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FEASIBILITY STUDY FOR THE DEVELOPMENT OF RAINFED AGRICULTURE IN KARAK AND MA'AN PROVINCES IN THE HASHIMITE KINGDOM OF JORDAN

KHARTOUM, JUNE 1977

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Honourable Chairman and Members,
of the Council of the Arab Organization
for Agricultural Development

In line with its sustained efforts perpetually pursued for bringing about substansive agricultural development in the Arab World, the Ministerial Committee of the Council, in its meeting held in Khartoum, during January 1977, accepted a request from the Government of the Hashemite Kingdom of Jordan for studying the technical and economic feasibility of the rainfed agricultural development in Karak and Shobak regions.

Accordingly I commissioned on 30th March 1977 a team of experts to undertake the study. The team was composed as follows :

Dr. Kamal Abdalla Agabawi,
Professor of Agronomy,
Faculty of Agriculture,
University of Khartoum — Team Leader

Engineer Thu El Kifl Ghosha,
Head, Crop Husbandry Research Section
Ministry of Agriculture - Amman — Counter-part to Team Leader

Engineer, Burhan Abu Hweig,
Assistant Director,
Department of Agricultural Economics,
Ministry of Agriculture - Amman. — Member

Dr. Husni Ahmed Khalifa,
Animal Production Consultant,
Arab Organization for Agricultural
Development, Regional Office,
Jordan. Member

Engineer Nabil Katkhutha,
Head, Field Crop Section,
Research and Extension Department
Ministry of Agriculture, Amman. Member

Dr. Yahia Mohy El Din,
Agricultural Economics Consultant,
Arab Organization for Agricultural
Development, Regional Office, Bagdad. Member

Dr. Yousif Abdel Hadi,
Director, Soil Survey and Classification
Project, Department of Project Execution
Ministry of Agriculture, Amman Member

At a later date two members joined the team :

Sayed Ayoub Batarsa,
Director, Cooperative Training Centre,
Cooperative Orgaization - Amman.

Engineer, Kinana Abdel Hadi
Assistant Director, Department of
Project Execution,
Ministry of Agriculture, Amman

The study commenced on the 10th of April 1977. The first task was to determine land areas to be encompassed by

the project. This was done in accordance to government strategy for the development of rainfed agriculture, whereby dryland farming is restricted to areas receiving average annual precipitation greater than 250 mm. Using this criteria it was soon obvious to the team that the project will encompass three geographically separate locations which manifest distinct variability in utilizable resources. At this early stage, the team was fortunate enough to have had a meeting with His Excellency the Minister of Agriculture, who indicated the advantages of detailing the study in a manner which will obviate the technical and economic feasibilities for all project areas jointly as well as for each project area independently. At a later date, the team was requested to present the major issues in one of the regular meetings which are presided by His Excellency the Minister of Agriculture and which are attended by the central and regional heads of departments of the Ministry of Agriculture. The meeting which was held on 9th June 1977, unanimously blessed the approach, the objectives and the project components conceived by the team.

The team approached the issue of developing dryland farming in Karak and Ma'an through the perception of problems and constraints limiting optimum production in the context of available resources and existing pattern of utilization. It was apparent to the team that the 'landscape' in the project area is a coherent complex agro-environment which was formed by the intricate actions and interactions of numerous attributes. As such the 'landscape' cannot be subdivided for solving, in a pragmatic manner, the problems it discharges ; it was, therefore, cogent to treat the agro-environment in its totality. This has led the team to adopt the integrated project approach. In broad terms, development will be based upon :

- subjugation of the difficult topography with the aim of increasing cropable land,

have given to the team and for facilitating the whole progress of the study. The management of the Arab Organization for Agricultural Development is confidant that this study will effectively contribute to development in the Kingdom.

Dr. Mohamed Mohib Zaki
Director General

Khartoum, June 1977

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ANNEX III.

- consolidation of existing fragmented land holdings to form viable units suitable for the adoption of modern techniques of production,
- soil conservation,
- timely provision of production requirements,
- development of existing orchards,
- horizontal expansion of orchards in areas already prepared for fruit planting and in suitable areas located in landscapes where slopes exceed 8%,
- development of seasonal cropping.

Project execution is entrusted to a Board of Directors which will involve representatives of all institutions concerned with the implementation of the project. Farmers are to be represented in the Board since they are the direct benificiaries. Bearing in mind three very crucial facts viz :-

- the Ministry of Agriculture is the government institution entrusted with the development of agriculture in accordance with national plans for the country at large,
- the proposed project, in the final analysis, is part and parcel of the overall agricultural development plan,
- the successful implementation of the project will depend on the technical support that must be given by the technical departments of the Ministry of Agriculture. Such technical support is not available in its totality except in the Ministry of Agriculture,

it is proposed that the Board of Directors should be constituted in such a manner which would not permit the detachment

of the project from the Ministry of Agriculture. At the same time sufficient autonomy and flexibility must be allowed in administrative and financial dealings without necessarily adhering to central government practices ; a special set of regulations may be included in the act of constitution of the Board.

The study has also looked into the possibility of raising the utilization of animal resources in the project area through modern production techniques. Estimates reveal that feed production even at full development will fall short of satisfying maintenance requirements of current populations of large animals. It was, therefore, not possible to suggest a new pattern of production.

4. The approach used for suggesting the optimum pattern of resource use rested mainly upon the following focal points :

- conservation of national wealth-the soil,
- the need to subjugate the steep terrain for growing fruit trees with the aim of increasing cropped land,
- growing crops in agro-environments which are most suited to their production,
- the specific needs of the project and meighbouring areas in particular and the needs of the country for agricultural commodities.

Altogether, the proposed pattern will bring about the following changes in resource use at full development :-

- increase of the area annually put under crops from 396,000 dunums to 533,000 dunums. This is a direct result of the planned substantial horizontal expansion of orchards over steep landscapes. The area under orchards which

averaged 18,900 dunums during 1969 - 75, the projects base year, and rose to 36,600 in 1977 will ascend to 162,000 dunums at full development. Inspite of this ascent the area of seasonal crops will be maintained at present levels.

- raising the intensity of seasonal cropping from 60.6% to 77.3%. It is worthy of note, that the area available for seasonal crops at present is 623,000 dunums while only 480,000 dunums are allocated for field and vegetable crops in future.

- wheat and/or barley will not be allowed to occupy the same piece of land in successive seasons.

The proposed project will bring about substantial increases in total annual production. This is evinced by the ensuing comparison :

Item Produced	Production, 000 tons		Percent increase
	Present	Future	
Fruits	1.8	39.0	2,066
Vegetables	1.1	15.9	1,345
Field crops	18.6	29.5	59
Straws	19.4	32.7	69

As a result of additional feed, it is anticipated that the level of animal feeding will be improved bringing about improvements in animal production.

5. The economic and financial feasibilities were worked out on the basis of 1976 prices. Sensitivity analyses were made for increased costs and reduced value of production. In all cases the approach was one of comparing situations

before and after the execution of the project in order to arrive at internal rates of return. Analyses were carried out for each project area separately and for all project areas jointly. An additional set of computations was made for Karak and Tafila together in order to reveal the situation in case it has been decided to develop irrigated agriculture in Shobak, i.e. when the project is confined to Karak Province. Briefly :-

i - From the following economic analyses the following rates of return emerged :

		per cent
a)	economic analysis at assumed costs and value of production :	
	- all project areas	29.40
	- Karak area	31.54
	- Tafila area	15.30
	- Shobak area	18.44
	- Karak and Tafila areas together	28.39
b)	sensitivity analysis at increased costs by 20 per cent :	
	- all project areas	18.39
	- Karak area	22.32
	- Tafila area	8.02
	- Shobak area	9.87
	- Karak and Tafila areas together	19.36
c)	Sensitivity analysis at decreased value of production by 20 per cent :	
	- all project areas	16.58
	- Karak area	19.87
	- Tafila area	7.55
	- Shobak area	8.73
	- Karak and Tafila areas together	18.17

ii - Financial analyses revealed the following diversity of returns :-

	Per cent
a) financial analysis at assumed costs and value of production :	
- all project areas	31.17
- Karak area	47.92
- Tafila area	19.32
- Shobak area	19.15
- Karak and Tafila areas together	36.68
b) sensitivity analysis at increased costs by 20 per cent :	
- all project areas	24.48
- Karak area	30.68
- Tafila area	11.99
- Shobak area	13.05
- Karak and Tafila areas together	25.52
c) sensitivity analysis at decreased value of production by 20 per cent :	
- all project areas	21.19
- Karak area	28.72
- Tafila area	10.31
- Shobak area	9.06
- Karak and Tafila areas together	20.41

These results show clearly that, taking the project as a whole, economic returns are rewarding even when costs rise or the value of production declines by 20%. And so is the case with respect to Karak alone or Karak and Tafila together. When Tafila and Shobak are viewed independently, both fail to show rewarding returns at increased costs or decreased value of production.

iii - The benifit/cost ratio amounts to 1.75 at current prices and to 1.53 at an 11% discount rate.

iv - Total project costs are estimated at JD 133.5 million, of which JD 4.3 million are capital costs and JD 129.2 million are operating costs. The broad break-down of these costs is as follows :-

a) capital costs :

item of expenditure			cost JD'000
i	-	construction of stone walls	2,112
ii	-	construction of earth banks	860
iii	-	machines and equipment	51
iv	-	fruit tree transplants	1,179
v	-	buildings	80
		total	4,282

b) operating costs :

item of expenditure			cost JD'000
i	-	planting and husbanding fruit trees and seasonal crops	124,420
ii	-	salaries, wages and allowances	4,300
iii	-	maintenance and fuel	480
iv	-	other supplies	40
		total	129,240

An economic cost of JD 3.333 million was also borne by the project. This is made up of JD 1.198 million being previous government expenditure on soil conservation works in the project area, the balance represents the value of existing fruit trees. In addition, the project will bear the cost of interest amounting to JD. 2.704 million on a loan of JD 9 million in case the government has to borrow for

the fulfilment of its own obligations towards the project and for lending farmers their financial needs.

v - The project is anticipated to add to GND about JD 136 million representing value added at current prices or a present value of JD 38.5 million when a discount rate of 11% is used. The contribution of the project to the national income is effected by way of both major and secondry products valued at JD 273 million, broken-down as follows :-

Item produced	Value (JD'000)
- fruits	125.6
- vegetables	28.4
- field crops	74.0
- straws	45.0
- total	273.0

vi - The project is anticipated to have a positive contribution to the balance of trade as a result of increased annual production, mainly of fruits (37,200 tons), wheat (3,000 tons) and lentils (2,600 tons).

vii - The execution of the project necessitates the importation of machinary and equipment and chemicals to the value of JD 500,000, of which JD 454,000 will be spent on machinary in the early stages of execution. The rest will be spent on chemicals throughout the lifetime of the project. This will have a trivial negative effect on the Jordanian balance of payments.

Recognizing the fact that the project is made up of three distinct locations which are geographically separated and only weakly integrated economically, the team recommends the implementation of the project in Karak area alone. This

recommendation is based on financial and economic returns only.

Nevertheless, it is worth stating that the overall social and economic development, in view of its being social as well as economic, must take into consideration criteria other than financial and economic rates of return. The implementation of the project in Tafila and Shobak has a number of positive aspects relating to the overall social and economic development. Chief amongst these are :-

1. Each of the Tafila and Shobak locations make up about 10% of the total project area. If included in the project, their high sensitivity to rising costs and declining returns can be subdued.

2. Large tracts of land in these two districts lie on steep slopes & could be utilized for fruit tree planting which will ensure a stable income for a long period of time, which could exceed twice the estimated projects' life if planted with olives .

3. A large proportion of steeply sloping lands in Shobak and Tafila are presently used for seasonal cropping which is wrongly conducted. If modern development techniques are not adopted, this pattern will definately continue to result in serious soil erosion and loss of this national wealth which should be conserved for future generations.

4. The development of agricultural resources in these two areas will enhance the contribution of local production in satisfying food requirements.

5. The proposed pattern of resource use will create more stable job opportunities, increased incomes and a higher standard of living for the rural population, all of which are factors which will advance rural development.

It is, therefore, concluded that the decision whether Tafila and Shobak should be included or not will be based on criteria other than economic returns. It must be added that the benifits of the projects in these two areas are amongst the major targets of the national socio-economic development plan of Jordan.

CHAPTER I

BROAD CHARACTERISTICS OF JORDANIAN AGRICULTURE

1. The total area of East Jordan is 92.6[1] million dunums[2] of which 12 million dunums are thought to be potentially suitable for arable farming. To-date only 5.3 millions have been put under the plough for seasonal and perennial cropping. The present land use pattern is officially given as follows :-

Land Use	Area (000 dunums)	%
1. Agricultural Crops :		
a. Rainfed	4,897	5.3
b. Irrigated	386	0.4
c. Sub - total	5,283	5.7
2. Forests	400	0.4
3. Arid Land *	75,000	81.0
4. Uncultivable	11,896	12.9
5. Grand Total	92,579	100.0

* Land receiving less than 200 mm. of rainfall per annum, partially exploilable for grazing purposes.

Source : Five year Plan 1976 - 80.

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(1) Source : Agro - environments in Jordan - Working Paper - 1974.

(2) Dunum (d) = 1000 sq m. in Jofdan.

2. In terms of land areas dryland farming is dominant, occupying 93% of the presently tilled land. Animal production still remains at the traditional nomadic level where animals depend on communal grazing of arid pastures of low carrying capacities during the months of February to May. Thereafter, animals are led to rainfed crop-land mainly to make use of crop residues.

3. Low input traditional agriculture predominates the landscape. Dependence on traditional concepts which cast aside modern techniques render farmers incapable of controlling the environment to the degree that would enable them to prevent its unfavourable effects and at the same time make optimum use of available resources. Soil erosion is causing serious loss of agricultural land, yields per dunum are far below the demonstrated potential and production of both plant and animal crops show wide seasonal fluctuations caused mainly by variation in quantity and distribution of rainfall.

4. During the period 1972 - 75 agriculture contributed an annual average of JD 26.4 million (12% of the total GDP) of which JD 17 million was derived from crops and JD 9.4 million from animal production. The contribution of dryland cropping is however, relatively low. While occupying 93% of the tilled land rainfed production is estimated at JD 6.8 million which is equivalent to only 40% of the total annual value of plant products.

It is estimated that 18% of the active labour force is

engaged in agriculture and that 405,000 of the population depend on this sector as the main source of their income.

5. Jordan depends heavily on imports for satisfying its basic food requirements. Inspite of the significant development that has taken place in the agricultural sector Jordan still imports more than half its basic food requirements, in particular grain and animal products, at an annual average cost of JD 34 million during 1973 - 75 . On the other hand surplus production was attained in lentils, some fruits and vegetables which were exported at an average annual value of JD 6.5 million.

6. It is government policy that the country should reach self-sufficiency in the major food crops and that it should increase the exportable surplus of those crops which are best suited to the Jordanian environment. For attaining this goal a number of development projects has been planned and executed with the aim of raising the efficiency of resource use, (Annex 1). This trend is again stressed in the five year plan, 1975 - 80, which specifies production targets as shown in table 1.1. The value of agricultural produce is anticipated to increase from JD 30 million to JD 42 million, at an annual rate of 8%. This will be brought about through both vertical and horizontal expansions which are to be achieved by strictly observing two strategic concepts, viz : adherance to the principle of growing crops in agro-environments which are most suited to their production and the use of modern inputs at all stages of production. This policy will result is substantial reduction in areas allotted to grain crops. Much of the land now wrongly used for seasonal cropping is projected for dryland fruit production. Of

TABLE 1/1

PRODUCTION TARGETS OF MAIN AGRICULTURAL COMMODITIES 1980

(000 TONS)

Commodity	Production			Domestic Consumption			Share of Production in covering consumption %	
	Actual 72-74	Expected 1980	Increase %	Present	Expected 1980	Increase %	72-74	1980
Wheat	162	221	36	270	340	26	60	65
Lentil	20	25	25	12	19	58	167	131
Barley	26	91	250	32	50	56	81	183
Tomatoes	123	202	64	76	121	59	162	167
Eggplant	26	40	54	15	18	20	173	222
Cauliflower & Cabbages	13	21	62	8	12	50	163	175
Cucumbers	14	32	129	11	17	55	127	188
Potatoes	1	20	1900	15	20	33	7	100
Olives	27	58	115	24	40	67	113	145
Grapes	19	40	111	21	38	81	90	105
Bananas	4	6	50	3	5	67	133	120
Citrus	22	44	100	14	26	86	157	169
Beef	1	2	50	3	5	67	33	40
Mutton	7	9	29	12	30	120	58	30
Poultry Meat	4	9	125	5	9	80	80	100
Eggs x	83	312	276	166	312	88	50	100
Milk	43	67	59	57	97	70	75	69

x : Eggs in millions

Source : Five year plan 1976 - 80, with a few corrections in % ages.

specific interest to the development of rainfed agriculture is the " Integrated Rainfed Agricultural Development Project (IRADP)" in Irbid District. Based on studies carried out by an FAO Investment Centre mission in 1974, modern production techniques were applied through FAO assistance over a pilot wheat area of 2000 dunums in 1975 - 76 season. The success of the demonstration led to the inclusion in the current five year plan, of a rainfed agricultural development project covering 600,000 dunums in Irbid district. Concurrently the Arab Organization for Agricultural Development has, on government request, completed a feasibility study for the development of rainfed agriculture in Amman District. The present study which is concerned with both Karak and Ma'an is another step towards completing the studies of the East Bank drylands. There still remains Balgaa and small parts of Irbid to be covered.

