Table 5.14: Summary of Cost of Full Alternative Rehabilitation

Description	Cost in US$	Forex Component
Pipe-laying	4,961,175	843,400
Rehabilitation of existing Reservoirs	0	0
Head Works	600	84
Night Storage Reservoirs	417,780	58,489
Total Cost of Full AlternativeRehab.	**5,379,555**	**901,973**
Cost of Full Alternative Rehab. per ha	**10,846**	

The cost of full rehabilitation using gravity flow pipes results in a investment of US$ 5,379,555 or US$ 10,846 per ha.

Hill Lake

The proposed Hill Lake will raise the average investment to US$ 203,563 per ha and US$ 212,136 per ha for the full conventional rehabilitation and full alternative rehabilitation respectively, considering the 6.2 ha this lake can irrigate.

The effects of the different options of rehabilitation of this scheme on the Rate of Return are discussed in the Appendix on Irrigation of the Main Report. For reasons of comparison, all schemes that are part of this study were analysed financially and economically, using the conventional rehabilitation as described above. For this scheme the analysis is done in the next chapter.

ANNEX II-1

APPENDIX A

IRRIGATION

ANNEX II-1

REGION OF SAFA SOURCE

CHAPTER 6

FINANCIAL AND ECONOMIC ASPECTS

6. FINANCIAL AND ECONOMIC ASPECTS

6.1 INTRODUCTION

6.1.1 General

The purpose of this report is to determine the economic feasibility of rehabilitation and modernisation of irrigation and cropping in region of Safa Source. This region is located in the Mahafazat of Mount Lebanon, south east of Beirut. The financial and economic analysis of the rehabilitation project in the region of Safa Source provides conclusive evidence on the advantage the project would have for the farming community, and on the macro-economic benefits for the country as a whole. Moreover, the section contains the elements needed for an appraisal of the project by the World Bank, which envisages giving a loan to the Government of Lebanon for the rehabilitation of small irrigation schemes

The Government of Lebanon has appointed a team of experts of from Jouzy & Partners CEB and HASKONING, Royal Dutch Consulting Engineers and Architects to investigate the cost and advantages of rehabilitation 28 small and medium irrigation schemes in all four Mouhafazat (Departments) of the country. The present feasibility study is the product of these investigations, which entailed agricultural, socio-economic, technical and soil surveys in all the schemes.

The economic feasibility study applies the theory of the cost-benefit analysis, and applies it to the different schemes. This requires first a description of rehabilitation activities and results (see Section 6.2) and followed by a critical evaluation of construction and recurrent costs, which form the subject of Section 6.3. The estimation of possible benefits requires the determination of actual and future crop and farm budgets as well as incremental economic returns that can be achieved (see section 6.4). The market and economic prices for produce and inputs are an important key element in defining economic returns, and Section 6.4 also addresses them.

The calculation of the financial internal rate of return and the net present value of net benefit stream figure prominently in Section 6.5. The section also looks in the financing aspect of the scheme, by defining how much should be borrowed and how much would come from the state budget. In the financial evaluation also attention is given to the servicing of the loans that are needed to finance the rehabilitation works. The financial analysis also comprises sensitivity tests whereby project costs and benefits are varied. Moreover, the sensitivity analysis reviewed what impact would have the inclusion of depreciated investment cost in the waterfees farmers

pay. Finally, the analysis considered a delay in the maturing of project benefits with either one or two years.

Besides an evaluation of the rehabilitation works against market prices, the study has also appraised the viability of rehabilitation in economic terms (see Section 6.6). In a sensitivity analysis of the economic results, it is tested what impact variations in costs, benefits and maturing of benefits have on the rate of return. In Section 6.7 the report reviews the possible risks project implementation faces. The benefits of the scheme on employment and foreign currency generation concern the topic of Section 6.7. Section 6.8 addresses the potentil indirect benefits of the rehabilitation. Finally, Section 6.9 summarises the project results and the economic indicators.

6.1.2 Socio-Economy of the Scheme

The Safa Source scheme lays in the Mohafazat of Mount Lebanon, caza El Chouf, at an altitude between 975 and 775 m. The socio-economic survey indicated a population of 48,350, a total number of households of 3,710. Farm holdings number 1,139, which cultivate 1,148 ha of agricultural land. Hence, the average holding size is 1.01 ha. The major agricultural activities are irrigated agriculture, covering 868 ha (average per holding 0.76 ha), mainly fruit trees, tomato, garlic, onion and other field vegetables. Rainfed cultivation (fruit trees) accounts for 280 ha (average per holding 0.24 ha). The large distance (50 km) of the scheme to Beirut is an important constraint, because the capital is the main market for produce and the place where inputs are acquired.