CHAPTER II
PROJECT AREA

1. Location and Areas :

1.1. The Government of the Hashimite Kingdom has requested this study to cover rainfed areas in both Karak and Ma'an Provinces which are situated in the southern most part of the country. The two capital cities are located some 130 km and 220 km respectively to the south of Amman. Together the two provinces cover 49 million dunums, about 54% of the area of East Jordan. The bulk of the area, however, falls within the arid and marginal zones and receive an average annual rainfall of less than 350 mm, (table 1.2.).

Table 1.2.

AREA OF DIFFERENT ENVIRONMENTAL REGIONS IN KARAK AND MA'AN

(Area in Dunums)

Variable	Karak	Ma'an
1. Total Area	4,681,240 (100%)	44,599,700 (100%)
2. Area of arid region (< 200 mm)	2,576,570 (55%)	44,178,660 (99%)
3. Area of marginal region (200 - 350 mm)	2,044,190 (44%)	421,040 (1%)
4. Area of semi-arid region (350 - 500 mm)	60,480 (1%)	- -

Source : Working Paper, Agro - Climatological Zones in Jordan - Amman 1974.

1.2. In conformity with the government strategies prescribed for rainland farming development the team agreed with the Ministry of Agriculture to limit the proposed project to areas receiving not less than 250 mm of annual rainfall. On the other hand the team was aware of the fact that individual land holdings are commonly made up of isolated plots situated in different locations within the village boundary. Consequently, the selection of the project area on the sole criterion of rainfall may result in the selection of only part of the individual holdings and the exclusion of other parts. Such a situation will no doubt create unnecessary administrative problems and might discourage farmers from accepting the basic project actions. In cognizance of these two fundamental influents, annual precipitation and incoherence of holdings, the project area was carefully selected by flexibly coordinating isohyets with village boundaries in a manner which encompasses or otherwise excludes whole villages which are partially located within the stipulated minimum isohyets. The selected project area is portrayed in the map designated FIG. 1.2 and is made up of three distinct areas :

- Area I, (Karak) is the northern part of Karak Province including Karak town and lying between Wadi El Mugib and Wadi El Hassa. It is made up of 47 villages.

- Area II, (Tafila) is in the Tafila district in the south of Karak Province and includes six villages.

- Area III, (Shobak) is in the Shobak district which lies in the northern part of Ma'an Province with ten villages.

1.3. Appendix tables 1.2, 2.? & 3.2 show the details of land classes as extracted from the records of the Land and Survey Department at Amman and Tafila. Table 2.2. displays a summary of land areas which highlight the following :-

- Total project area is 1.007 million dunums of which two-thirds are in area I (Karak district).

- Only 24% of Shobak lands were settled while settlement in Tafila and Karak lands covered 78% and 77% respectively.

- 606 thousand dunums (60% of the project land) were officially registered as land potentially suitable for agriculture. The percentage of suitable land, however, varies from one area to another, being 32% in Shobak, 62% in Tafila and 69% in Karak.

2. Land Holdings :

The project area is recorded by the Lands and Survey Department under 34,687 registrable plots, table 3.2. Average holding size is 29 dunums and 95% of the land is composed of plots which are less than 100 dunums. The average plot area may seem rather high but it must be remembered that this overall average includes 325,000 durums of forest and government land which constitute 32% of the total area. Such land is registered in the form of largein-tact plots which are not subjected to the usual land fractionation factors from which privately owned land suffers. Plot size is further reduced by the fact that a plot of land may be owned and actually amicably divided amongst a number of individuals inspite of

TABLE 2.2.

AREAS OF DIFFERENT CATEGORIES OF LAND HOLDINGS IN PROJECT AREA

(A) Area in dunums (B) % Age

District		Total Area	Settled Land	Forest Land	Govt. Land	Unsettled Land	Wells & Buildings	Public Utilities	Agric. Land
Karak	A	674358	525879	75885	47394	10675	1898	12627	465908
	B	100	78,0	11,2	7,0	1,6	0,3	1,9	69,1
Tafila	A	110425	84841	22206	566	645	87	2080	68113
	B	100	67,8	20,1	0,5	0,6	0,1	1,9	61,7
Shobak	A	222288	53564	22333	78852	66311	71	1157	71512
	B	100	24,1	10,1	35,5	29,8	(x)	0,5	22,2
Project Area	A	1007071	664284	120424	126812	77631	2056	15864	605533
	B	100	66,0	12,0	12,6	7,7	0,2	1,5	60,1

Note : X less than .5%

Source : Extracted from appx. tables 1.2, 2.2 and 3.2.

TABLE 3.2.

NUMBER AND AVERAGE SIZE OF PLOTS

Location	Total area (000 dunum)	Number of plots	Average Plot area (dunums)
Karak	674	24,432	28
Tafila	110	6,238	18
Shobak	222	4,017	55
Whole Project	1006[x]	34,687	29

x Differences due to approximations = - (1)

Source : Lands and Survey Department - Amman

its official registration in the name of only one person. It may, therefore, be confidentlv concluded that effective average plot area of privately owned land is much less than what the data in table 3.2. may otherwise suggest. The negative practical implications of small rectangular plots located longitudinally in the direction of the slope is obvious. In such holdings it is impossible to carry out cultural operations along the contours.

3. Climate :

3.1. Although nine meteorological stations exist within the project area, the actual information recorded is far from being adequate. The main deficiencies are shortness of duration and irregularity of recording. In many cases only rainfall is recorded. Three stations viz : Rabba, Tafila & Shobak were selected as representatives of the three project areas. Complete records only cover rainfall and temperature during the period 1967 - 75. This obvious deficiency in recording period was partially off-set by supplementary information extracted from rainfall maps which were drawn from data collected over the period 1938 - 67. In addition it is important to mention that the general pattern of the climate in areas receiving similar rainfall does not show wide variations in the different localities in the Kingdom.

3.2. Rainfall :

The project area falls into the category of mediterranean semi-arid stage with a clearly defined cool wet winter season and a hot dry summer. Rainfall ranges from 250 to 350 mm. Areas falling below and above the 300 mm isohyet were measured

from rainfall maps and are shown in table 4.2.

Appendix tables 4.2 to 6.2 display the data pertaining to annual and monthly rainfall in the three selected stations. In essence the pattern of fall is similar to what prevails over the Kingdom at large ; precipitation occurs during October to May with 70 - 80% of the average annual quantity falling in December to March. However, both the annual quantity and its distribution during the season show extreme variability. In view of the importance of these two factors in determining acreage and level of yields of both summer and winter crops it is felt essential to mention explicitly their major influences on cropping in the project area :-

3.2.1. Average annual rainfall determines the type of crop that could be grown as well as the intensity of cropping which could be followed. Under the agro-climatological conditions prevailing in Jordan an average annual rainfall of 300 mm is considered the minimum amount required for producing a satisfactory winter, summer or fruit crop.

Under such a relatively low rainfall it is absolutely necessary to carry out all possible dryfarming techniques which help water penetration and conservation in the soil for the benefit of the crop.

Officially, technical government departments do not recommend crop production where average annual rainfall is below 250 mm. Where rainfall ranges between 250 - 300 mm barley cultivation is encouraged in preference to wheat in view of its lower water requirements. A two-course rotation consisting of barley followed by a cultivated fallow (for purposes of water conservation) is recommended, thus

TABLE 4.2.

AREAS RECEIVING DIFFERENT RAINFALL AVERAGES IN PROJECT AREAS

(1) Area 000' Dunums (2) % of Total Area

District		Average annual rainfall (mm)		Total
		250-300	>300	
Karak	(1)	106	568	674
	(2)	16	84	100
Tafila	(1)	77	33	110
	(2)	70	20	100
Shobak	(1)	222	-	222
	(2)	100	-	100
All Project Areas	(1)	405	601	1006 (x)
	(2)	40	60	100

(x) Difference due to approximations.

Source : Rainfall maps.

precipitation from two rainy seasons is utilized to grow one barley crop. Fruit trees may be grown below 300 mm on slopes with deep soil receiving run-off water from bare land situated up the slope. In order to harvest water from such " catchment areas" for use in the cropped land it is necessary to construct soil conservation works to avoid soil erosion and effect the highest possible water retention.

3.2.2. The distribution of rains over the cropping season is a basic influent in determining total acreage as well as acreage of individual crops. Early rains encourage winter cropping, in particular wheat and barley. Occasionally and in anticipation of an exceptionally good season, above average early rains are conducive to sowing barley in locations with low average rainfall which are not usually used for crop production more often than not crops fail because the season had turned out to be average or below average.

The area of summer crops is positively correlated with the amount of precipitation occuring during December to March, rainfall in February and March being the most important. Furthermore, planting and success of fruit seedlings is favoured by good rains received during the two months.

3.2.3. During the period of the most effective rains, December - March, precipitation usually exceeds potential evapotranspiration because plants are still small, temperatures relatively low and relative humidities are very high. Consequently rainwater falling in excess of the soil infiltration capacity will cause both run-off and soil erosion which is more serious in sloping land. Subsequently, from April onwards, the moisture situation is reversed, rainfall decreases

and ultimately ceases, temperatures rise, relative humidities fall and crop plants are much larger; the overall net result is increased potential evapotranspiration. Under such conditions the key to successful farming is the ability of the farmer to acquire and store into the soil the maximum possible quantity of water falling during winter for use by crop plants in spring and summer. Thus practices directed towards reduction of run-off and improved infiltration would substantially increase the total amount of stored winter water. Subsequently, weed control and the use of light impliments aiming at shallow working of the soil will contribute to conserving the soil moisture in favour of crop plants.

3.3. Temperature :

Data presented in appx. tables 7.2 to 9.2 reveal a general pattern of low temperatures reaching sub-zero levels in winter and a gradual rise through spring to peaks of 31 - 35°C in July and August. Table 5.2 is of special interest to the project. It reveals that Shobak is much cooler than either Karak or Tafila. While average monthly sub-zero temperatures are experienced only during January and February in Karak and Tafila, such temperatures prevail throughout the period November to April in Shobak. Furthermore, the lowest temperature recorded in Shobak was 12°C in comparison to 3°C and 6°C recorded in Karak and Tafila respectively. The most pertinent feature of this data is that frost is likely to occur in Shobak area from November to April, a fact which imposes unfavourable limitations on the type of crop to be grown and the cropping pattern to be followed. This is particularly important for fruit tree development

TABLE 5.2.

MAXIMUM AND MINIMUM MONTHLY TEMPERATURES IN THE PROJECT AREA, NOVEMBER - MAY

(Average of 1967 - 75) oc

Location		Nov.	Dec.	Jan.	Feb.	March	April	May	Av. 1967-75
Rabba :	Max.	25.9	20.8	17.2	22.5	26.5	30.4	34.6	22.1
	Min.	3.7	0.3	-1.1	-0.4	0.9	3.0	6.1	10.2
Tafila :	Max.	24.5	20.6	19.2	21.7	26.5	29.5	32.9	21.3
	Min.	4.3	0.7	-0.8	-0.8	1.4	4.7	7.8	12.5
Shobak :	Max.	22.2	18.5	16.8	19.7	24.2	26.9	30.4	19.1
	Min.	-0.3	- 6.6	-6.5	-7.7	4.4	-2.8	0.6	5.7

Source : Department of Meteorology - Amman

and is discussed in more detail in later chapters of this report.

3.4. Relative Humidity and Evaporation :

Relative humidities in the project area average 51% at Rabba, 53% at Tafila and 54% at Shobak. Evaporation, measured with class A pan, is lowest at Shobak being 5.5 mm per day while at Rabba it was 10.4 mm.

3.5. Wind :

Cold dry easterly and northerly winds frequently blow over the project area during January and February resulting in a drop of temperature and a rise in evapotranspiration. Damage to crops depends on wind speed, temperature and duration of blowing. Much more serious however are the dry, hot " Khamasin" winds which blow in April and May, coincident with the cessation of rainfall, maturation of winter crops, establishment of summer crops and flowering of most fruit trees. These winds cause severe physical damage and greatly increase potential evapotranspiration ; the resultant loss in crop yields may be quite spectacular depending on the severity and duration of blowing.

4. Topography and Suitability of Land to Cropping :

4.1. The project area is situated in the southern highlands west of the desert region between Wadi El Mugib and Wadi Musa. Elevation above sea level is indicated below :-

District	Meters above sea level
Karak	700 - 1,200
Tafila	700 - 1,200
Shobak	1,000 - 1,500

4.2. Detailed topographic information is far from being complete but the map contained in Fig. 2.2 discloses the extensive network of water channels and streams which are indicative of the rugged topography of Karak district. Actually the roughness and variability of the terrain is easily seen by the visitor. In view of the decisive influence of topography on the edaphic environment, soil conservation works and type of crop to be grown it was deemed necessary to estimate areas of land falling in the different slope classes.

A detailed topographic survey was carried out over 72,000 dunums in Karak district (Fig. 3.2) during the implementation of of the Highland Development Project. The results of this survey were accepted as representative of the Karak area. Field visits were made in conjunction with agricultural officers actually working in the area to evaluate the major categories of land slopes in other areas. Bearing in mind areas resigstered as " cropable land" receiving the required rainfall it was possible to estimate land areas occuring in the various slope classes and thereafter allocate areas to the various types of crops. All suitable land lying between 0-8% slope was reserved for seasonal crops. All usable land on slopes greater than 8% in Karak and Tafila was allotted to fruit trees. In Shobak, part of the land falling between 8-15% slope was left for seasonal cropping in view of low rainfall and elevation which imposes limitations on fruit culture. The details of land areas falling in the different categories of slopes are given

in appx. tables 10.2 to 12.2. Overall, 641,500 dunums are estimated to be suitable for farming. Seasonal crops are to be grown on 479,500 dunums and fruit trees on 162,000 dunums (Appx. Table 13.2.). The share of each project area is as follows:-

Location	Area Suitable for cropping (000 dunums)	Area allotted for seasonal crops (000 dunums)	Area allotted for fruit trees (000 dunums)
Karak	515.5	410.0	105.5
Tafila	65.0	20.0	45.0
Shobak	61.0	49.5	11.5
All Project Areas	641.5	479.5	162.0

(for details see appx. tables 10.2 to 12.2)

5. Water Resources :

The East Bank of Jordan is relatively poor in water resources which are limited to the Ghor canal, small streams, springs and wells. To-date 386,000 dunums are under irrigated farming(1) in the Kingdom. In Karak and Ma'an Provinces there are 175 springs used as shown below :-

(1) Five Year Plan 1976 - 80

Province	No. of Springs	Type of Use				Total annual discharge (m^3 million)
		Domestic	Irrigation	Domestic + Irrigation	Unused	
Karak	104	8	15	81	-	46.083
Ma'an	71	5	4	59	3	7.013
Total	175	13	19	140	3	53.096

Source : Sources of Irrigation Water in Jordan, Authority for Natural Resources - 1974

No reliable records are available regarding the size of land which is irrigated from these springs but it is quite obvious that small scattered vegetable and fruit areas receive supplementary irrigation. More recently, underground water has been discovered in Abu Maktoub (Shobak District). It is estimated that 20 million M^3 could be pumped annually to irrigate 16,000 dunums. To-date 8 bore-wells were dug with a total annual capacity of 15 million M^3 sufficient to develop about 12,000 dunums.

6. Soils :

6.1. Thorough soil study is the solid foundation on which any plans for sound land use should be based. This way the soil may be put to the best use that would secure the highest possible sustained production. Realizing the importance of proper soil studies, the Jordanian government has prepared a plan for a complete soil survey and classification for the whole country as an integral

part of its development plans. For implimentation, a department of soil survey and classification was established within the Ministry of Agriculture in 1972. The five-year plan (1976 - 1980) includes a complete project for soil survey and classification to cover all the East Bank, at an estimated cost of JD 1.7 million.

The Soil Survey Department has already completed a semi-detailed soil survey for 600,000 dunums in Irbid District, a detailed survey for another 24,000 dunums in the same district and 72,000 dunums in Karak. The Natural Resources Authority has also carried out a reconnaissance survey in an area of 12,000 dunums in Shobak District to determine the soil suitability for irrigated farming. No soil survey was carried out at Tafila.