Irrigation in the scheme receives its water from a group of three sources, called Es Safa Springs. These springs are Nabaa Es Safa, Nabaa Er Rouyane and Nabaa El Qaa. Discharge estimates indicate a daily discharge of 52,300 m^3/day. Faourara village, which also lays in the scheme does not possess water right from Es Safa Springs, and receives its water from other sources, one of which is connected to Nahr El Barouk. Discharge and rainfall analysis estimate the dry period yield of the Faourara springs at 18,800 m^3/day in August, when the yield is lowest.

Moreover, there is a hill lake in the region with an estimated annual volume of 67,000 m^3. However, this lake does not have any function in the irrigation at this moment, and will not be considered either. The lack of accurate details on water inflows and the seize of the hill lake makes an evaluation of the benefits very unreliable.

Farmers own almost 92% of the land they cultivate. The socio-economic survey also found rental of land (8%), and hardly any sharing of land.

According to the socio-economic survey, 45% of the population of the region works in agriculture, meaning that agriculture is not the main income source. In the scheme wage employment accounts for a large part (54%) of the work. Women and child participation in agriculture is confined to planting, weeding, spraying and irrigation. An important number of foreign workers are employed in agriculture (84% of the total). This is reflected in the daily wage rate for hired labour, being LL 20,000, which is somewhat lower than the average in the region.

When looking at the social infrastructure in the region, it is noted that there are five private, eight public and two open schools in the area covered by the scheme. There are also two technical schools. Moreover, there are three dispensaries.

6.1.3 Institutional Arrangements

In part of the scheme the local authority of Barouk distributes water. This is also the case in Deir El Qamar, Oudi Es Sitt and El Faouara. In Maaser Beit Ed Dine farmers organise their own water distribution.

Each farmer pays LL 17,000 per hour per season for water charges. This is converted to annual water charges per ha, knowing that in August 868 ha is irrigated. Furthermore, there are 2,940 irrigation hours in the month (14 hours per day). This gives an average water fee per ha of LL 57,850 in the months of August, or LL 175,000 for the whole season (July to August).

Agricultural extension is virtually non-existent in Lebanon, although the World Bank will finance extension services under the rehabilitation and modernisation project for the agricultural sector. A this stage it means that farmers have to rely on advice given to them by merchants of inputs, notably those providing them with fertilisers and chemicals. It seems not unrealistic to state that the advice given by these merchants is not always in the best interest of the farmers. The quantities of fertiliser and chemicals used by the farmers are high.

The same merchants that provide the farmers with fertilisers and chemicals, also give credit to farmers. Only purchases of fertilisers and chemicals benefit from this credit, for all other inputs there are no agricultural credit facilities, although the World Bank will create such facilities under the rehabilitation and modernisation project of the irrigation sector. The interest rates charged by input suppliers is around 25%, which looks reasonable, when compared with commercial bank rates, which are around 40% per annum.

6.2 REHABILITATION

6.2.1 Water Resources

There is little un-exploited water available in the scheme. However, the scheme needs to be rehabilitated, which will lead to higher distribution efficiencies. The present irrigation efficiency is low due to poor land levelling, hence one has to considered a small reduction in the irrigated area, next to improving water supply.

There is one hill lake in this scheme, but its water does not arrive in the irrigation system. This potential source of mobilised water could be tapped. However, as explained before, the present study omits this possibility for lack of details.

6.2.2 Agriculture

Having no extra water for irrigation, means that agricultural development has to find means of optimising cropping with the given volume of water. This could mean, either the introduction of water conserving techniques (i.e. drip irrigation) on the same area, or taking areas out of irrigated production by converting them to rainfed cultivation. To be expected are certainly also distribution efficiency improvements as result of rehabilitation works. Nevertheless, it is recognised that the project does not look into so called under-irrigation techniques, which practice less than optimal water supply to crops, but in such a way that damage is limited.

There are certain economic limitation to what is considered possible under the present conditions. Farming in most of the schemes (with the exception of some large farmers in the Central Beak and the Southern Mohafazat) is a part time business for the majority of their inhabitants. This means, in fact, that the farmers have other objectives in mind. Whereas, full time farmers have to concentrate on acquiring the total family needs from their farming activities, this is much less the case when other income sources also exist. In practice, it means that full time farmers try to spread their risks, and they have, as a consequence, a long term scope (i.e. tree crops). Part time farmers, on the contrary, are probably much more inclined to rent land, and try to obtain "quick" results. They will engage in more risky activities, keep their options open and probably grow vegetables, ornamentals and annual crops.

Most orchards are over 20 years old, indicating that an incentive for renovation of the plantations hardly existed in the recent past. Renovation requires a heavy initial investment which only starts to pay off after at least 5 years. Full returns are only attained after about 10 years. Possible

incentives to regenerate orchards are a good medium-term financial return and confidence in the medium-term recovery of the entire agricultural sector in Lebanon. These incentives hardly exist at present.