Based on available soil survey information and on visits made by the soil specialists to the project area, a brief discription of the main soil types is given below :-

6.2 Karak Area

Using aerial photographs (scale 1 : 10,000) and after thorough field studies, the different soil types in the area selected for survey were identified. Representative profiles were dug to varying depths according to the nature of the particular site. Profiles were described and sampled for laboratory analysis. Although results of analysis are not complete yet, the identified soils were classified by the Soil Survey Department into specific orders and series. Annex II includes description for seven profiles representing the identified soil types. In this section a brief account

of the main features of the soils in Karak district is given :

Soils in this area were formed on two types of parent material, accordingly they were put in two groups VIZ :-

Group No. (1) :

This first group represents soils formed on basalt and associated limestone, designated here as soil series (15). These are red or dark brown soils, with a deep profile, and a heavy clay texture dominated by montmorilonitic clay which is characterized by high water holding capacity. They have a blocky structure, with hard blocks that can only be broken with difficulty when dry. The dry soil has wide, deep cracks, more than 1 cm wide, that extend from the surface down to the second horizon, a depth of about 70 cm. Cracking is a known feature of montmorillonitic clay that exhibits swelling and shrinkage on alternate wetting and drying.

Cracking increases the chances of water evaporation from the subsoil and is also harmful for plant roots. Slickenside is observed at a depth of 25 - 70 cm.

These soils exist in slightly sloping landscapes (0 -8% slopes) where annual average rainfall is more than 300mm. As such they are considered to be suitable for field crops. However, under this amount of rainfall and sloping topography they are liable to be eroded and soil conservation works are necessary for maintaining soil productivity.

Group No. (2) :

This comprises soils formed on limestone which were classified into series (11), (12), (31), (32), (33), and (34). They are included in three orders :-

Order No. (1)

This order includes series (11) and (12) which may be found under annual average rainfall both below or above 300 mm. Soil properties are similar to those of series (15), the only difference being the parent material.

Order No. (2)

This encompasses series (31), (32), (33). Soils are brown to dark yellowish brown, with a silty to silty clay texture ; moderately hard when dry and contains varying amounts of calcium carbonate nodules throughout the profile. The profile is of intermediate depth and there are no cracks and no slickenside. These soils exist in areas of 250 - 300 mm annual rainfall, on landscapes of 3-15% slope. Soil moisture is moderate throughout the year, thus making these soils suitable for summer crops.

Order No. (3)

This comprises soil series (34). It is a relatively shallow soil, ranging from skeletal to a depth of 75 cm. It is light textured with low clay content. The top horizon has a light yellow to pale brown colour due to the large amount of calcium carbonate. It forms a calcareous surface crust of 0.5 - 1 cm thick that hinders water infiltration. The second horizon which is formed from soft calcareous rocks reveals a very slightly developed,

white coloured soil, with a very low water holding capacity. As such it is dry most of the year. This series is found on slightly to moderately sloping landscapes under about 250 mm of rainfall. From these features this soil is considered to be of a very limited suitability for crop production.

6.3. Tafila Region :

No soil study was carried out in this region, but field observations of the investigating team show that most of the soils are formed from limestone which was seen in surface outcrops. So, it is expected that most of the soil types encountered in Karak Region will be found here with the exception of series (15).

6.4. Shobak Region :

The Natural Resources Authority conducted a reconnaissance survey for 12,000 dunums at Abu Makhtoub to determine its suitability for irrigated agriculture. This survey indicated that the soils have formed mainly on chert rocks with some soils formed on basaltic and calcareous rocks. The soils encountered in some of Shobak villages were identified as entisols.

6.5. Soil Classification According to the American System :

In the American system of soil classification soils are grouped into ten orders, where soils of similar properties are put in the same order. Soils within each order differ in the degree of development of their profiles due to differences in the rate of the forming processes. This system

is considered a comprehensive system and it has been adopted in several countries. The adoption of the American system of soil classification in the Arab countries was recommended by the Advisory Committee of the Arab Centre for Dry and Arid Zone Soil Studies and also by the Middle East Research Centre at Ein Shams University (ARE). Accordingly, soils of Amman Governate have been classified according to the American system, and so will be the soils surveyed at Irbid Region. Similarly the soils of the project area were classified into :-

(1) Vertisols - which comprise soil series (11), (12), and (15).

(2) Inceptisols - comprising soil series (31), (32), and (33).

(3) Aridisols - represented by soil series (34).

(4) Entisols - encountered at Shobak region.

7. Infra-structure and Services :

7.1. A reasonable network of minor roads facilitate movement between villages in the project area and at the same time provide the required connection with the major national trunk roads. The main towns and villages are supplied with satisfactory telephone and post-office facilities.

7.2. Springs and wells provide all the requirements of domestic water supplies in addition to a surplus which is utilized for watering some vegetable and fruit crops.

Sufficient local power is available to satisfy the present electricity demands of Shobak, Tafila, Nigil and some neighbouring villages. Work is now in progress in a power project which will cover all the needs of Karak Province.

7.3. Elementary and junior secondary education is available at the level of each village. Senior secondary schools are situated in towns and large villages. The only agricultural training schools in the East Bank are located in Rabba and Shobak.

Health services are also adequate, the main hospitals are in Karak and Tafila and health centres exist in all major villages.

7.4. Storage in the project area is very inadequate and is mainly made up of household stores. The only modern store (two thousand tons' capacity) is situated in Rabba and is used for grain storage by Ministry of Supplies. However, two silos, each with a capacity of 50,000 tons are projected in Aqaba and Amman and will provide all storage requirements of grain produced in the project area.

7.5. The Ministry of Agriculture is represented by regional offices at Karak and Tafila and by an extension service office in Shobak. Agricultural services are offered to farmers through several well staffed advisory units and veterinary centres. In addition to research stations have been established in the project area , at Rabba and Shobak.

7.6. The Agricultural Credit Corporation offers credit facilities through three regional offices located at Karak Tafila and Ma'an. In 1976 credit supplied by these offices amounted to JD 227,000 from Karak, 144,000 from Tafila and 90,000 from Ma'an . These amounts appear insignificant when viewed in relation to the financing requirements of agricultural production in the two provinces.

7.7. In order to pave the way for the introduction of modern technology efforts were made to consolidate the fragmented land holdings into larger viable tracts of land . Agricultural cooperatives were used as a voluntary means of land consolidation but with very limited success. However, Karak and Tafila districts have had a reasonable share of development through the implimentation of the Soil Conservation and Olive Tree Planting Project since 1964 and the Development of Dryfarming Project since 1971.(1) The following works were completed :-

Item	Karak	Tafila
Area planted with fruit trees(d)	16,028	8,115
Area completely prepared for planting (d)	29,454	15,885
Total	45,482	24,000

(1) Also refered to as Highlands and Drylands Development Projects

8. Socio-economic Aspects :

8.1. The total population of Karak and Ma'an Provinces is 171,000[1]; the majority of whom, 166,000, live in Karak and 45,000 live in Ma'an. Within the areas selected for the project, the total population is estimated at 78,663 ; Karak leads with 56,457 persons followed by Tafila, 15,871 and Shobak 6,335. Average family size is 6.6 with equal number of males and females.

8.2. The majority of the population is engaged in sheep and goats rearing and in rainfed farming, either on their own lands or share-cropping land of absentee owners. Incomes fluctuate sharply from year to year following rainfall variability. In very poor seasons the government offers both food and feed materials at subsidized prices.

8.3. According to the 1975 census, illiteracy amongst the population of Karak and Ma'an Provinces was 45%. Those who can read or have received elementary or junior secondary education were 49% and 5% hold senior secondary school certificates. About 300 persons hold university degrees.

8.4. About 38% of the population are below 10 years of age, 22% are between 15 - 34 years and 16% in the 35 - 54 range.

8.5. The majority of manpower engaged in agriculture is in

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(1) Ministry of Municipal and Rural Affairs estimates.

the age-group 35-54. Most of the youth (15 - 34) seek jobs in other sectors and although no official statistics are available yet it is generally known that large numbers have left the rural area to other parts of the country or to other countries. Table 6.2 shows estimates of the various categories of manpower in the project area.

TABLE 6.2.

POPULATION AND MANPOWER IN PROJECT AREAS

District	Population	%	Permanent labour	%	Seasonal Labour	%
Karak	56,457	71,8	9,033	71.8	12,420	71.7
Tafila	15,871	20,2	2,579	20.1	3,492	20.3
Shobak	6,335	8,0	1,014	8.1	1,294	8.0
Total	78,663	100	12,585	100	17,306	100

Source : Agricultural Census 1975 and Ministry of Municipal and Rural Affairs.

Apart from sheep growers, farmers in the project area are temporarily unemployed during part of the year. On the other hand they face severe labour shortage during harvest. It is estimated (1) that farmers put in annually 127 man days (2) and that each family employs additional labour to the extent of 14 man days.

(1) Dryland Development Project Studies.

(2) An eight-hour working day.

CHAPTER III

PATTERNS OF LAND USE IN THE PROJECT AREA

1. Introduction :

In its efforts to establish the present level of land use in the project area the team resorted to the Department of Agricultural Economics and the regional agricultural offices at Karak, Tafila and Shobak in order to obtain the original crop statistics recorded at village level. Data related to field and vegetable crops covering the period 1969 - 75 was treated mathematically to arrive at average areas grown, tonnage produced and yields per dunum. These computed averages (which are detailed in appendix tables 1.3 to 21.3) were considered as representatives of the present state of seasonal cropping in the project area. Statistics on fruit trees similarly compiled in appendix tables 22.3 to 32.3 revealed some serious inconsistencies and fluctuations regarding the areas occupied by the various types of fruiting and non-fruiting trees from one season to another. Increases in areas of trees which have reached the production stage are at parity with the recorded decreases in areas of non-fruiting trees ; and new plantings do not correspond with the areas given for non-fruiting trees. In addition, occasionally records do not distinguish between rainfed and irrigated trees. All these inconsistencies have been taken as pointers to inaccurate recording ; such data was therefore overlooked except when discussing the general pattern of land use. Here the total area of fruit trees was considered as representing the status of fruit culture during the period 1969 - 75, the base year. For determining the up-to-date situation the records were completed from information provided

by the Department of Project Implimentation, Ministry of Agriculture, the department which has been responsible for carrying out development projects through which the largest portion of orchards has been planted in the project area.

2. Areas and Cropping Pattern :

2.1. Cultivable Land :

It is estimated that there is about 641,500 dunums suitable for crop production. Karak has the largest land area, 515,500 dunums, Tafila 65,000 and Shobak 61,000.

2.2. Crop Areas :

Over the period 1969 - 75 an average area of 396,000 dunums , about 62%, was annually put under the various types of crops. However, large fluctuations were experienced, and the total area has ranged from 517,000 dunums in 1974 to 230,000 dunums in 1970, (appx. table 33.3 - 36.3). From the available records the main highlights of cropping could be summerized as follows :-

a - Fruit Trees :

An average, 18,900 dunums were under orchards during 1969 - 75. The launching of the two development projects mentioned in earlier chapters has brought about a spectacular change in the landscape particularly since 1975. By June 1977, 27,227 dunums were planted with fruit trees and 45,339 dunums, were fully prepared to receive transplants (appx. table 37.3). It is pertinent to observe in this connection that despite the obvious suitability of the agro-environment for fruit tree culture, the area actually planted remained relatively meagre.

It must also be added that the greater part of the 162,000 dunums estimated as suitable for fruit trees is located on slopes exceeding 8%, and that 39% of this area lies on slopes of more than 15%. Yet the bias was towards seasonal cropping with all the concomitant dangers which ultimately result in soil erosion and loss of land. This seemingly illogical situation is attributable to :-

i - high initial costs of orchard establishment and the need for continued expensive cultural operations over a number of years before economic production is realized.

ii - the meagre financial resources at the disposal of farmers who are generally reluctant to invest in agriculture.

iii - low level of technical know-how amongst farmers.

iv - scarcity and high prices of transplants.

b - Field Crops :

These are by far the most popular crops grown in the project area, occupying 377,000 dunums annually, which constitute 98% of the total area put under seasonal crops. The major portion of this area (297,000 dunums) was cropped in Karak district, Tafila's share was 23,000 dunums and Shobak's 54,000 dunums. The emphasis on field crops is not unexpected in view of their relative superiority in resisting drought, pests and diseases. The availability of farm impliments all over the area is an added favourable factor. Furthermore, they do not pose any special difficulties of storage, packing or transport.

Wheat is the dominant crop, occupying an average annual

area of 259,600 dunums, followed by barley, 78,000 dunums. Together, wheat and barley were cropped in 90% of the land in the project area. This dominance is true in the project area as a whole and in each of the three locations when considered separately (appx. table 38.3). Amongst the factors contributing to this situation are :-

i - wheat and barley are more tolerant to drought than other field crops.

ii - wheat is the basic component of the farmers' diet and barley is the chief concentrate feed. Farmers always prefer to secure their requirements from these two commodities from the produce of their own fields.

iii- The two crops are amenable to mechanization, particularly harvesting which poses the biggest problems for the production of other field crops both in terms of effort and cost.

Lentils hold the third position in the order of popularity with an annual average area of 23,000 dunums which make up only 6% of the area put under field crops.

C - Vegetable Crops :

These occupy insignificant areas relative to field and fruit trees. Only 2,608 dunums, mainly in Karak, were annually grown. A small unrecorded portion of this area is known to receive supplementary irrigation from springs and wells. Production from this area does not cope with the needs of the region, a fact which is clearly reflected in shortages of vegetables in local markets. The lack of popularity of vegetable growing is a result of the following main factors :-

i - low average annual rainfall coupled with the absence of effective soil and water conservation practices.

ii - lack of technical knowledge regarding suitability of the various types and varieties of vegetables to the environment of the region.

iii - remoteness of the area from the main consumption centres.

iv - lack of know-how amongst farmers.

v - the high cost of production is, in most cases, beyond the farmers' limited resources.

2.3. The pattern of land use, in its totality shows marked seasonal fluctuations in both the gross area put under crops and the area alloted to specific crops. This pattern is indicative of the absence of any particular crop sequence or rotation ; actually the quantity of rainfall and its distribution during the season are the prime determinants of cropping.

3. Average Per-dunum Yield :

The striking feature of yields is the very wide fluctuation from season to season as illustrated in appendix tables 8.3 to 11.3 and 18.3 to 21.3. It can be seen in these tables that yields of wheat had ranged from 13 to 77 kg per dunum, averaging 54 kg during the period 1969 - 75. The fluctuation of yield is more apparent when individual areas are viewed separately. In Tafila yields per dunum varied from nothing to 62 kg and in Shobak the range was 22 to 95 kg. Barley yields were likewise variable ; they averaged 40 kg in 1969, 12 kg in 1970 and rose to 64 kg in 1972. Other crops show a similar unstable pattern.

A crucial fact is that the average per dunum production of the major crops in the project area is far below the Kingdom's national average, being only 77% and 60% for wheat and barley respectively (appex. table 39.3). The low level of yields is put in its correct perspective only when viewed in relation to production actually attained in the same area and over the same period in time. This is clearly evinced by the following comparison of wheat yields obtained by farmers with yields of demonstration plots grown in the project area during 1969 - 75 :-

	Variable	Location		
		Karak	Tafila	Shobak
1.	Yield from demonstration plots (kg /dunum)	132	132	117
2.	District average (kg/dunum)	57	40	45
3.	Difference (kg/dunum)	75	92	72
4.	Difference (% age)	132	230	160

Source : Yield of demonstration plots computed from the Research and Extension reports covering the period 1969 - 75.

It may be clarified that demonstration plots are tracts of land (about five dunums each) located in farmers fields. Cropping is completely taken over by the Research and Extension Department which is responsible for the impliment-ation of a National Wheat Development Project. The demonstra-tion plots receive the recommended inputs but are otherwise managed by the farmer in the same manner as the commercial crop. Concurrently an equal adjacent plot, completely

cropped by the farmer is demarcated as 'control' for comparison purposes. It is interesting to note that overall average yield of wheat reaped from controls grown in the project area during 1969 - 75 was 83 kg per dunum. This relatively high yield is attributed to three factors ; (a) plots are usually chosen in large fields which belong to the more progressive farmers. (b) such farmers usually adopt some of the demonstrated practices which help them to increase production and (c) farmers usually pay more attention to control plots.

Inspite of their relative superiority these high yields obtained from demonstration plots do not in reality reflect the real potential of the available resources in view of the absence of soil and water conservation works. Results of experiments conducted in the area are perhaps the closest to the maximum potential productivity which can be obtained. These compare as follows with yields previously discussed :-

Location	Yield per dunum (kg)			% Ages	
	Experimental plots (1)	Demonstration plots (2)	Farmers Av. Yield (3)	(2):(1)	(3):(1)
Rabba	210	132	57	63	27
Shobak	193	117	45	61	23

In addition to superiority of yields records reveal that annual production in experimental and demonstration plots show a much lower degree of seasonal fluctuation than commercial production.

4. Production :

The wide fluctuations of both annual crop areas and average yields per dunum previously discussed are naturally reflected in a wide variations of total annual production. This is true at the level of the individual farm as well as the whole project area. This feature has consequently resulted in unstable incomes and uncertain food and feed supplies.

5. Constraints

In view of the foregoing, it is evident that farmers have not been able to utilize efficiently the available resources. In order to enable the team to envisage a much improved pattern of production it was necessary to review and come to grips with existing cultural practices with the aim of detecting problems and bottlenecks which must be removed to pave the way for better resource use. An appraisal of the detailed account of crop production practices contained in annex III exposes the following major deficiencies :-

5.1. Land Fragmentation

Holdings are generally small and commonly made up of small narrow rectangular strips running length-wise along the slope. Under such conditions correct mechanized cropping practices which contribute to soil and water conservation could not be implemented with any degree of assured success.

5.2. Low Level of Soil and Water Conservation :

Rainfall interacts with sloping topography to cause considerable loss of both soil and rain water. Under such circumstances the use of modern inputs would only yield sub-optimal harvests. The loss is accentuated by the practice of deep ploughing carried out in the direction of

the slope. The reversal of this detrimental process can only be achieved through the full knowledge of soil condition, topography and rainfall and necessitates the construction of suitable anti-erosion works and the use of the correct implements for land preparation and sowing. Farmers, crippled by lack of know-how and limited financial resources are unable to cope with the situation and stand helpless against the obvious loss of national wealth.

5.3. Failure to Grow Crops in the Most Suitable Environment:

Extension organizations emphasize the importance of growing each crop in the most suitable environment for its production. Extension programmes are planned to convince farmers not to grow field crops in areas where average annual rainfall is below 250 mm. Barley is the only crop recommended between isohyets 250 - 300 mm.. Gently sloping land (0 - 8%) should be reserved for seasonal cropping where there is greater need for the use of machinary. Steeper slopes with shallower soils are recommended for fruit trees. However, the present pattern of land use is still too remote from what the extension service hopes to achieve ; wheat and barley are grown in areas much too dry for their needs, seasonal cropping is practised in very steep slopes and orchards continue to be established in the plains.

5.4. Inadequate Crop Rotations and Sequences :

Appx. tables 33.3 -36.3. are interesting because they clearly show the absence of any regular cropping pattern. Annual crop and fallow areas vary widely from one season to another ; the decision whether land is to be cropped or fallowed is a matter which ultimately depends on the farmers' own assessment of the amount of moisture stored in the soil

at the time of sowing.

5.5. Shortage of Quality Seeds & Seedlings :

The limited agricultural research facilities in the country have been mainly directed towards the two major crops, wheat and barley. Research activities have yielded superior varieties which out-yielded local varieties under all agro-environmental regions of the country. The wheat variety Deir Alla 2 and Barley varieties Deir Alla 102 and 106 have proved their superiority beyond doubt in the project area both in experimental plots at Rabba and Shobak and in demonstration fields in farmers land over many years. Unfortunately sowing seed is in short supply and these improved varieties did not find their way to farmers. It is noteworthy that the production of sowing seed in Jordan falls severely short of demand. During 1969 - 75 only one thousand tons of wheat seed and one hundred tons of barley seed were annually produced, while the demand was 20,000 tons and 5,000 tons of wheat and barley seed respectively. Regarding other field crops, the available experimental data is too scanty to justify the adoption of varieties other than those traditionally grown.

Vegetable seeds are commonly produced in farmers fields without much technical know-how or supervision. Tomatoes and onions, seedlings are raised by farmers or in privately owned nurseries by traditional methods which pay little attention to variety, uniformity or crop sanitation. Recently, however, the Arab Organization for Agricultural Development has completed a feasibility study for the production of vegetable seeds in the Kingdom. The results were encouragingly positive.

It is of interest to note that farmers strictly observe the practice of treating wheat and barley seeds against covered smut. No other seeds are treated, simply because there are no specific directives to do so from the appropriate government authorities.

The bulk of fruit tree seedlings is produced in government nurseries. In the past problems were encountered in connection with uniformity and variety of both scion and stock. More recently, however, the situation has been rectified and government nurseries work on a pre-planned system which specifies variety, stock and scion for each type of tree in each agro-environment.

5.6. Low Standard of Seed-bed Preparation :

Deep ploughing along the slope is presently the basic land preparation operation. Ironically, inspite of its unfavourable influences on water and soil conservation, this operation is much more expensive than the recommended shallow contour ploughing. Seed beds for vegetable crops are not taken to the required fine stages and furrowing is done much earlier than is necessary thus leading to loss of soil moisture.

Excluding areas encompassed by development projects, many orchards have been established on sloping stoney land without removal of stones or erection of stone walls. Under such conditions problems of soil erosion, water loss and proper husbandry of orchards are commonly experienced.

5.7. Inadequate Fertilizer Use :

Despite the great efforts of the Ministry of Agriculture to promote the use of fertilizers the response of farmers has been disappointing. In its endeavours to encourage fertilizer use the government has imported and offered to farmers nitrogenous fertilizers at cost prices. Only a limited number of farmers made use of this facility, the majority considered the price beyond their financial ability.

5.8. Low Standard of Seeding and Planting :

Most field crops are sown by hand broadcasting of sub-optimal seed rates which are subsequently disced into fairly rough seed-beds. This practice results in irregular seed distribution, both horizontally and vertically and produces a thin patchy crop-stand which fails to make use of the available resources.

Vegetable farmers, obsessed by inadequate soil moisture content are usually inclined towards wide spacing. Coupled with irregular spacing this practice results in an inadequate crop-stand.

Orchards also show defective practices such as narrow irregular spacing of a mixture of types and varieties in the same piece of land. Such practices make it exceedingly difficult to carry out cultural operations and result in serious reduction in both quantity and quality of produce.

5.9. Low Level of Crop Husbandry

The standard of husbanding all crops is generally low. in particular pests, diseases and weeds are very poorly controlled. Pruning, shaping of fruit trees and thinning of fruits are neither correctly nor timely performed.

6. Animal Production :

Annex III includes a detailed account of the pattern of animal production as practised in the project area. Its main feature is transhumance or semi-nomadism which are followed in persuance of utilizing natural grazing and cultivated crop residues. The factor which is most limiting to animal production in the project area is improper feeding.

CHAPTER IV

1. Objectives

THE PROJECT

1. The rainfed agricultural resources of the East Bank of Jordan have not, as yet, had the opportunity to reach anywhere near their potential productivity. In consequence, returns from dryland farming have remained low and unremunarative, particulary when compared with other sectors of the economy, a fact which has substantially contributed to the serious exodus of rural youth to towns. Concurrently, the dominance of deep ploughing in the direction of slopes is causing serious erosion and progressive loss of soil. Farmers are unable to cope with this critical situation which unavoidably calls for government intervention to halt the deterioration of the country's national wealth and concurrently to raise production and productivity to levels which would ensure incomes capable of supporting the high standard of rural life that the government seeks.

The Jordanian government has for long recognised the problem. Increasing government awareness of the need to develop rainfed resources is shown by the emphasis put on dryland farming as an integral part of the strategy for the overall socio-economic development. Specifically, the five year development plan (1976 - 80) includes ' The Integrated Rainfed Development Project at Irbid' over an area of 600,000 dunums with an estimated cost of JD 5.6 millions. This project was initiated, as mentioned previously, by a request from the Jordanian Government for FAO assistance in rainfed development. As a result of an FAO Investment Centre report submitted in 1974, a pilot area of 2,000 dunums of wheat developed in 1975 - 76 through FAO assistance north of Irbid demonstrated the success of the proposed modern technology. Government keenness to develop dryfarming is further stressed by the requests made for the Arab Organization For Agricultural Development to conduct

- provision of all requirements in a manner which will effectively ensure the use of modern inputs.

The following programmes have, therefore, been proposed for synchronized implementation and in close coordination with other current and projected development programmes :-

2-1. Semi-detailed soil survey.

2-2. Consolidation of the fragmented land holdings to form viable units suitable for the implementation of the proposed programmes.

2-3. Soil conservation.

2-4. Timely Provision of production requirements.

2-5. Development of seasonal and fruit crops to include :

- development of existing orchards (1977 areas)
- horizontal expansion of fruit production in areas already prepared for planting. Expansion will also cover suitable lands located in slopes which exceed 8%.
- development of seasonal cropping.

2-6. Strengthing adminstrative and technical institutions including agricultural research and extension.

It is to be noted at this point that the study has considered the desirability of raising the utilization of the available animal wealth as part of an integrated project. The investigations contained in Annex III have shown that the general pattern of animal production depends on transhumance and semi-nomadism within and outside the two provinces in order to utilize seasonal natural grazing ; thereafter animals depend on fodders and crop residues produced in rainfed areas. Estimates reveal that feed production, even after the implementation of the project, will fall short of satisfying maintenance requirements of current populations of large animals. It has, therefore, been concluded that it is not possible to include in this

project a component of animal development for this is a matter which must be based on a national policy for the development of natural pastures.

With regards to forestry, the five year plan (1976- 80) includes an afforestation project covering 150,000 dunums at an estimated cost of JD 1.68 million. Afforestation is undertaken by the government on a national scale and has, therefore, been excluded from this project.

3. Soil Survey Programme :

In view of the serious lack of information regarding soils and topography a semi-detailed soil survey is proposed for all lands within the project boundaries, with the exception of 72,000 dunums already covered. This will provide the scientific base for land use planning and for drawing up the details of soil conservation works.

The total area to be surveyed is 935,000 dunums, and the survey is expected to be completed in 42 months. It is proposed that this work may be undertaken by the Soil Survey Section of the Department of Project Execution after it is sufficiently strengthened to cope with the work. Total cost is estimated at JD 239,000, (for details see annex IV). In case implementation of the whole project is delayed for any reason it is strongly recommended that the project area should be given high priority within the national soil survey project contained in the current development plan.

4. Consolidation of Fragmented Holdings :

This is considered the foundation upon which all development will be built. The introduction of modern inputs necessitates the use of machinary for soil conservation works and for cross-slope contour cropping which can only be carried out in larger land units. Cooperative societies are considered

the most effective means of grouping fragmented parcels. However, consolidation of larger holdings could be brought about on the basis of kinship groups. In this latter case owners will undertake in writing that they will use all cultural practices recommended by the technical departments concerned.

It is worthy of mention at this juncture that agricultural cooperatives have not met much success in Karak district in the early stages of the Highland and Dryland Development Projects. A dramatic change has fortunately taken place during 1976 and 77 ; farmers applications to join the Dryland Farming Project were far in excess of the most optimistic anticipations, so much so that the project administration was unable to cope with all of them. On the other hand a spectacular success, both in terms of numbers and performance was made by cooperatives formed under the auspices of the Integrated Rainfed Agricultural Development Project in Irbid District. It is perhaps imperative to state that this keen interest to join development projects is motivated primarily by government subsidies provided for soil conservation works, agricultural machinary, inputs and cultural operations, at a time when demonstrations have convinced farmers of the value of modern techniques in raising productivity.

In view of the past unhappy experience of the cooperative societies in Karak, it is proposed that efforts must be concerted in the project area to consolidate holdings. These should be jointly coordinated to include extension servicemen, information officers and cooperative leaders from Irbid district. Convincing farmers may require a call on their patriotism to conserve national wealth, an aim which could only be achieved by grouping of small land parcels. Further, it is suggested that government subsidies, in particular for soil conservation, should be maintained at a level which provides sufficient incentives for farmers to maintain present interest.

5. Soil Conservation Programme :

The aim of this programme is two-fold :

- to protect the soil from deterioration and loss caused by erosion
- to reduce run-off and keep rain water for the longest possible time to allow maximum retention by the soil.

It is needless to mention that under such arid conditions rain water conservation is the most important single pre-requisite for the utilization of modern inputs by crop plants.

Soil conservation works are to be carried out in all cropable lands, as yet unconserved. Contour earth banks are estimated to cover 469,500 dunums (the area allotted for seasonal cropping), while stone terraces will be constructed on the 80,000 dunums planned for the horizontal expansion of orchards. It is to be noted that these works will extend to adjacent lands which might be of potential danger to crop land. It is envisaged, that one fifth of the area will be covered annually .

Total costs will amount to JD 2.971 million. Estimates were based on actual costs incurred in 1976 during the execution of the Development Project at Irbid. These costs were increased by 20% in view of the remoteness and ruggedness of the present project area (for details see Annex IV, 2.) It is proposed that the project administration should undertake execution in collaboration with the Soil Conservation Section of the Department of Project Execution. Furthermore, it is suggested that a small soil conservation unit be kept within the project administration to maintain, follow-up and promote effectiveness of soil conservation works. It is anticipated that such a unit will be formed in year six, i.e. after completion of the original major works, for a period of ten years at an estimated cost of JD 287,000.

6. Provision of Inputs :

Perhaps the most important and far reaching single function of the administration lies in the timely acquisition and provision of production requirements. It is proposed that such requirements will be acquired by the project administration and loaned to farmers and cooperative societies in accordance with conditions to be laid by the appropriate government institutions.

7. Development of Fruit Trees and Seasonal Crops :

The basic concepts on which development will rest are :

- growing crops in agro-environments which are most suited to their production,

- subjugation of the rugged topography for growing fruit crops and in consequence enlarging crop areas,

- intensification and diversification of cropping with the aim of reducing the fallow and stablizing farmers' incomes,

- the correct use of suitable agricultural machinary,

- use of modern agricultural inputs already proved to raise yields and reduce production fluctuations.

Accordingly the various components of the programme have been worked as follows :-

7.1. Development of Fruit Trees :

7.1.1. The area suitable for cropping in slopes greater than 8% is estimated at 181,500 dunums. Much of this land is under seasonal cropping at present, being subjected to serious erosion hazards. In line with government policy to discourage seasonal cropping in such sloping lands it is proposed to devote all such areas in Karak and Tafila which receive an annual average rainfall of 275 mm and above to fruit tree

planting. In Shobak, however, elevation imposes limitations on olives and almonds, the most drought tolerant trees. Therefore an area of 19,500 dunums falling between 8 - 12% slopes will be allotted to seasonal cropping and only 11,520 dunums will be developed with fruit trees other than olives and almonds. Irrigated fruit gardens are excluded. The total area of fruit trees to be included in the project will thus be 152,566 dunums categorised as follows :-

- 27,227 dunums already under rainfed fruit trees (appx. table 1.4)
- planting of trees on 29,454 dunums in Karak and 15,885 dunums in Tafila, previously stone - terraced through the activities of The Highland and Dryland Farming Projects.
- horizontal expansion over 80,000 dunums on land situated in slopes greater than 8% and receiving no less than 275 mm of average annual rainfall.

7.1.3. Types of Fruit Trees to be Grown :

Proposals regarding the areas to be planted by the various types of fruit trees were based on the following considerations :-

7.1.3.1. In view of the unfavourable effects of elevation upon flowering and fruit-set, olive planting should be restricted to locations within 900 m above sea level.

7.1.3.2. Almonds which normally flower in February or March are execluded from planting in Shobak where flowers are prone to damage caused by frost likely to occur all through the winter months and until April.

7.1.3.3. The relatively dry conditions of the project area dictates growing the most drought tolerant types of

fruit trees.

7.1.3.4. The need for using stocks capable of tolerating the very high level of calcium in the soil.

7.1.3.5. High transportation costs reduce the competitiveness of fruits produced in this remote project area. To overcome this problem special favour was given to late maturing varieties of grapes. The prevailing low temperatures in the project area - particularly in Shobak - are advantageous since they will help in the production of an even later & more competitive crop than could be produced elsewhere in Jordan.

7.1.3.6. Area located in elevations above 900 mm should be planted with grapes and other suitable fruit trees(1)

7.1.3.7. For the best utilization of resources, areas favoured by relatively deep soils and high rainfall may be planted with olives interplanted with grapes. This arrangement would allow the use of spaces which are not needed by the young olive trees before they reach the size which requires all the allotted space.

7.1.3.8. Only one type of tree will be grown in locations with relatively shallow soil and low rainfall.

7.1.3.9. The area suitable for cropping in slopes exceeding 8% is 181,500 dunums equivalent to 38% of the gross area occuring in slopes of more than 8%. Theoretically, an area of 298,500 dunums lying adjacent to or above orchards will not be used. In practice, however, such areas are of appreciable value to fruit production by way of their sizable contribution to the amount of water received by crop land. Lying mostly on very steep slopes, with surfaces dominated by bare rock or exceedingly shallow soils, these areas are incapable of

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(1) These include plums, apples, quince, pears, cherries and pistachio.

retaining rainwater. Depending on location, run-off water is either naturally or could artificially be channelled to increase the amount of rainwater received by cultivated land.

On account of the foregoing considerations the areas shown in table 1.4 were assigned for the horizontal expansion of the different types of fruit trees. The overall picture of orchards will be as contained in table 2.4.

7.1.4. Phasing Development :

Development will begin with areas which are ready for fruit tree planting ; these should be completed in the first two years. Horizontal expansion will start in year 2 ; one fifth of the area will be developed annually. Areas to be developed, by type of fruit and location, in the first six years are shown in appx. table 2.4.

7.1.5. Yields per Dunum :

Fruit tree development is primarily based on the proper scientific study of each orchard location and on :

- the correct implementation of soil conservation works,
- adoption of all modern techniques of planting and husbanding orchards,
- increase of stored soil moisture for use by trees,
- plant protection against pests, diseases and weeds,
- proper fertilizer use.

Under such conditions yields per dunum are projected to be at the levels shown in table 3.4. Detailed costs of production are based on 1976 prices and are contained in Annex Tables 6.4. to 9.4.

TABLE 1.4.

AREAS PROJECTED FOR HORIZONTAL EXPANSION OF FRUIT TREES

(A) Area already terraced through the activities of dryland and Highland development projects.