The field survey indicates that if more irrigation water becomes available, farmer's preference for use of the additional production capacity, is spread over an extension of the orchard area and an increase of short term crop area (i.e. vegetables, ornamentals). Comparison of the available water and consumptive use indicates that in many schemes the irrigated area is due to shrink or, in the best cases, to remain constant. Potential for area extension is exceptional.

Vegetable production requires lower initial investments than the establishment of a new orchards. Revenues from vegetable cultivation are generated within a very short time span. Therefore, with assured availability of irrigation water in the with project conditions, farmers might convert part of their present orchard area into vegetable plots, rather than invest massively in planting new orchards. At the other side, farmers willing to keep their orchards will try to spread investment costs for renewal by gradually replacing less productive or dead trees.

It is assumed that with improved water management:

- Yields of existing orchards will increase by about 20 % annually during the first five years after rehabilitation; increasing returns from orchards are an incentive for the farmer to invest in orchard renewal,

- Orchard renewal will start not earlier than 5 years after rehabilitation, when old orchards attain a new improved production ceiling and annual financial revenues reach the maximum,

- Continuing gradual replacement of less productive trees will ensure the farmer a steady income after year 5.

Taking into account the above scenario, it is envisaged that hardly any orchard replanting will take place, and that almost all farmers will engage in upgrading existing orchards. This scenario is also supported by the present economic situation in the financial markets, which results from the enormous public debt (see in the main report the macro-economic section). As result of this debt, interest rates are very high (reaching 40% for commercial operations), which is a major constraint to making investments in agriculture and certainly has a drawback on the development of new orchards.

The irrigated area in the region of Safa Source will change considerably as result of modernisation and rehabilitation works. Today the cultivated

irrigated area accounts for 398 ha, this is likely to reduce to 594 ha (+49%). The present cropping intensity of 100% will decrease as part of the area reverts to rainfed cultivation. This results in a decrease to 57%.

6.2.3 Rehabilitation works

Rehabilitation work cover in principle the entire irrigated area, although it may happen that part of the non- irrigated area may receive water after rehabilitation, simply because there is more efficient use of water to increase the area under full irrigation criteria. When this happen rehabilitation of the secondary and tertiary system covers the area under rehabilitated irrigation. However, always the entire existing main canal will be rehabilitated. This allows for some sort of water supply to lands outside the rehabilitated areas to receive water in June and July when there is generally a surplus.

For the economic analysis this has some important implications, notably on the irrigated area taken into consideration, when making the analysis. The comparison made in the economic analysis only takes into consideration areas covered by the scheme and its water sources. While it is more than likely that the "developed area[1]" exceeds what the scheme could properly irrigate (e.g. provide with the required volume of water), the analysis, nevertheless, consider only the scheme could supply of water.

So it becomes essential that the economic analysis starts with the area the scheme could provide with water after rehabilitation. The existing cropping patterns is applied to this area. In the present, without project situation, less land can be irrigated. The cropping pattern of this land reflects what is found today in the schemes. However, one expects that the difference between irrigated area before and after rehabilitation, would be under rainfed crops today. In general, this rainfed areas consist of orchards and cereals or grain legumes.

There are also some implications for the farm income. The followed analytical method, although correct in the economic sense, in fact only accounts for the additional farm income over the area supplied of water by the scheme. Dividing the additional income over all the farmers in the "developed area", calculate only an average incremental income per holding, considering that some farmers fall outside the area irrigated , but still inside the "developed area".

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1 This considered to be the area covered by the scheme's irrigation infrastructure. This could very well exceed what can be irrigated under average conditions, as over the years farmers tend to expand the infrastructure in years with much water

The general state of the irrigation infrastructure in the Safa Source scheme is bad, with large sections of the existing canal network in need of rehabilitation. Of the sources in use one needs rehabilitation of the headworks, in order to achieve a higher degree of efficiency. Moreover, three of the sources lack a storage reservoir, and the rehabilitation works envisage the construction of night storage.

Rehabilitation works thus consists of canal reconstruction (over 20,919 m), construction of distributory turnouts (35 in number), and field turnouts (217 in number). Construction works also comprises rehabilitation of headworks (one spring) and night storage in three locations.

Detailed design of the rehabilitation works will take at least one year, while implementation should not require more than one year as well. This means that from year three onwards the scheme will be technically rehabilitated and in operation.

6.2.4 Support Services

The rehabilitation sequence would include, as a necessary step, the involvement of agricultural support services. At this moment most farmers are unaware of recommended fertiliser and pesticides doses and as a consequence they rely completely on the advice given to them by traders. Genuine and unbiased recommendations are a necessity to develop a sustainable (economic and environmental) agricultural sector. This requires first of all an agricultural research infrastructure, and secondly an independent extension service to disseminate research results to farmers.