(B) Newly proposed areas.

(C) Total area

(Dunums)

		Karak	Tafila	Shobak	Total
1. Olives	(A)	-	-	-	-
	(B)	10,000	-	-	10,000
	(C)	10,000	-	-	10,000
2. Grapes	(A)	5,000	2,000	-	7,000
	(B)	5,000	3,000	5,000	13,000
	(C)	10,000	5,000	5,000	20,000
3. Mixed Olives & Grapes	(A)	20,000	10,000	-	30,000
	(B)	20,000	10,000	-	30,000
	(C)	40,000	20,000	-	60,000
4. Others	(A)	4,454	3,885	-	8,339
	(B)	15,000	7,000	5,000	27,000
	(C)	19,454	10,885	5,000	35,339
5. All Types	(A)	29,454	15,885	-	45,339
	(B)	50,000	20,000	10,000	80,000
	(C)	79,454	35,885	10,000	125,339

Source : (A) Department of Projects, Ministry of Agriculture, Amman

(B) Team estimates.

TABLE 2.4.

TOTAL AREAS OF FRUIT TREES AFTER DEVELOPMENT

(DUNUMS)

Fruit Tree	Karak	Tafila	Shobak	All project areas
Olives	15,077	366	285	15,728
Grapes	13,371	5,420	5,040	23,831
Mixed Olives and Grapes	47,500	22,500	-	70,000
Others	22,147	15,760	5,100	43,007
Sub Total	98,095	44,046	10,425	152,566
Irrigated Area	7,387	954	1,095	9,436
Grand Total	105,482	45,000	11,520	162,002

TABLE 3.4.

PROJECTED PER DUNUM YIELD OF FRUIT TREES (KG)

Crop	Year 1-3	4	5	6	7	8	9	10	11	12	13	14	15	16-30
1.Olives	-	-	-	30	-	40	-	50	-	110	110	110	110	110 (1)
2.Grapes	-	70	140	200	560	560	560	560	560	560	560	560	560	- (2)
3.Mixed olives & Grapes :														
A.Olives	-	-	-	30	-	40	-	50	-	110	110	110	110	110 (1)
B.Grapes	-	35	70	100	280	280	280	280	280	280	280	280	280	- (3)
4.Others	-	-	150	150	800	800	800	800	800	800	800	800	800	- (4)

(1) Alternate bearing assumed to be effective before year 11.

(2) Grapes will be uprooted after harvest in fifteenth year and replanted in the following year.

(3) Grapes will be uprooted after harvest in year 15 and no replanting takes place

(4) Other fruit crops will be uprooted after harvest in year fifteen and replanted in the following year.

7.2. Development of Seasonal Crops :

7.2.1. Total area allotted for seasonal crops is 479,500 dunums as compared to 622,600 dunums estimated to have been used at present. The reduction in area is due to the proposed horizontal expansion in orchards over land which is more suited to trees than seasonal crops.

7.2.2. Crop Rotations and Areas :

For the purpose of designing crop rotations each project area has been divided into units of similar average annual rainfall (table 4.4.). The proposed crop rotations took into consideration the following points :-

TABLE 4.4

AVERAGE ANNUAL RAINFALL IN AREAS ALLOTTED FOR SEASONAL CROPS - BY LOCATION

(AREA IN 000' DUNUMS)

Location	Average Annual Rainfall		Total
	250-300 mm	> 300 mm	
Karak	62.0	348.0	40.0
Tafila	16.0	4.0	20.0
Shobak	49.5	0.0	49.5
Total	127.5	352.0	479.5

7.2.2.1. Limiting barley cultivation within areas which receive an annual average rainfall of less than 300 mm.

7.2.2.2. The insistence of farmers to secure their wheat requirements from their own production. This necessitated the inclusion of wheat in areas receiving less than 300 mm of annual precipitation in Tafila and Shobak. However, it is

recommended that wheat should be restricted to deep soils occuring in the vicinity of the 300 mm isohyet.

7.2.2.3. Crops other than wheat and barley could be grown in deep soils situated in favourable locations close to the 300 mm isohyet to satisfy farmers needs.

7.2.2.4. The need to increase area under legumes.

7.2.2.5. Wheat and barley should not follow one another in any piece of land. Thus, together, they should not occupy more than half the area allotted for seasonal crops.

7.2.2.6. The fallow system should be retained in areas receiving an average annual rainfall of less than 300 mm. When fallow, the land will be worked with the aim of weed control and moisture conservation.

7.2.2.7. Complete mechanization of wheat and barley production.

7.2.2.8. Shortage and high costs of labour required for pulse and vegetable production and in particular during harvest time.

7.2.2.9. Expansion of onion production, a crop which can easily be produced, stored and marketed.

7.2.2.10. Adoption of the cultural practices proposed in Annex IV.

On the basis of these assumptions a number of rotations have been suggested and elaborated in Annex IV. When implemented crop areas by location will be as shown in appx. table 3.4. Altogether, the proposed fruit tree and seasonal crops areas will bring about the following changes in the overall pattern of resource use :-

i - Increase of the annual crop area from 396 to 533 thousand dunums. This is a direct result of the horizontal expansion of fruit growing in steep slopes.

ii - Enlargement of orchards from the present base year level of 18,900 dunums to 162,000 dunums. Inspite of this ascent, the area of seasonal crops will be maintained at present levels.

iii- Intensification of seasonal cropping from 60.6% to 77.3%.

iv- Changing the cropping pattern in a manner which reduces areas of wheat and barley and increases the area of other seasonal crops.

7.2.3. Projected per Dunum Yields :

For the estimation of target yields use was made of the results of the relevant experimental and demonstration plots grown within and outside the project area. Note was also taken of average yields actually obtained during 1969 - 75. Recognizing that soil and water conservation will cover all crop land and that all recommended inputs will be used, target yields are expected to exceed present yields by about 40 - 100%. It is supposed that the upward trend from existing level will follow the compound interest path to reach its targets over a period of five years.

Projected crop yields by location and on a year-by-year basis are presented in tables 5.4 - 7.4.

7.2.4. Phased Development of Crop Areas :

Seasonal crop areas will develop in synchrony with soil conservation works over five years as shown in appx. tables 4.4 and 5.4.

TABLE 5.4.

PROJECTED DEVELOPMENT OF PER DUNUM YIELDS OF SEASONAL CROPS PRODUCED IN KARAK

(KG)

Crop	Present Yields	Projected Yields				
		Year 1	2	3	4	5
Wheat	57	64	71	80	90	100
Wheat Straw	57	64	71	80	90	100
Barley	40	45	50	56	63	70
Barley Straw	40	45	50	56	63	70
Lentils	43	45	50	56	63	70
Lentils Hay	62	68	75	84	95	105
Vetches	32	36	40	45	50	56
Vetch Hay	48	54	60	68	75	84
Chick Peas	59	64	68	72	77	83
Chick Peas Hay	84	96	102	108	116	125
Other Field Crops	55	59	63	67	71	75
Other Field Crops Hay	83	89	95	101	107	113
Tomato	458	510	585	660	745	850
Onions	294	340	390	450	510	600
Melons	488	545	610	685	770	850
Cucurbits	357	400	440	490	540	600
Others	145	160	180	200	230	250

TABLE 6.4.

PROJECTED DEVELOPMENT OF PER DUNUM YIELDS OF SEASONAL CROPS PRODUCTION IN TAFILA

(KG)

Crop	Present Yields	Projected Yield				
		Year 1	2	3	4	5
Wheat	40	45	50	56	63	70
Wheat Straw	40	45	50	56	63	70
Barley	37	41	46	52	58	65
Barley Straw	37	41	46	52	58	65
Lentils	60	64	69	74	79	84
Lentils Hay	90	96	104	111	119	126
Vetch	77	80	83	86	89	92
Vetch Hay	116	120	125	129	134	138
Chick Peas	54	57	61	66	71	77
Chick peas Hay	81	86	92	99	107	116
Other Field Crops	50	54	59	63	69	75
Other Field Crops Straw	75	79	89	95	104	113
Tomato	-	-	-	-	-	-
Onions	294	340	390	950	510	600
Melons	488	695	725	765	800	850
Cucurbits	357	-	-	-	-	-
Other Veg. Crops	145	160	180	200	230	250

TABLE 7.4.

PROJECTED DEVELOPMENT OF PER DUNUM YIELDS OF SEASONAL CROPS PRODUCED IN SHOBAK

(KG)

Crop	Present Yields	Projected Yields				
		Year 1	2	3	4	5
Wheat	45	50	56	63	71	81
Wheat Straw	45	50	56	63	71	80
Barley	39	44	49	55	61	68
Barley Straw	39	44	49	55	61	68
Lentils	47	-	-	-	-	-
Lentils Hay	71	-	-	-	-	-
Vetches	77	-	-	-	-	-
Vetches Hay	116	-	-	-	-	-
Chick Peas	38	-	-	-	-	-
Chick Peas Hay	57	-	-	-	-	-
Other Field Crops	39	43	47	51	55	60
Other Field Crops Straw	59	65	71	77	83	90
Melon	818	-	-	-	-	-
Cucurbits	520	-	-	-	-	-
Other Veg. Crops	300	-	-	-	-	-

7.2.5. Costs of Production :

These were estimated on a per-dunum basis for each crop to be grown in each project area and are presented in annex tables 11.4 and 12.4. The unavoidable assumption was made that all recommended practices will be followed.

7.2.6. The Impact of the Project on Total Agricultural Production :

Taking into consideration all the influents discussed in the proceding sections of this report annual total production, over the lifetime of the project, has been computed and presented in tables 8.4 and 9.4, while production by location is contained in appx. tables 6.4 - 9.4. Comparison between present and projected production is approached differently for seasonal and perennial crops. For the former the comparison was made between present and target production stably attainable from year 9 onwards. The latter presents a different pattern, because fruit tree production with the only exception of olives, never assumes a stable pattern for two obvious reasons :-

- trees are planted during the first six years,
- with a life span of fifteen years trees are cut out and replanted in the sixteenth year.

Thus total productive areas and overall age structure of orchards assume a changing annual pattern. Therefore, the impact of the project on fruit production will be put in its proper dimension only when present production (the annual average of 1969 - 75) is compared with the average annual production during the lifetime of the project. Such a comparison had to be made inspite of the doubts mentioned in Chapter II regarding the reliability of present levels of

TABLE 8.4.

TOTAL PROJECTED FRUIT PRODUCTION

(000 TONS)

Year	Olives	Grapes	Others	Year	Olives	Grapes	Others
1	0.2	3.5	2.2	16	7.8	31.3	24.8
2	0.2	3.6	2.3	17	8.4	15.8	18.8
3	0.8	3.7	2.3	18	9.0	12.5	12.7
4	0.8	4.7	2.5	19	9.0	8.6	10.4
5	0.8	7.6	2.8	20	9.0	6.2	6.8
6	1.3	13.6	4.5	21	9.0	5.1	4.7
7	1.9	22.3	6.8	22	9.0	8.1	8.9
8	2.0	25.4	13.8	23	9.0	9.5	15.9
9	2.3	28.6	20.6	24	9.0	11.0	20.2
10	2.5	30.6	27.1	25	9.0	12.3	24.2
11	2.8	30.1	28.4	26	9.0	11.2	25.5
12	10.0	30.1	31.9	27	9.0	11.2	28.3
13	4.1	30.1	31.9	28	9.0	11.2	28.3
14	5.2	30.4	31.9	29	9.0	11.2	28.3
15	7.0	28.5	28.7	30	9.0	11.2	28.3

TABLE 9.4

PROJECTED ANNUAL PRODUCTION OF SEASONAL CROPS IN ALL PROJECT AREAS

(TONS)

Crop	Year 1	2	3	4	5	6	7	8	9	10-30	Total (000Tons)
Wheat	2,381	5,024	8,001	11,351	15,075	16,418	17,499	18,246	18,620	391,020	504
Wheat Straw	2,381	5,024	8,001	11,351	15,075	16,418	17,499	18,246	18,620	391,020	504
Barley	442	933	1,485	2,102	2,788	3,033	3,228	3,363	3,433	72,093	93
Barley Straw	442	933	1,485	2,102	2,788	3,033	3,228	3,363	3,433	72,093	93
Lentils	463	977	1,552	2,198	2,915	3,169	3,372	3,514	3,585	75,285	97
Lentils Hay	695	1,466	2,328	3,297	4,373	4,754	5,058	5,271	5,378	112,938	145
Vetches	144	304	484	684	908	988	1,052	1,096	1,120	23,520	30
Vetch Hay	216	456	726	1,026	1,362	1,482	1,578	1,644	1,680	35,280	45
Chick Peas	320	680	1,040	1,425	1,840	1,915	1,440	2,045	2,075	43,575	57
Chick Peas Hay	480	1,020	1,560	2,138	2,760	2,872	2,985	3,068	3,113	65,373	85
Other Field crops	106	221	344	476	617	652	678	696	705	14,805	19
Other Field Crops Straw	159	332	516	714	926	978	1,017	1,044	1,058	22,208	29
Total Grain	3,856	8,139	12,906	18,236	24,143	26,175	27,819	28,960	29,538	620,298	800
Total Hay &Straw	4,285	9,048	14,334	20,239	26,782	29,011	30,822	32,080	32,719	687,099	886
Tomato	408	876	1,404	2,000	2,680	2,952	3,146	3,316	3,400	71,400	92
Onions	721	1,548	2,502	3,583	4,855	5,406	5,851	6,169	6,360	133,560	171
Melons	383	807	1,279	1,805	2,383	2,578	2,732	2,838	2,890	60,960	78
Cucurbits	400	840	1,330	1,870	2,470	2,670	2,830	2,940	3,000	63,000	81
Other Veg.crops	81	172	273	388	515	560	596	621	632	13,272	17
Total veg.crops	1,993	4,243	6,788	9,646	12,903	14,166	15,155	15,884	16,282	341,932	439

production. It may be stated, here, that the team considers the recorded present yields of rainfed fruit trees much higher than what could be obtained in view of a number of factors, chief amongst which is the incorrect pooling of irrigated and rainfed production.

The main points emerging from the comparisons which are portrayed in appx. tables 10.4 - 14.4 when viewed in conjuction with areas allotted for crops are :-

- the project will bring about appreciable increases in the production of all types of crops. This increase however, varies between crops and amongst project areas.
- increases in wheat and barley production are realized as a result of vertical expansion since they will occupy a smaller area in future.
- increased production in all other crops is a result of both horizontal and vertical expansion.

Project Management :

It is proposed that the management of the project should be part of within the Department of Project Implimentation of the Ministry of Agriculture which is the Government institution responsible for the implimentation of all agricultural projects. The proper execution of project actions in the desired manner calls for the positive involvement and contribution of all those who are concerned, and in particular farmers who are in fact the direct benificiaries. It is therefore suggested that the project should be run by a Board of Directors which will be directly responsible for laying out the general policy for the execution of all administrative, financial and technical project actions. The Permanent Undersecretary of the Ministry of Agriculture is proposed as Chairman. The Board membership should include a representative of

the Ministry of Agriculture. These proposals are made to ensure a complete coordination between the policies laid down by the Ministry and its technical departments on the one hand and the policies and executive organs of the Board of Directors on the other hand.

This arrangement is imposed by the fact that the project is in the final analyses, a part of the national agricultural development plan and that its execution will depend on the technical support which must be provided by the government technical institutions. The Board must therefore be constituted in such a manner which will not permit complete separation from the Ministry of Agriculture. At the same time sufficient autonomy and flexibility must be allowed in dealing with administrative and financial matters without necessarily adhering to central government practices. A special set of financial regulations may be included in the act of its constitution. Of fundamental importance is the right of the board to appoint personnel, either by direct contract or on secondment basis in accordance with government practices. The board will pay all salaries and allowances directly to its staff as a measure which dictates allegance to a single institution, the project.

8.1. Board of Directors :

The board will be constituted with the Permanent under Secretary of the Ministry of Agriculture as an ex-officio chairman. Members will be representatives of the following institutions.

- Ministry of Agriculture
- The Jordanian Cooperative Organization.
- Agricultural Credit Corporation.
- Agricultural Marketing Organization.

- Agricultural Cooperative Societies in the Project Area.
- Farmers who are not members of Cooperative Societies.

The Project Manager should be a member of the board. Membership may also include any other persons considered as important contributors to the board.

The functions of the Board shall be :

- laying down the overall policy of implementation,
- monitoring of execution,
- appointment of technical and administrative personnel and drawing up rules and regulations governing terms of reference,
- general coordination between the executing parties in order to curb conflicts and reduce costs.

8.2. The Administrative and Technical Organization :

It is proposed that the management will consist of a project manager, an assistant and five divisions which function at headquarters level. These are :-

i- Research and Development Division :

This will include specialists in field crop, vegetable and fruit production assisted by three research assistants. They will undertake :

- conducting applied research aiming at improvement of production,
- assisting in the implementation of methods of production which prove their suitability.

ii- Agricultural Extension, Information and Cooperatives Division :

The head of this unit will be assisted by two high ranking officers, one for agricultural extension and the other for cooperatives. This department will organize and supervise farmers cooperatives in addition to carrying out all extension service activities.

iii- Planning and Control Division :

Made up of an economist and and an assistant this division will be responsible for monitoring and reporting of the progress of execution as well as collecting all statistics concerning the project.

iv - Agricultural Engineering Division :

Three agricultural engineers are required to man this division throughout the lifetime of the project. In addition the soil conservation unit previously proposed to be kept within the project administration between the 6th and fifteenth year will be attached to this division. Responsibilities given to this division are :-

- to assist in the procurement of the most suitable agricultural machinary and thereafter supervision of mechanized cultural operations ,
- follow-up and rationalisation of soil conservation works,
- introduction of more suitable and efficient impliments.

v - Administration and Accounts Division :

A head together with accountants and clerks will man this division and will undertake administrative and accounting responsibilities.

At field level it is proposed to create 20 extension units to function at village level. These will be situated in major villages and will be in close association with cooperative societies and individual farmers. On the other hand they will have direct and perpetual contact with divisions operating at headquarters levels in order to :

- expose problems faced at field level,
- seek solutions to such problems,
- acquire any new technical information or administrative guidance.

The project manager will be responsible to the Board of Directors for :-

- Coordination between the Board of Directors and executing bodies,
- the overall project administration and coordination between the various divisions for attaining the objectives of the project in conformity with policies laid down by the Board,
- creating a work environment which encourages personnel to give their best efforts to the project,
- evaluation, follow-up and improvement of performance,
- any other responsibilities assigned by the Board.

The assistant will help the manager in carrying out his duties and deputize him in his absence.

8.4. Administrative Costs :

Capital and operating costs amount to JD 97,500 and JD 125,760 respectively (appx. tables 15.4 and 16.4). Estimation of costs took into consideration the following points :-

8.4.1. Salary and wage scales prevailing in 1976.

8.4.2. Provision of material incentives through wages higher than standard government rates.

8.4.3. Provision of residance and motor car for the project manager and his assistant.

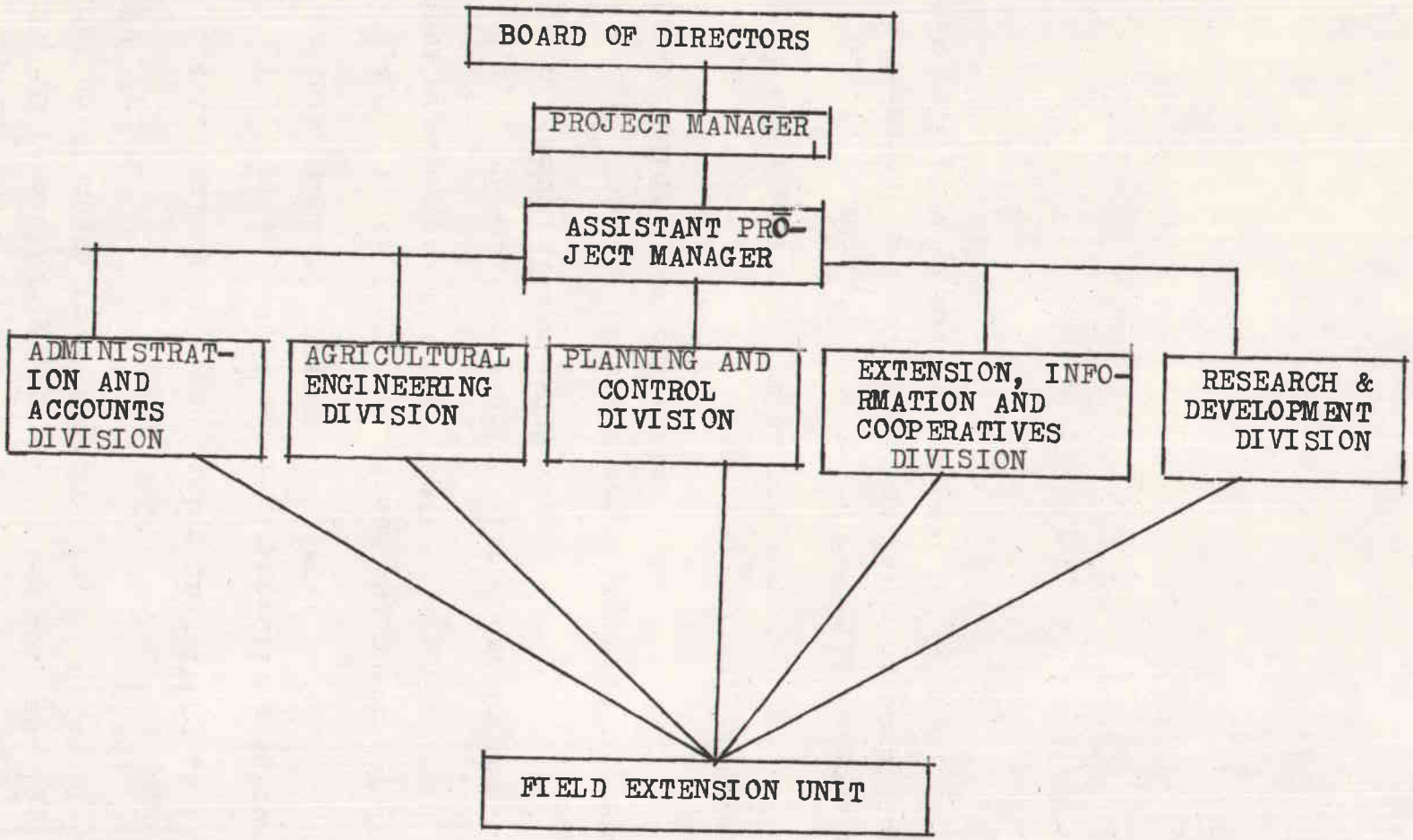
8.4.4. Payment of housing allowances to technical staff including technical assistants.

8.4.5. Payment of transport allowances to technical staff excluding technical assistants.

8.4.6. Agricultural extension and cooperatives supervision will be the responsibility of one person.

8.4.7. Administration buildings will be constructed at Rabba Research Station. Research farms at both Rabba and Shobak will be used by the project.

FIGURE 1.4.


BOARD OF DIRECTORS
PROJECT MANAGER
ASSISTANT PRO-JECT MANAGER
ADMINISTRAT-ION AND ACCOUNTS DIVISION
AGRICULTURAL ENGINEERING DIVISION
PLANNING AND CONTROL DIVISION
EXTENSION, INFO-RMATION AND COOPERATIVES DIVISION
RESEARCH & DEVELOPMENT DIVISION
FIELD EXTENSION UNIT

CHAPTER V

ECONOMIC & FINANCIAL ANALYSES

1. Project Assumptions :

The economic and financial analyses for the project area as a whole and for each of the three regions were worked out in accordance with the following assumptions :-

1.1. Prices of agricultural products, costs of inputs and labour are those prevailing at farm gate in 1976, (appx. tables 1.5 & 2.5).

1.2. All agricultural products which are expected to be produced in the project will be sold by the farmers in the same year of production, consequently no storage costs are charged for the period between harvest and selling.

1.3. Presently, no taxes are charged on agricultural resources or products and no subsidies are given. This situation is assumed throughout the life of the project.

1.4. When computing costs and returns at the level of individual project districts, the combined administrative costs[1] will be allocated to each district in proportion to the respective cropable area included in the project.

1.5. The present net returns accruing from the utilization of the agricultural resources in the project area in its present form will be forgone and are therefore considered as costs borne by the project.

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(1) These include buildings, salaries, wages repairs, maintenance and supplies which serve the project as a whole

1.6. No residual value will be given to fruit trees at the end of the project life.

1.7. Costs incurred by the government on soil conservation works in preparation for planting fruit trees in Karak and Tafila will be added to the capital costs when treating economic returns. These will be divided equally between the first two years of the project since half the area will be planted with fruit trees in each of the first two years.

1.8. The value of the existing fruit trees which are projected for development will be considered capital costs brone by the project in the first year.

1.9. The official value of the Jordanian Dinnar will be equal to its market value throughout the life of the project.

1.10. The opportunity cost in Jordan is assumed at 11% and 8% annually for purposes of calculating economic and financial returns respectively. These rates will prevail throughout the life of the project.

1.11. The project life was put at 30 years for two major reasons ; firstly, the last portion of olive trees will be planted in year six and will reach its production peak in year eighteen ; secondly, other fruit trees have a life span of 15 years ; the selected project life will therefore allow for two such plantings.

2. Production :

Over thirty years, production from the project area is estimated at :-

- 1,169,000 tons of fruits
- 439,000 tons of vegetables
- 800,000 tons of grain and other seeds
- 884,000 tons of straws and hays.

(For details see appx. table 3.5).

For reasons explicit in Chapter IV present annual production (the average during 1969 - 75) was compared with the target annual production in the ninth year for field crops, and with the overall annual average production of fruits. It can be seen from the figures displayed below that the project will bring about substantial improvement in the production of all types of produce :-

Item produced	Production (000 tons)		% age increase
	Present	Expected	
Fruits	1.8	39.0	2066
Vegetables	1.1	15.9	1345
Field crops	18.6	29.5	59
Straw	19.4	32.7	69

The contribution of each of the three project areas to the amount of annual production is detailed in appx. tables 6.4. to 9.4.

3. Gross Returns :

Gross returns during the project life are estimated to build up to JD 273 millions. Annual returns, however, vary from year to year ; the general trend being a steady increase from one million JD in the first year reaching JD 12 million in year twelve. Subsequently it remains stable around this level until the sixteenth year. Thereafter, returns decline gradually towards a trough of about JD 8 million in year twenty-one before they pick up again to reach JD 10 million in year twenty four and the twelve million level in year twenty eight (appx. table 4.5.). This rather unusual trend is a direct result of the changing tonnage of fruit tree production.

In view of the fluctuation of annual returns during the life of the project, present returns are compared with (a) project's annual average (b) maximum annual returns and (c) returns of the ninth year, when field crops attain target yields. The comparison is as follows :-

Variable	Annual Gross returns (JD Million)	Increase over the present value (JD million)	% age increase
1. Present value	2.8	0.0	0
2. Annual average	9.1	6.3	252
3. Maximum value	12.3	9.5	339
4. Value in year nine	10.5	7.7	285

The value of fruits makes up the highest proportion of the total expected value of products, followed by field crops, straw and vegetables in the order shown below :-

Item produced	Value (JD million)	% Age
Fruits	125.6	46.0
Field Crops	74.0	27.0
Straw	45.0	16.5
Vegetables	28.4	10.5
Total	273.0	100.0

The contribution of each of the three regions to the total production value differs as follows :-

Location	Value of production (JD million)				Total
	Fruits	Field/crops	Straw	Veg.	
Karak	76.3	67.7	41.4	27.5	212.9
Tafila	37.3	1.7	1.5	0.9	41.4
Shobak	12.0	4.6	2.1	0.0	18.7
Total	125.6	74.0	45.0	28.4	273.0

The values of the expected annual production of each crop produced in each region are detailed in appx. tables 5.5. to 8.5.

4. Project Costs :

Total financial costs are estimated at JD 133.5 million, of which JD 4.3 million are capital costs and JD 129.2 million are operating costs.

4.1. Capital Costs :

Capital costs may be elaborated as follows :-

Item of Expenditure	Cost (JD'000)
Construction of Stone walls	2,112
Construction of earth banks	860
Machines and equipment	51
Fruit tree transplants	1,179
Buildings	80
Total	4,282

Expenditure on soil conservation works i.e. stone walls and earth banks, will be spread equally over the first five years. Buildings will be completed in year one and expenditure on machinary and equipment will be mainly incurred in the first year, the only exception being replacement costs which will ensue at a later date. Expenditure on fruit transplants must be synchronized with the planting programme.

Economic costs amounted to JD 3.333 million, made up of government expenditure of JD 1.198 million on soil conservation works already completed in 45,339 dunums in Karak and Tafila to be borne equally in the first two years and of JD 2.135 million being the value, at government rates, of fruit trees already established in the project area.

4.2. Operating Costs :

These costs amount to JD 129.24 million and will be spent as follows :-

Item of Expenditure	Amount (JD'000)
Planning and husbanding seasonal crops and fruit trees	124,419.7
Salaries, wages and allowances	4,300.0
Maintenance and fuel	480.3
Other supplies	40.0
Total	129,240.00

The net returns attainable at present amount to JD 252,000 annually. These were considered an opportunity cost to be added to the projects' operating costs.

5. Financial Rate of Return :

For the project as a whole, the internal rate of return is 31.17%, a high rate when compared with the opportunity cost in Jordan. It is to be noted that this rate represents the profit of the owner-farmer who will, in addition, collect whatever he can earn as wages for any work he carries out in his farm. It may be seen from appx. table 9.5 that computations included all capital and operating costs but no interest was charged on the sums required for implementation of the project.

Increased costs and decreased returns by 20% will reduce the financial rate of return to 24.48% and 21.19% respectively (appx. tables 10.5 and 11.5). Nevertheless, all these rates are financially rewarding and should encourage farmers to implement the project actions.

Financial rate of returns and sensitivity analyses were carried out separately for each project area. This detail was dictated by differences in areas, costs of production, tonnage produced, gross returns as well as the geographic separation and the weakness of economic integration of the three locations. Computations contained in appx. tables 12.5 to 20.5 show that financial rates of return are far in excess of the prevailing opportunity cost in all cases. Sensitivity analyses, however, reveal that Karak district is the only project area which maintains a high rate of return in all cases. Increased costs or reduced value of products by 20% will pull down financial returns in Tafila and Shobak to levels close to the opportunity cost. The ensuing summary would suggest that the project is undoubtedly feasible only in Karak :

Location	Financial Rate of Return %		
	At Standard Cost and Returns	At 20% increase in costs	at 20% reduced returns
Karak	47.92	30.68	28.72
Tafila	19.13	11.99	10.31
Shobak	19.15	13.05	9.06

In case Shobak district is developed as an irrigated area, the present project will be limited to Karak Province i.e. Karak and Tafila districts. The combined financial rate of return for the province will be 36.68% and drops to 25.82% and 20.41% with a 20% increased costs or reduced value of production respectively (appx. tables 21.5 to 23.5).

Assuming that the government could obtain a loan of JD 9 million with such easy terms as :

- a simple interest rate of 4%,
- payment over fifteen years in equal instalments to commence in the sixth year.

- interest amounting to JD 2.704 million to be paid annually when it falls due as from the first year.

In this case the financial rate of return for the whole project will drop to 29.09%, a level which is very encouraging for the implementation of the project.

The financial computations contained in appx. table 24.5 reveal that, at current prices, the benefit cost ratio amounts to 1.75 and drops to 1.53 when net present values are calculated at an annual interest rate of 11%. These rates are adjudged remunerative.

6. Economic Rate of Return :

The overall rate of return for the project is 29.4%, a high rate when compared with the opportunity cost in Jordan. When costs rise or gross returns decline by 20%, the economic rate of return drops to 18.39% and 16.58% respectively (for details see appx. tables 25.5 to 27.5).

For reasons stated previously, economic and sensitivity analyses were made for each project district separately and for Karak and Tafila jointly (appx. tables 28.5 to 39.5). Karak district alone stands out as the most encouraging district under all assumptions. When taken separately, both Tafila and Shobak have an economic rate of return higher than the opportunity cost. However, when costs rise or gross returns decline by 20%, this rate drops discouragingly below the prevailing level of opportunity cost. It may be seen from the summary of economic analyses displayed below, that when Tafila is added to Karak, returns maintain a high level which is very close to that shown by Karak alone :

Location	Economic Rate of Return (%)		
	at standard Cost & Returns	at 20% increase in costs	at 20% reduced returns
Karak	31.54	22.32	19.87
Tafila + Karak	28.39	19.36	18.17
Tafila	15.30	8.02	7.55
Shobak	18.44	9.87	8.73

Taking the project as a whole and including a loan component of JD 9 million with the conditions stated previously, the economic rate of return will drop from 29.09% to 26.3%, a rate which is high enough to encourage government borrowing and investing for developing available resources.

7. The Impact of the Project on the Jordanian Balance of Payments :

As envisaged in this report, the implimentation of the project will necessitate the importation of machinary (1) and crop protection materials which are not produced in the country. It is estimated that total costs, based on 1976 prices, will amount to JD 0.5 million of which JD 0.454 will be spent on machinary. This will have a slight negative effect on the Jordanian balance of payments.

(1) Requirements are (a) heavy machinary and equipment for use in soil conservation works during the first five years, and (b) agricultural machinary for crop production throughout the project life.

8. The Effect of the Project on Employment Opportunities :

It is estimated that the project will require 2.032 million man-days annually. Assuming that the agricultural worker in the project area could put in 127 man-days annually, the total labour requirement will be 16,000. This number is at present available within the project area. Furthermore, the existing pattern of labour demand which is characterised by unavoidable sharp peaks dictated by the dominance of field crops is planned to change. The project is envisaged to introduce a pattern of resource utilization which spreads work days over the year more evenly than what prevails today. It is, therefore, possible to increase the number of man-days worked by a labourer or a farmer during the year and in consequence reduce the required number of workers and at the same time raise their incomes from the present level of JD 254.