The World Bank's Irrigation Rehabilitation and Modernisation Project includes most of the required support services for research, extension, credit, etc. However, this project concerns the Yammouneh, Quasmieh-Ras El Aïn, Danniye, Akkar El Bared and South Bekka schemes, as well as only 10,000 ha (out of 27,000 ha) of the small and medium irrigation schemes under review.

In economic terms this scenario implies that all agricultural support service costs can be considered "sunk" cost, as they are part of an overall project already implemented at the time rehabilitation work on the scheme in Safa Source starts. However, what should be considered though, are specific requirements for the scheme, notably salary and recurrent cost for extension agents, and possibly office accommodation in the scheme.

In detail, rehabilitation and modernisation of the scheme demands the recruitment and training of supervisors (needed input of 0.6 man-year), and extension agents (needed input 1.8 man-year), to cover all irrigated land (after rehabilitation) of the scheme. As the scheme is remote, it would be

convenient to recruit the same supervisors and agents for more schemes in the area, i.e. also for Barouk and the scheme of Jahliya and surrounding area. The supervisor could be located in Barouk, which is centrally located.

6.2.5 Cost Recovery

The project envisages that farmers will contribute towards the cost of rehabilitation and operation of the schemes. Cost recovery has to come from the water charges farmers pay. The present practice with water charges is different in every scheme and sometimes it is not uniform within a scheme. The actual practices are no at all transparent and should be discontinued. Consequently, it is proposed here to levy a water charge consisting of the depreciated investment cost and the operation and maintenance cost related to water distribution.

The institutional arrangements to operate this system require the creation of irrigation committees at the level of each scheme, if they do not exist already. These committees will be made responsible for operation and maintenance of the scheme, and they will also recruit one shawi per 5 km canal to co-ordinate water allocation to the farmers. Each committee should have its own operational account with the nearest bank, from which all expenses are paid. However, it is recommended that the farmers elect the committees, and that the Government monitors the functioning of the committees. Every year, during the committee's general meeting farmers endorse the budget, approve any increases in water charges and approve the accounts of the committee. Any deficit incurred by the committee should be met by the farmers.

There could be some argument to make farmers pay as well for the agricultural services provided. The recommendation voiced here, is to pay the cost of the extension service from the national budget. Farmers subsequently have to pay income or land taxes, in order to cover part or the totality of expenses made by the Government to support agricultural production.

6.2.6 Expected Benefits

Farmers will benefit from rehabilitation and modernisation works. Farming income will increase as result of more rational production and better water distribution, despite the fact that the project opts to remove poorly irrigated land from the irrigation scheme. The actual 398 ha irrigated will be affected by the rehabilitation, only 594 ha remains as irrigated cultivation. The remainder needs to be treated as rainfed cultivation.

Better water distribution, coupled to the better yields on the irrigated land, will result in, an increase in farming income (over the total project period), even with the reduction of irrigated cropping. The incremental farming income counts LL 104,585,000 (US$ 67,042) for the average farm (0.52 ha irrigated land after rehabilitation), as against cost of LL 1,581,000 (US$ 1,013) per farm.

6.2.7 Boundary Conditions

The success of rehabilitation and modernisation depends on a number of conditions. First, progress made in implementing detailed design and construction works defines on the whole the success of the project. Delay in implementing construction works after detailed designs are ready, has a negative effect on project benefits. Consequently, every effort should be made to execute and implement the programme in time.

Secondly, existence and functioning of agricultural support services are a key element to the achievement of potential production levels. Creating an extension service from scratch, as is needed in Lebanon is no sinecure, and demands a strong support from the Government. Every effort has to be made to get a functioning extension service in the scheme at the time construction works terminate.

Thirdly, markets for produce could form a constraint, as is the price farmers would receive. At this stage one expects that the sheer side of the schemes and the expected extra production will not lead to any effect on prices, but it could be needed that extra cool stores are needed to preserve the produce. The analysis of the project gives an indication of the likely extra production that becomes available, but no analysis is made of cool store requirements.

Finally, processing is not considered in the feasibility study, but it could prove limiting and thus have a price depressing effect. The present feasibility study does not look into the needs for agro-processing units or cool storage.

6.3 PROJECT COST

6.3.1 Investment Cost

Estimates for rehabilitation works cover in great detail the activities to be done and have been based on a survey of quantities. Engineers have calculated unit prices for each type of work, i.e. rehabilitation of headworks, canals, turnouts, etc. Unit prices are given in constant 1996 US$. Based on the unit rates and the quantity surveys, costs of

rehabilitation are then calculated. The sum of all construction costs for rehabilitation yields the base cost of rehabilitation.

All rates contain a contingency value of 10%, except field turnouts where a 5% contingency rate applies. Except for labour, all cost items carry a foreign exchange component, which vary for each cost item. Concrete pipes and fittings have a foreign component of 25%, locally fabricated steel parts contain 30% foreign components, and gates possess 75% foreign components.

Studies, design and supervision are estimated as 15% of the base cost. This seems a reasonable estimate, which takes into consideration the fact that most schemes are small and have generally more than one source of water supply. No differentiation was made to take into account that not all schemes are the same, some may be larger or have only one source of water supply.

Cost of extension service consists of salaries and recurrent cost for extension agents and supervisors. Salary costs are based on current levels paid to field workers in the administration, plus an extra for overtime. Recurrent costs cover the cost of operating and maintenance of a motorcycle for the agents. The supervisor receives a car to do his work, while office accommodation (50 m^2) is considered as well.

Currency exchange rate used in the calculations is estimated at LL 1,560 for 1 US$. Considering that there are no restrictions on the trade of goods and services, the Lebanese pound is freely convertible, and that domestic markets are generally free from price distortions, no conversion factor applies to the investment streams. This means that economic prices equal market rates.

There could be ample argument to let farmers pay for the cost of rehabilitation works. This means that irrigation charges consist of a fixed rate to cover depreciation of rehabilitation works, and in addition also contain a variable tariff, which takes into account the recurrent cost of the system. The depreciated value (over 25 years) of the investment costs is calculated at LL 77,664 per ha per year (US$ 50). There could be a point of discussion here, as one can argue rightly that the authorities should provide the base for further irrigation development by paying for rehabilitation[2],

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2 Much in the same manner as they construct roads, or provide electricity and water to industries, or as for instance the Dutch economy paid for the polders.

and farmers have only to pay for recurrent cost. There are also arguments[3] why farmers have to pay for everything, rehabilitation as well as O&M.

6.3.2 Recurrent Cost

Annual recurrent costs include incremental cost for operation and maintenance of the system, water allocation and agricultural services. In the present situation farmers pay for irrigation water, whose price combines maintenance and distribution costs. In the financial and economic calculations water charges form part of the crop budgets. O&M costs in the new situation are estimated as 1% of the base cost, which takes into account that the irrigation system consists of concrete structures. In the scheme in Safa Source, O&M costs amount to LL 15,658,000 per annum (US$ 10,037). This equals to LL 26,000 per ha, or US$ 17.

Allocation cost is different, its base consists of the assumption that for every 5 km of canals there is one shawi active to allocate water. The shawi works 6 months per year for a salary of LL 25,000 per month. In the scheme allocation cost is thus LL 63,000,000 per year (US$ 40,385), which is equal to LL 106,000 per ha (US$ 68). The important length of the conveyance system accounts for the relatively high water allocation charges.

6.3.3 Cost Streams

Appendix B, Table: 1 gives the distribution of cost streams over the years of implementation in market prices. As explained before the economic construction cost is the same as the financial cost.

6.4 PROJECT BENEFITS

The aggregation of extra farming incomes at the scheme level forms the base for calculation of benefit streams of the economic and financial analysis, taking into account evolving cropping patterns and adoptions of input rates for each scheme. One calculates the incremental project benefits by sub-tracking the without project agricultural returns from those in the with project situation.

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3 Mainly the fact that farmers do not pay any taxes, so why should public money be used to pay for rehabilitation.

6.4.1 Prices

Prices of traded goods are either based on market prices (financial analysis) or on border prices (economic analysis). In the financial analysis, crops and inputs have been priced through their farmgate price, which is derived from an analysis of market prices and from data collected during the surveys. There seems to be a parity between the market price of crops and the corresponding farmgate price. The surveys revealed that farmgate prices are 65% of the market price. For inputs the market price is the same as the farmgate price. Any transport between the market and the farm is accounted for in the budgets under transport charges.

The forecast of commodities by the World Bank provides the basis for the world market prices used in the border price analysis (see Appendix B, Table: 2). The economic price of crops has been derived from a border price analysis, either on the basis of import parity for those crops for which Lebanon is a net importer (wheat, bananas, pulses) or on the basis of export parity, e.g. for oranges, grain legumes and vegetables, as these produces account for a large share of total exports of agricultural products. For crops which are either not intentionally traded or for which no world market reference price is obtainable, i.e. apricots, cereal straw and legume hay, economic prices have been based on the current market prices.

The financial and economic analysis uses constant 1996 prices. However, the evaluation period covers 25 years and hence price forecasts should be made for each year of the period. As it is impossible to make realistic predictions of market prices for the coming 25 years, one estimates that 1996 market prices represent best the price for the whole period. Moreover, it can be assumed that the production (7,954 tons per year in the steady stage) of the scheme will be less compared with what is marketed at this moment, and consequently does not have any influence on price formation in the market.