9. The Effect of the Project on the Balance of Trade :

From the ninth year onward, annual production of wheat is expected to increase by 3,000 tons which will help to reduce imports. Concurrently an additional amount of 2,600 tons of lentils will be available for export. Fruit production which will increase by an annual average of 37,200 tons will help to cut down imports of some types of fruits and increase exports of olives and olive oil.

10. Effect of the Project on National Income :

The project is anticipated to add to the national income a total of JD 135.763 million at current prices ; or an annual average of JD 4.525 million. The present value of this increase at an annual interest rate of 11% is JD 38.524 million (appx. table 40.5).

11. Social Effects :

The utilization of local resources will help to satisfy a greater portion of the food requirements from locally produced commodities. New job opportunities will be created together with increased incomes. In addition, increased production will activate marketing and bring about a greater trade movement. The overall result will be higher standards of living, decreased immigration to towns and greater contribution to rural development.

12. Project Financial Requirements :

The following assumptions are made :-

12.1. The government will contribute 30% of the cost of stone terraces and earth banks in addition to all the following :-

i - Capital costs for vehicles, laboratory equipment, buildings and equipment required for maintenance of soil conservation works.

ii - All administrative and technical operating costs. (For details see appx. table 40.5).

12.2. Capital costs to be borne by farmers are, 70% of stone terraces and earth banks and all the cost of transplants. Farmers will also bear all operating costs relating to the production of seasonal and fruit crops, including the required agricultural machinary (appx. table 41.5).

12.3. The present savings of the farmers are sufficient to meet the costs of transplants, labour and agricultural machinary. Other capital costs are assumed to be met from a long term loan to be provided by the government, at 6%

interest rate per annum. A grace period of five years will be allowed and payment will be made in equal instal-ments starting from the sixth year. The remaining operating costs will be met through seasonal loans, (appx. table 41.5.).

12.4. The Government is expected to borrow from an outside source JD 9 million in the manner shown in para 5 of this Chapter.

In accordance with these assumptions, capital requirements for the implimentation of the project will amount to JD 8.773 millions to cover the following shared expenses :-

Item	JD'000		
	Government	Farmers	Total
1. Capital Costs	996.5	2834.0	3830.5
2. Operating Costs	1305.3	3637.0	4942.3
3. Total	2301.8	6471.0	8772.8

Extracted from appx. table 42.5.
Loan programme is supplied in appx. table 43.5.

To sum up :-

The preceding display of social, economic and financial aspects shows that the project for the Development of Rainfed Agriculture in Karak and Ma'an Provinces is feasible. Financial and economic returns are high at standard prices as well as when costs rise or gross returns decline by 20%. This is true when taking the project area as a whole or when Karak and Tafila are taken together as a separate project. However, when each of the three project areas is considered as an independant project, only Karak area will show high financial and economic returns which encourage investment in developing agricultural resources. On the other hand both Tafila and

Shobak show a high sensitivity to increased costs and reduced value of production to the extent that pulls down financial and economic rates of return just above or even below the level of prevailing opportunity costs.

Recognizing the fact that the project is made up of three distinct locations which are geographically separated and only weakly integrated economically, the team recommends the implementation of the project in Karak area alone. This recommendation is based on financial and economic returns only.

Nevertheless, it is worth stating that the overall social and economic development in view of its being social as well as economic, must take into consideration criteria other than financial and economic rates of return. The implementation of the project in Tafila and Shobak has a number of positive aspects relating to the overall social and economic development. Chief amongst these are :-

1. each of the Tafila and Shobak locations make up about 10% of the total project area. If included in the project, their high sensitivity to rising costs and declining gross returns can be subdued.

2. Large tracts of land in these two districts lie on slopes and could be utilized for fruit tree planting which will ensure a stable income for a long period of time, which could exceed twice the estimated projects' life.

3. A large proportion of steeply sloping lands in Shobak and Tafila are presently used for seasonal cropping which is wrongly conducted. If modern development techniques are not adopted, this pattern will definately continue to result in serious soil

erosion and loss of this national wealth which should be conserved for future generations

4. The development of agricultural resources in these two areas will enhance the contribution of local production in satisfying food requirements.

5. The proposed pattern of resource use will create more stable job opportunities, increased incomes and a higher standard of living for the rural population, all of which are factors which will advance rural development.

It is, therefore, concluded that the decision whether Tafila and Shobak should be included or not will be based on criteria other than economic returns. It must be added that the benifits of the project in these two areas are amongst the major targets of the national socio-economic development plan of Jordan.

ANNEX I
DRYLAND FARMING
DEVELOPMENT PROJECTS

1. Development of Dryfarming :

Activities in this project started in 1969 in the Baqa'a area and was subsequently shifted to Karak to cover three locations with a total area of 70,000 dunums. The project aims at developing steeply sloping drylands suffering from the combined adversities of land fractionation and soil erosion. Food incentives, provided through WFP assistance are used to encourage farmers to consolidate their holdings in units of more than 200 dunums so that soil conservation works , tree planting and modern technology could be introduced.

The project lasted until the end of June 1977 and has achieved the following in the present project area :-

i - Soil survey over an area of 72,000 dunums.

ii - Terracing and tree planting in 15,000 dunums.

iii- Terracing of 14,000 dunums.

2. Wheat Production and Research Project :

This is a nation-wide project which was started with the help of USAID since 1967 in an effort to improve wheat production. It involves carrying out of a number of demonstrations on farmers' fields using modern inputs which were extrapolated from experimental results carried out both in Jordan & in similar environments in Origon State. Over

the the period 1967 - 1975 the use of improved seed, fertilizers, herbicides & suitable machinary has attained on overall increase in yield of 57% compared to what farmers could get in the same fields.

3. Integrated Rainfed Agricultural Development - Irbid :

With assistance from FAO a pilot project was initiated to improve wheat production over some 2,000 dunums in Irbid District in 1975 - 76 season. The project as conceived in the five - year development plan covers 600,000 dunums at an estimated cost of 5.6 million JD. The local operational point of the project rests on convincing farmers to pool together their fragmented holdings into such viable units as will facilitate the correct implimentation of soil & water conservation works. Upon this basic physical improvement of the land improved cultural practices will be superimposed in order to raise the productivity of plant and animal crops and consequently improve farmers incomes. The project components include training of farmers to deal with the new type of machinary and other inputs.

4. Soil Survey Project :

The five year development plan includes a project for soil surveying of all lands in the East Bank. Work has started in Irbid in 1975.

5. Soil Conservation and Olive Tree Planting :

This project, which was started in 1964, involves WFP food assistance to develop steeply sloping hilly drylands through the construction of dry-stone terraces and planting of olive trees. In Karak, the present project area, 10,000

dunums were planted with fruit trees and 30,000 dunums were stone-terraced. The agreement which expires in December, 1977 is anticipated to be renewed for another three years to cover 90,000 dunums in the East Bank.

6. Fruit Tree Project :

This project is a prerequisite for the implimentation of all fruit tree projects. The Ministry of Agriculture will produce every year 300,000 olive transplants, half a million grape plants and 200,000 plants of other fruits for planting in the various areas projected for development.

7. Annual Afforestation Project :

At a total estimated cost of 1.68 million JD, the five year plan stipulates the afforestation of 150,000 dunums throughout the country over the period 1976 - 1980.

8. Development of Forest Nurseries :

Concurrently with the annual afforestation project, JD 100,000 were allotted in the five year plan to produce five million forest - tree transplants.

ANNEX II

Profile Description of Soil Series (15)

A - Information on the Site :

1. Profile No. : 101
2. Location : Qasr Village
3. Soil Series designation : 15/B.
4. Date of examination : 1.10.72.
5. Land form : Wadi side (depression).
6. Shape of slope : Concave
7. Degree of slope : 6%
8. Present land use seasonal crops (harvested).

B - General Information on the Soil :

1. Surface cracking
2. Chert, limestone, and basalt stones of 8-15 cm diameter on the surface, at intervals of more than 8 m.
3. Parent material, basalt, associated with limestone.

C - Profile Description :

0-10cm: Yellowish red, (5YR 4/6) dry ; silty clay ; strong granular structure ; hard dry, sticky wet ; few pores ; medium bulk density ; strong reaction with dil. HCL ; medium and fine roots throughout.

10-40cm :Yellowish red, (5YR 3/6) dry ; silty clay, strong coarse subangular blocky structure throughout ; about 15% ; calcium carbonate nodules abundant to extremely abundant ; high bulk density ; strong reaction with dilute HCL.

Profile Description of Soil Series (11)

A - **Information on the Site** :

1. Profile No. : 102
2. Location : Al-Yarout Village
3. Soil series designation : 11/B
4. Date of examination : 5.12.1972
5. Land Form : Hilly
6. Shape of slope : Smooth
7. Degree of slope : 4%
8. Present land Use : Seasonal crops (harvested)

B - **General Information on the Soil** :

1. Cracked
2. Chert and limestone stones of 8-15 cm. diameter distributed on the surface at intervals of more than 8 meters.
3. Parent material hard limestone.

C - **Profile Description** :

0-15 cm : Reddish brown (5YR 4/4) moist ; silt to clay silt ; strong sub-angular blocky structure ; friable ; plastic and sticky wet ; few fine pores ; limestone pebbles about 5% ; medium bulk density, strong reaction with dilute HcL ; fine and medium roots.

15-40 cm : Reddish brown (5 YR 4/4) dry ; silty clay ; strong subangular blocky structure ; hard and very compact ; plastic and sticky wet ; weak slickenside with patches ; few fine pores ; limestone pebbles about 2% ; few small calcium carbonate nodules ; bulk density medium to high ; strong reaction with

dilute HcL ; roots of all sizes abundant.

40- 63cm : Yellowish red (5YR 4/6) slightly moist ; silty clay to clay ; strong to moderate blocky structure ; very compact ; sticky, very plastic wet ; slikenside ; few fine pores ; limestone pebbles 15%; small and medium calcium carbonate nodules very common ; high bulk density ; strong reaction with dilute HcL ; abundant fine roots.

63- 120 cm : Yellowish red (5YR 5/6 - 5/8) moist ; silty clay to clay, strong to moderate blocky structure ; firm ; sticky and very plastic wet ; slikensides, few pores ; limestone pebbles about 15% ; abundant to very abundant calcium carbonate nodules ; high bulk density ; strong reaction with dilute Hcl ; few fine and medium roots.

Profile Description for Soil Series (12)

A - Information on the site :

1. Profile No. : 20
2. Location : Mowta Village
3. Soil series designation : 12/A
4. Date of examination : 19.10.74
5. Land form : Undulating
6. Shape of slope : Smooth
7. Degree of slope : 2%
8. Present land use : seasonal crops (harvested).

B - General Information on the Soil

1. Cracked
2. Chert pebbles covering about 12% of the surface
3. Parent material : Limestone

C - Profile Description :

0 - 30 cm : Brown (7.5YR 5/4) dry ; clay silt ; strong coarse blocky structure ; soft dry ; very plastic and sticky wet ; few pores ; medium bulk density ; strong reaction with dilute HcL ; roots abundant.

30 - 70 cm : Dark brown (7.5 YR 4/4) slightly moist ; clay silt ; strong angular blocky structure, hard , compact, plastic and sticky wet ; slikenside ; few fine pores ; high bulk density ; strong reaction with Hcl ; abundant fine roots ; clearly defined boundary.

70 - 90 cm : Dark brown (10 YR 4/3) slightly moist, clay to silty clay ; strong subangular blocky structure ;

moderately hard ; sticky and very plastic wet ; few pores ; limestone pebbles about 5% ; strong reaction with dilute Hcl ; few roots ; clearly defined irregular boundary.

90 - 140 cm : Dark yellowish brown (10 YR 4/4) moist; clay ; strong blocky structure ; very firm ; very plastic ; few fine pores ; abundant calcium carbonate nodules ; high bulk density ; strong reaction with Hcl ; few roots.

Profile Description of Soil Series (31)

A - Information on the Site :

1. Profile No. : 103
2. Location : Mazar Village
3. Soil Series designation : 31/A
4. Date of examination : 23.10.72
5. Land form : Undulating
6. Shape of slope : Smooth
7. Degree of slope : 2%
8. Present land Use : Seasonal crops (harvested)

B - General Information on the Soil :

1. No surface cracking
2. Limestone and chert stones of 8-15 cm diameter spread over the surface.
3. Limestone outcrops covering about 5% of the soil surface.
4. Parent material is soft limestone

C - Profile Description :

0-10 cm : Yellowish red (5YR 4/7) dry ; silty clay loam to slity clay ; moderate, fine granular structure ; hard ; plastic and sticky wet ; limestone pebbles about 5% ; low to medium bulk density ; strong reaction with dilute Hcl ; abundant fine roots ; high biological activity.

10-40 cm : Reddish brown (5 YR 5/7) dry ; silty clay ; weak to moderate blocky structure ; hard ; very plastic and sticky wet ; few pores ; limestone pebbles and stones about 10% ; few calcium carbonate

nodules ; medium bulk density ; strong reaction with dilute Hcl ; few medium and fine roots ; abundant biological activity.

40 - 70 cm : Reddish yellow (5 YR 6/8 - 7/6) dry and slightly moist ; silty clay ; moderate coarse, and fine blocky to subangular blocky structure ; hard ; very plastic and sticky wet ; abundant medium pores ; limestone pebbles and stone very abundant, about 60% ; common to abundant calcium carbonate nodules ; medium bulk density ; strong reaction with dilute Hcl ; few fine roots.

Profile Description for Soil Series (32)

A - Information on the Site :

1. Profile No. : 105
2. Location : El Thomiya Village
3. Soil series designation : 32/B
4. Date of examination : 22. 10. 1972
5. Land form : Hilly
6. Shape of slope : Smooth
7. Degree of slope : 4%
8. Present land use : Seasonal crops (harvested)

B - General Information on the Soil :

1. No surface cracking
2. Stones of 8-15 cm diameter distributed on the surface at 0.4 - 2.5 m intervals.
3. Bare limestone outcrops of less than 15% coverage.
4. Parent material ; hard limestone.

C - Profile Description :

0-14 cm : Dark brown (7.5YR 4/4) dry ; silty clay loam; moderate, medium subangular blocky and fine granular structure ; moderate compaction ; slightly plastic and slightly sticky wet ; abundant pores ; limestone and chert pebbles of about 5% ; low to medium bulk density ; strong reaction with dilute Hcl ; abundant medium and fine roots.

14 - 40 cm : Strong brown (7.5YR 5/6 - 5/8) dry ; silty clay loam ; moderate, medium subangular blocky and fine granular structure ; compact ; plastic

and sticky wet ; abundant pores ; limestone and chert pebbles about 10% ; few calcium carbonate nodules ; medium bulk density ; strong reaction with dilute Hcl ; abundant fine roots.

40 - 55 cm : Reddish yellow to pink (7.5 YR 6/8 -8/4) dry ; same properties as horizon above except for a higher content of pebbles - about 30% .

Profile Description for Soil series (33)

A - Information on the Site :

1. Profile No. : 106
2. Location : Mawta Village
3. Soil Series designation : 33/C
4. Date of examination : 24.6.1973
5. Land form : Undulating
6. Shape of slope : Convex
7. Degree of slope : 13%
8. Present land use : Fallow

B - General Information on the Soil :

1. No surface cracking
2. Limestone and chert stones over the surface about 15% coverage.
3. Parent material , soft limestone.

C - Profile Description :

0 - 15 cm : Brownish yellow (10YR 6/6) dry ; silty clay - moderate fine granular structure - compact ; slightly sticky ; chert and limestone pebbles throughout ; fine cracks ; strong reaction with dilute Hcl ; common fine roots, irregular boundary.

15 - 40 cm : Yellowish red (5 YR 5/6) slightly moist ; silty clay - moderate subangular blocky to fine granular structure ; compact ; chert stones throughout and few limestone ; few fine pores ; strong reaction with dilute Hcl, few fine roots ; clear boundary.

40 - 70 cm : Strong brown (7.5YR 5/6) slightly moist ; clay to sandy clay ; moderate fine granular structure ; compact, fine pores ; limestone pebbles throughout ; strong reaction with dilute Hcl.

70 - 130 cm : Strong brown (7.5YR 5/6) slightly moist; clay to sandy clay - chert pebbles throughout about 80% ; the bottom is a layer of soft limestone.

Profile Description of Soil Series (34)

A - Information on the Site :

1. Profile No. : 104
2. Location : El Thaniya Village
3. Soil series designation : 34/c
4. Date of examination : 23.10.1972
5. Land form : Hilly
6. Shape of slope : Convex
7. Degree of slope : 9%
8. Present land use : Seasonal crops (harvested)

B - General Information on the Soil :

1. No surface cracking
2. Stone of 8-15 cm. diameter distributed on the surface at 2.5 - 8 m intervals.
3. Parent material, soft limestone.

C - Profile Description :

0-10 cm : Dark yellowish brown (10YR 4/4) dry ; silty clay loam ; subangular blocky to fine granular structure ; compact ; slight stickness and plasticity wet ; abundant pores ; limestone pebbles throughout , about 10% ; low to moderate bulk density ; strong reaction with dilute Hcl ; abundant fine and medium roots.