Economic prices derived from the border price analysis, also have to take into account fluctuations over the coming 25 years. However, predictions published in the World Bank commodity price forecasts, are no going beyond 2008. In stead of using annual prices for each year given in the World Bank forecasts, the analysis uses one average price for the entire evaluation period, which is the nearest price to the mid-evaluation period year (2008). The forecast of the international trade price of 2008 represents best this mid-period price. This price remains constant over the total evaluation period.

Irrigation water has been costed in the financial analysis's crop budgets at the amount of water fees paid by farmers, as this reflects the true crop gross margins. The water price paid by farmers after rehabilitation could be

derived in two ways: either it equals O&M cost of irrigation, or it includes the depreciation of rehabilitation works plus the O&M cost of irrigation. In the financial analysis it is considered that the second reflects the "true" water price, although in the sensitivity analysis the impact of the depreciation component is tested.

In the economic analysis water charges have been excluded as investment and O&M cost are already included in the project cost. Since water savings in each of the projects are used to increase cropped areas or cropping intensities, total irrigation water usage in the project area does not change with the implementation. In schemes where there is also domestic consumption from the sources used for irrigation, the study assumes that the volume used for domestic consumption does not affect in any sense irrigation demands and the other way around. This means that the opportunity cost of water equals zero.

The economic wage rates are assumed to correspond to the actual wage structure. There is virtually no structural unemployment of labour in Lebanon and during harvest seasons external labourers, mainly from Syria come to work in agriculture. Hence, a conversion factor of one applies to agricultural labour wages. Hence, a conversion factor of one applies to agricultural labour wages. Family labour wages rates in the economic analysis reflect their opportunity cost, for which the analysis uses 75% of the hired labour wage. Wage rates differ per scheme, and the actual figure found in the socio-economic survey is used.

Fertilisers have been priced at import parity taking into account the World Bank's commodity price projections for Urea, TSP and Potassium Chloride. The crop budgets give fertiliser rates in elements. This is done to counter the widespread use of fertilisers of different composition. The financial prices of other tradable inputs (mechanisation, seeds, plant protection chemicals and herbicides) are not subsidised. This means that respective market prices do no differ significantly from economic values, which have been used in the economic evaluation.

Prices imputed for greenhouses and drip systems conform to what is actually paid by farmers. Steel structures of greenhouses have an almost permanent life, but plastic covers must be replaced every 3 years. In the crop economics a depreciated annual price is used. Financial prices are somewhat higher than economic prices because of the inclusion interest. Farmers use only small pumps (1 HP) for the drip system, if they are able to take water from the irrigation network. For these also a depreciated price is used. Actual practices and prices define the operational cost for these pumps.

Appendix B, Table: 3 gives an overview of the used prices for the economic and financial analysis of the scheme in Safa Source.

6.4.2 Crop Economics

Crop economics derive from data collected during the surveys of the schemes, as well as from documents of the World Bank[4] and FAO[5]. Quantities of inputs reflect current practices, which do not seem to progress very much. Production levels are based on the 1995/1996 situation, which seems to be statistic as well, although account is taken of the production changes as result of weather conditions.

The future with project situation reflects the opportunities that exist. It is assumed that improved support services (access to credit, extension) and rationalisation of input use and agriculture practices (as result of extension), could lead to a 20% reduction in the use of inputs, while at he same time one may expect that production levels will increase. Moreover, post harvest handling should be strengthened, resulting in cost increases of 20%, but at the same time this could result in a 15% better price.

It should be noted that the future with project situation will not be achieved directly after completion of construction works. There will be a transition period before the future production levels are realised in each of the schemes, as there will be a time lag between capacity creation and capacity utilisation, which is estimated at five years. This means that during a period of five years after the end of construction works, agricultural yields and practices will change gradually to achieve the ultimate level of the with project situation.

The following details apply to the scheme's crop budgets:

- Hired labour in the scheme earns on average LL 20,000 per day, which is somewhat lower than usually paid in the region,
- A separate budget for tomato is considered, concerning a local variety that produces very high yield, up to 100 tons per ha. Although these yield may seem very very high, they are confirmed during the agricultural survey,

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4 World Bank. 1994. Staff Appraisal Report: Lebanese Republic, Irrigation Rehabilitation and Modernisation Project.

5 FAO Investment Centre. 1995. Lebanon, Agricultural Infrastructure Development Project.

- A factor of 10% for other charges figure in the budgets, this represents all input items not listed, e.g. packaging material, small implements and usable goods,

- Interest has to be paid for all inputs provided through merchants. The on-going interest rate is 25%, but the duration of credit supply is only 3 months,

- The farmers pay actually water charges, and the study takes into consideration the cost paid for operation and maintenance of irrigation infrastructures. The socio-economic survey reveals a cost per ha of LL 17,000 per hour per year, which works out at LL 175,000 per ha,

- Landrent takes into account that farmers not only use owned land, but also have to rely on hired land or share cropping arrangements. In the scheme in Safa Source and surrounding area landrent charges amount to LL 1,300,000 per ha for irrigated crops according to the socio-economic survey,

- For transport the study assumes per crop a general transport charge equal to 30 km distance. This general transport charge covers possible trips the farmer has to make for visits to Beirut where he buys inputs and sells his crops. Separate transport charges for inputs and produce are considered.

Appendix B, Table: 3 and 4 provide all details on the economic and financial crop budgets for the irrigated crops grown in the scheme in Safa Source. The first table covers the situation before rehabilitation, while the second table presents the situation as it will be after rehabilitation.

6.4.3 Farm Budgets

The farm size and results of crop economics define the agricultural income per farm. The field surveys could not provide details on the farm sizes existing in the scheme for Safa Source, hence, the analysis could only be carried out on the average farm size. Moreover, little is known on dry land cropping, so that this part of the farming income could not be included. This means that farming income only concerns irrigated cropping, which is fully acceptable because the analysis of income should prove if farmers can sustain the water charges levied upon them. Distribution of cultivated areas over owned, hired and shared cropped land has been taken into account, by using a landrent in the crop economics.

In the scheme, average annual incremental farming income in the steady stage of the project amounts to LL 5,256,000 per holding (US$ 3,369).

6.4.4 Agricultural Production

The crop budgets and the cropping pattern for the actual situation and what is expected to happen after rehabilitation, provide the basis for calculation of the agricultural returns. In the financial analysis one takes also into consideration the financing of the scheme. It provides insight into the advantage of rehabilitation works for the main beneficiary, notably the Government of Lebanon.

Appendix B, Table: 6 gives the financial and economic results for the situation before rehabilitation. In Appendix B, Table: 7 those for the after rehabilitation situation are given..

6.5 FINANCIAL ANALYSIS

6.5.1 Feasibility

The first part of the financial cashflow table given a balance of project costs and benefits for the 25 years of the evaluation period (see Appendix B, Table: 8). The cashflow before financing is the balance of project cost and incremental benefits against market prices. The Financial Internal Rate of Return (FIRR) the project achieves is 71%. The Net Present Value at a discounting rate of 14% equals LL 19,519 million or US$ 12,512,000.

In the second part of the cashflow table attention is given to financing options for the rehabilitation works. As it is very likely that any scheme that will be executed will be financed with a loan from the World Bank, this is the mode of financing that is reviewed. World Bank loans have an interest rate of 7%, a grace period of five years and should be repaid over a 20 year period. In the cashflow table it is assumed that repayment will start as from year six onwards.

Now that the conditions of the loan are known, it remains to make an assumption on what would be covered by the loan and what needs to be financed through other sources. In the financial cashflow it is assumed that the World Bank loan would pay for 80% of the cost of civil works and 90% of the cost related to studies, design and implementation. All other expenses have either to be financed by the farmers or must come from the Government budget.

Farmers' contributions to the financing of the scheme's costs concern the O&M part of the base cost as well as depreciation charges. Because these contributions exceed O&M cost only, there will be a net flow of funds to the Government (which is indicated as a negative Government contribution). The balance of annual cost after deduction of the loan

amount and the farmers' contribution, has to be met by the Government budget. The Government has also to take charge of the loan servicing.

The financial cashflow after financing is the balance of the pre-financing incremental benefits and the expenses made by the Government to finance the scheme. The figures in the table indicate the revenues of farmers remain very positive, except for the first years, if and when they would also have to pay the money needed for loan servicing, through i.e. taxation.

6.5.2 Affordability to Pay for Services

When reviewing the extra farm income received by farmers, it shows that on the average LL 5,256,000 (US$ 3,369) is earned per year during the steady stage. This extra income already takes into consideration water charges, which amount to LL 110,000 per farm or US$ 70. Water charges account for approximately 2% of the extra income earned in irrigated agriculture. This percentage is less than the upper limit of 5% generally used in studies, and thus it means that the farmers would probably be less willing to pay the preset water charges.

The financial cashflow table indicates that except for the first years the farmers would be able to pay also for the extension service cost. They already pay for water charges, but returns are high enough to make them pay for other services as well. However, earlier we recommended that the cost of agricultural services should not be invoiced directly to the farmers, but instead these costs should be recovered from taxation.

6.5.3 Sensitivity Analysis

The sensitivity analysis reviews the impact of changes in project costs and benefits. Also reviewed is the impact on incremental farming benefits whenever farmers would not pay the depreciation of the capital cost of rehabilitation as part of the water charges. Moreover, the analysis looks also into the effects of a delay in the maturing of project benefits; what will the effect be on incremental agricultural benefits whenever, there is a time lag of one or of two years (see for the results Appendix B, Table: 9).

It appears that the rehabilitation of the scheme can withstand increases in the costs up to 50%. The FIRR decreases to 56.8% and the NPV at 14% remains positive. The project is even less sturdy when benefits reduce. The FIRR and NPV drop considerably when benefits are reduced. However, the project can withstand a decrease in the benefits up to 30%. Below this level, the project becomes unfeasible.

Deleting the depreciation of civil works from the water charges paid by the farmers will increase their net revenues, although not much (0.01%).

Whenever, the maturing of benefits lags with one year, it appears the there is a drop in the FIRR of 16 %. A delay of two years results in a decrease with almost 25 %. Rehabilitation of Safa Source scheme is financially just viable. The project can sustain increase in cost, it also cannot counter a reductions in benefits, if a FIRR of 14% and more is required.

6.6 ECONOMIC ANALYSIS

6.6.1 Feasibility

When looking at the analysis at economic prices, one can observe that the rate of return is somewhat lower. This is mainly the result of the pricing of family labour at its opportunity cost, although on the other irrigation water is priced at zero value in the economic analysis (see Section 1. 4 .1). This results in a negative Economic Rate of Return, which follows from the differential between market and economic prices for the olives and some field crops. Hence, the project achieves a negative NPV at 14% of LL 17,268 million, which equals US$ 11,069,000. Appendix B, Table: 10 shows the details.

6.6.2 Sensitivity Analysis

The sensitivity analysis reviews the impact of changes in project costs and benefits (see for the results Appendix B, Table: 11). With the current rate of return, it is expected that the rehabilitation cannot stand increases in the project cost. As shown in the table, the project cannot withstand any increase in cost, as it is already un-viable. In all cases the NPV remains negative.

Whenever, a increase in project benefits takes place (for instance as result of better than estimated economic prices), the table shows, that here the project remains feasible when benefits decrease by 30%. In fact it could not bear any benefit reduction. The increase in costs can be withstand up to 50%.

Moreover, the analysis looks also into the effects of a delay in the maturing of project benefits. What will the effect be on incremental agricultural benefits whenever there is a time lag of one or of two years? The analysis shows that the EIRR will decrease by 14% for one year and by 23% for two years.

6.7 PROJECT RISKS

Project risks are mainly associated with delays in construction, institutional building and capacities, socio-economy and environmental impacts. As in

all construcion works contracts, the principal risk concerns increased costs and delayed benefits. The risk that the implementation of physiscal components is delayed is large, as no detailed design of the rehabilitation works has been done yet, nor have tender documents been prepared.

Risk on the sucessful implementation of the support sevices component is large as well. The exisitng extension pratices are leading to an over-use of agricultural inputs, as extension agents are employed by those firms that provide seeds and chemical inputs. Creating a complete new and effective extension service is no sinecure, which is the more difficult because of the smallness and sometimes remoteness of the schemes.

Risk of lower than expected acceptance of new technologies by the farmers is also existing. An important issue here would be the provision of agricultural services, i.e. credit. However, it is hard to see why an agricultural credit system would be more efficient than the present arrangements through input suppliers. If such a credit system gives preferential rates to farmers, it in fact subsidises the agricultural sector. What would be more fruitful to the sector is an understanding between the agricultural research and extension services and the input suppliers, so that the inputs available to the farmers are the best option for them.

6.8 INDIRECT BENEFITS

The rehabilitation and modernisation of small and medium irrigation schemes in different parts of Lebanon is expected to generate indirect economic benefits. This would stimulate economic activity and growth in the rural areas.

The first expected benefit is the generation of employment for local labour that will be recruited for the rehabilitation and modernisation of irrigation canals and for the cultivation of the new crops that will be introduced after the implementation of the project. The scheme in Safa Source, when fully rehabilitated and in its steady stage, generates a considerable amount of extra labour days. Hired labour days increase with +33%, while family labour demand goes up with +52%.This should have a tremendous impact on reducing the rural exodus one may say, but it should be noted that few farmers are working full time in agriculture, and that there seems little enthusiasm amongst the younger generation to "live of the land".

The second benefit is the generation of foreign exchange earnings due to higher level of agricultural exports to neighbouring Arab Countries and the Arabian Golf countries. The impact from the scheme could be important as the area is know for its good quality fruit, but unfortunately production goes down as result of taking areas out of irrigation. In particular apples, pears, peaches and plums are well sought overseas. Under the assumption

that the f.o.b. value of the products is 30% higher than the farmgate price (this seems to be the case with oranges), an estimate of the loss in potential export value of export crops measures LL 2,232 million per year during the steady stage, or US$ 5,920,000.

6.9 SUMMARY OF RESULTS

A summary of results can be found in Appendix B, Table 12.

ANNEX II-1

APPENDIX B

FINANCIAL ECONOMIC ASPECTS

APPENDIX B; FINANCIAL ECONOMIC ASPECTS

List of Tables