10 - 130 cm : Yellowish brown (10YR 5/6) dry ; slity clay ; moderate subangular blocky to fine granular structure ; compact, sticky and very plastic wet ; large pores ; limestone pebbles about 15% few calcium carbonate nodules ; strong reaction with dilute Hcl ; few to medium roots abundant.

ANNEX III

1 - CROP PRODUCTION IN PROJECT AREA

1. General Pattern :

Traditional agriculture characterised by heavy reliance on the fallow with low inputs is the predominant feature of the present form of crop production in the project area. Only a few progressive farmers have started to follow modern practices inspite of the concerted efforts of government and international organizations to uplift the general standard of resource use. In general projects concerned with fruit trees had a more effective impact on farmers' attitudes towards more advanced methods of production.

2. Field Crops :

The importance of field crops stems from (a) their adaptability to the prevailing dry environment and (b) their importance in satisfying the basic nutritional needs of both man and his animals ; wheat and lentils constitute the basis of human food and barley and vetch are the main concentrate feed for animals. A brief depiction of the present form of field crop production is hereunder given :-

2.1. Land Preparation :

The basic features of land preparation for most crops is very simple, deep ploughing in early autumn (October) is the major operation carried out, in hopeful anticipation of empowering the soil to collect the maximum amount of rain water. Unfortunately deep ploughs used in the direction of the slope bring about the very opposite effect since the operation forms drainage furrows which increase in size as the rainy season advances thus helping both soil

erosion and loss of water. Obviously the effects are more serious in steeper slopes. Rarely animal drawn ploughs are used and in such a case ploughing is carried out almost along the contour lines, a practice which reduces erosion hazards. When sufficient amounts of rains had fallen to break plough clods and germinate weed seed, the land is disced with light disc harrows with the aim of weed control and land levelling. In many cases farmers do not carry out any land preparation operations; crop seeds are broadcast on uncultivated land and subsequently disced into the soil by light disc harrows.

2.2. Seeds and Seeding :

Local varieties of poor productive capacities are in common use. Wheat varieties are inherently low producers, late maturing, prone to lodging and susceptible to rust. Local barley is low yielding, short stemmed and difficult to combine harvest. The other two important field crops, lentils and vetches, are also low yielding, with short stems and shattering pods which render them unsuitable for machine harvesting.

Farmers are generally very keen on treatment of wheat and barley seeds against covered smut . All other crop seeds are sown untreated.

Seeding rates vary with both rainfall and soil condition. Within the range shown below, seed rates are subject to farmers' judgement :-

Crop	kg/ dunum
Wheat	5 - 8
Barley	5 - 6
Lentils	8 - 10
Vetches	10 - 12

Hand broadcasting is the standard practice. Usually land is divided into strips 10 - 15 m wide and broadcasting is done up and down the slope in pursuance of a more even seed distribution. Seeds are then covered by light disc harrows which place seeds at varying depths in the soil. Both crop establishment and regularity are adversely affected by poor germination and emergence accruing from too deep or too shallow seed placement.

Perhaps one of the most important decision making problems which face a farmer in rainfed agriculture is when should he sow his crop. This is primarily due to the unpredictability of early season precipitation. Because the decision to sow the crop depends ultimately on the farmers' judgment about the suitability of the agroenvironment to produce a crop, sowing dates extend over an unnecessarly long period. Although early sowing is always more conducive to high yields, yet sowing dates extent too late into the season as shown below :-

Crop	Sowing date
Wheat	1st Nov. - 31st Jan.
Barley	1st Nov. - 15th Jan.
lentils	15th Dec. - 15th Feb.
Vetches	15th Dec. - 31th Jan.
Chick peas	1st March - 1st April

2.3. Fertilizer Use :

Inspite of the demonstrated value of nitrogenous and phosphatic fertilizers farmers still refrain from using them. Their reasons are :-

i - The cost is too high and is beyond their abilities.

ii - Fertilizers are not easily available when they are required.

iii- Farmers are not convinced that fertilizer use is economic.

iv - Uncertainity of rainfall and a possible failure of the season discourages farmers from incurring additional expenditure on a crop which they might not reap.

2-4 Weed Control :

Shortage of labour inducing high weeding costs has led farmers to ignore hand weeding. In the absence of other forms of weeding a very serious vicious circle of increasing weed infestation and increasing weeding costs has arisen. As a result of this situation the cost of production rose and crop yields declined. Chemical weed control by 2-4D formulations has been demonstrated effective on wheat and barley fields. However, no recommendations are made for chemical weed control on other crops.

2-5 Harvest :

Wheat and barley are generally combine-harvested while other crops are harvested by hand. However, short stands of wheat and barley in the plains and crops grown on steep slopes are also hand harvested. Harvesting of the various crops takes place in the months shown below :-

Crops	Harvest date
Wheat	June - July
Barley	Late May - June
Lentils	May - June
Chick peas	July
Vetch	May - June

2.6. Threshing :

Hand harvested crops are usually carried to the close proximity of homesteads where they are threshed by animals or animal drawn implements and thereafter hand winnowed. This method permits farmers to collect the maximum amount of straw which, in some years, may fetch an equal or even a higher price than the grain harvest. However, shortage of labour and increasing labour costs usually cause serious delays in both collection an threshing which result in uneconomic crop losses.

3. Vegetable Crops :

In view of relatively low rainfall, summer vegetable cropping is limited to very small areas. Onion is the only winter vegetable grown under rainfed farming. Crop cultural practices are as fallows :-

3.1. Land Preparation :

Deep ploughing is carried out during October and November. The land is disced once or twice during late winter - early spring in order to level the soil surface and to control weeds. Furrows are made at 1 - 2 m for tomatoes and 2 m. for melons sometime after ploughing and before sowing.

3.2. Method and Time of Sowing :

Onions :

The crop is seeded during Jan. and Feb. Small furrows 30 - 50 cms apart are opened by light single point ploughs. Bulbs are dropped into the furrow by hand immediately following the plough, before the next furrow is made. These bulbs are covered by soil moved sideways when the adjacent furrow is made. Bulbs may also be sown by hand in holes made on one side of large ridges raised by ridging ploughs.

Tomatoes :

Farmers obtain seedlings(about 1500 per dunum) from Ministry of Agriculture nurseries or they may raise their own. Transplanting takes place during late March & April in previously prepared furrows 1 - 2 metres apart. Seedlings are planted in watered holes opened by pegs and may be watered again in the next day. Replanting to fill-in gaps is carried about a week later.

Melons :

Water melons and sweet melons are sown during April in furrows 1.5 - 2 m. apart. Seed rates range from .4 to .6 kg an from .3 to .4 kg per dunum for water melon and sweet melon respectively.

3.3. Fertilizer Use :

Chemical fertilizers are not in use. Occasionly farmers may apply organic manures early in winter for land intended to be grown with tomatoes and water melon.

3.4. Weeding :

Farmers fully appreciate the dangers of weeds ; however, high labour costs usually stand against hand weeding. The only exception is the onion crop which is exceedingly sensitive to weed competition. Tomatoes and melon crop lands are ploughed with animal drawn ploughs in order to achieve both weed control and soil water conservation. As practised, however the operation falls short of achieving neither purpose.

3.5. Plant Protection :

Though the dangers of pests and diseases are generally rather small in arid environments, yet in certain seasons they can be quite serious. Mildews on tomatoes and water melons are common and farmers do their best to apply the sulphur compounds recommended for control.

3.6. Harvest :

Onions are dug out in June, dried in the shade and subsequently packed in sacks. Other vegetables are hand picked, roughly graded and packed as they mature. Harvest season extends from July to November for tomatoes and melons are collected during August and September.

4. Fruit Trees :

The environment in the project area is suitable for a wide range of fruit trees and Karak district is historically known to have supported a fabulous grape culture. Data presented elsewhere in this report, however, indicate that only very small areas have been planted before 1975. It is meaningful to mention, however, that of late, farmers' interests in fruit

tree planting have been spectacularly aroused by the activities of development projects in the region. The prevailing general pattern of fruit production is briefly described hereunder :-

4.1. Land Preparation :

Land intended for fruit growing is usually deeply ploughed in early autumn. In November fields are marked in such a lay-out as the farmer sees befitting topography, soil and type of tree to be planted. Spacing is therefore both variable and irregular, trees may be spaced anything :-

from 5 to 10 m for olives,
2 to 3 m for grapes,
3 to 5 m for nuts
and 4 to 5 m for stone fruits

Hole size is variable ranging from 60 X 60 X 60 cms for olives to 30 X 30 X 30 cms for grapes.

4.2. Tree Planting & Establishment :

Budded transplants are usually bought from government or private nurseries and planted in January and February. Fertilizer use is limited to a few farmers who use organic manures during land preparation. Plants are irrigated several times during the dry summers.

Farmers are well aware that weeds may be the limiting factor in orchard establishment. Light disc harrowing is the standard practice carried out to control weeds and to stir-up top soil as a measure of soil moisture conservation. However, the standard of harrowing is so low that it does not serve

neither purpose effectively.

4.3. Pre-fruiting Cultural Practices

Weeding, in the manner shown above, is persistently practiced. Pruning is generally either neglected or carried out in a manner which result in shaping trees in forms incompatible with neither vegetative nor reproductive growth. Occassionally farmers resort to severe pruning hoping to get a completely fresh regrowth.

4.4 Plant Protection :

Incidence of pest attack is quite common in the area and for this reason extension service men pay special attention to the need for pest control. The response from farmers has not been satisfactory.

The logical result of all the mal-practices depicted in the preceding paragraphs is retarded growth, delayed maturity and in consequence delayed returns on investment.

APPENDIX III

2 - ANIMAL WEALTH

1. Types and numbers of Animals in Jordan

The Jordanian animal wealth is composed of the following types and numbers :-

- Local type sheep (Awasi) = 761 thousand heads
- Local type goat (mainly black)=426 thousand heads
- Local type cattle = 35 " "
- Friesians = 6.2 " "
- Shami cattle = 1.9 " "
- Laying hens = 1.3 Million birds
- Broilers = 12.9 " "
  (annuallyes)

(Details are shown in annex tables 1.3 and 2.3)

2. Animal Wealth in Project Area :

It is not possible to give any meaningful estimates of the animal populations which utilize the project area because the majority of large animals are raised by communal transhumance dictated by and for the purpose of utilizing feed resources available during different seasons in natural pastures and in rainfed cultivations. Grazing is communal both in terms of animal herding and pasture use all over the two provinces. Discussion of animal wealth in the project area is, therefore, only possible within a context which enlinks the whole of Karak and Maan provinces.

Annex table 3.3 details numbers of animals in Karak and

ANNEX TABLE 1.3

ANIMAL POPULATIONS IN THE HASHIMITE KINGDOM OF JORDAN

(000 HEADS)

	Sheep		Goats		Camels		Local Cattle				Friesians				Shami Cattle			
Year	M	F	M	F	M	F	M	F	C	H	M	F	C	H	M	F	C	H
1969	80,5	774,0	72,4	460,4	3,6	9,8	5,0	20,8	5,6	7,5	0,3	6,5	0,7	1,7	0,08	0,75	0,17	0,30
1970	52,0	613,0	33,6	316,0	4,1	5,5	3,5	20,4	3,0	5,2	0,1	3,6	0,3	0,7	0,02	0,57	0,05	0,14
1971	65,0	626,0	36,6	324,8	3,8	13,5	3,9	18,9	3,1	4,7	0,2	1,7	0,3	0,4	0,06	0,68	0,14	0,21
1972	51,0	652,0	30,4	356,9	4,0	12,1	5,1	22,1	4,2	6,3	0,4	4,1	0,9	1,2	0,06	0,85	0,20	0,30
1973	47,5	802,4	38,6	463,1	4,8	13,4	7,4	21,8	3,4	5,0	0,3	4,9	0,9	1,0	0,05	1,02	0,19	0,27
1974	37,3	754,2	28,7	370,0	3,3	12,5	3,5	26,0	3,4	5,2	0,3	4,2	0,9	1,6	0,09	0,76	0,22	0,24
1975	41,0	731,5	31,5	423,4	3,4	14,8	4,6	24,6	0,2	0,4	0,7	4,8	0,3	0,7	0,16	0,86	*	*
Average	53,5	707,4	38,8	387,6	3,9	11,7	4,7	22,1	3,3	4,9	0,3	4,3	0,6	1,0	0,07	0,78	0,16	0,24

Notes : M = Males ; F = Females ; C = Calves ; H = Heifers.
* = Information not available.

Source : Reports of the Department of Veterenary Health and Animal Production.

ANNEX TABLE 2.3.

Poultry Numbers in Jordan (1969 - 75)

(000 birds)

Year	Laying birds			Broilers 1/		
	in Modern farms	By traditional Methods	Total	in modern farms	by traditional Methods	Total
1969	138	862	1000	7110	921	8031
1970	120	724	844	7373	946	8319
1971	113	606	719	10155	776	10931
1972	151	876	1027	14460	1791	16251
1973	220	683	903	15230	855	16085
1974	302	632	934	11735	294	12029
1975	496	828	1324	12560	327	12887
Average	720	744	964	11232	844	12067

1/ Broiler numbers are estimated in this table on the basis of five cycles annually instead of the six cycles used to estimate numbers in reports issued by the Department of Veterenary Health and Animal Production. This is because chicks are kept for 8 -9 weeks in each cycle and some time is required for cleaning.

Source : Based on the Department of Veternary Health and Animal Production, 1969 - 75.

ANNEX TABLE 3.3

ANIMAL POPULATIONS IN THE PROJECT AREA IN 1975

Project	Sheep		Goats		Camels		Local Cattle		Friesians		Laying hens (2)		Broilers	
	No. (000)	% (1)	No. (000)	% (1)	No. (000)	% (1)	No. (000)	% (1)	No. (000)	% (1)	No. (000)	% (1)	No. (000)	% (1)
Karak	139.7	18.1	39.2	8.6	4.5	23.7	823	2.8	150	2.3	30.8	2.3	726	5.6
Tafila	32.3	4.2	36.9	8.1	4.9	26.9	Nil	-	Nil	-	29.8	2.2	90	0.7
Maan	86.0	11.1	113.1	24.9	2.7	14.8	236	2.8	56	0.9	8.0	0.6	197.5	1.5
Total	258.0	33.4	189.2	31.6	12.1	66.4	1059	3.6	206	3.2	68.6	5.1	1013.5	7.8

(1) % Ages are computed from Annex tables 1.3 and 2.3

(2) Laying hens include both local and imported breeds.

Source : Annual Report, Department of Veterenary Health and Animal Production.

Maan . Estimates put sheep at 258,000, goats at 189,200, camels at 12,100, local type cattle at 1,059 and friesians at 206. In terms of animal units (1) the different types of animals compare as follows :-

Type	Animal units (000)	% of total
Sheep	42.2	54.5
Goats	20.6	26.6
Camels	13.2	17.1
Local cow	1.1	1.4
Friesians	0.3	0.4
	77.4	100.0

In terms of both numbers and animal units sheep are obviously the predominant type of stock, constituting slightly more than half the animal units, followed by goats which form about one quarter. The presence of camels in the area is transient, occuring only during the summer when shortage of drinking water supplies in the arid range land forces them into the project area and its surroundings.

Poultry industry is progressively flourishing, particularly in Karak. In view of its fast returns, broiler production which takes about 60 days, is the commonest activity ; One million birds, estimated to weigh 1550 tons, have been produced in 1975. The most recent reports of the Karak cooperative

(1) One local type cow = 275 kg = One animal unit. Average weights of other animals are assumed as, 400 kg for a friesian - 350 kg for a camel and 45 kg and 30 kg for sheep and goats respectively.

society for poultry production explicitly show the rising trend of broiler production in the district.

3. Animal Rearing Practices

Annex tables 3.3 and 4.3 evince the number of animals reared under the prevailing systems of animal husbandry. It is evident that :

a - Broilers are produced in small farms with capacities ranging from 3,000 to 6,000 birds at a time. It can be seen, however, that the detailed information displayed in the tables fall short of the overall total given in the preceding paragraphs ; the discrepancy is attributed to incomplete recording.

b - Egg-production is mainly a traditional homestead activity. Only 17% of the production in Karak, 4% in Tafila and 20% in Ma'an are produced in what could be called poultry farms. The average laying hen capacities of these farmers are 1,100 in Karak, 600 in Tafila and 200 in Ma'an.

c - Cattle are reared in the so-called "farms"(1) which are located in close proximity to farmers' dwellings. Records compiled in annex tables 3.3 and 4.3 are in disagreement with regards to average animal holdings, a matter which is attributable to incomplete recording of " farms". However, the average holding of 3 cows per farmer shown in table 3.3 is in conformity with the results of the 1975 agricultural census.

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(1) The term "farm" is used in official reports for any number of animals kept by a farmer.

ANNEX TABLE 4.3

Number and Capacity of Animal Farms in the Project Area (1975)

Locality	No. of Farms	No. of Animals	Av. Farm Capacity	% age
		Broilers (000 per annum)		
Karak	38	605,0	15,9	83,0
Tafila	3	90,0	30,0	100,0
Maan	8	165,5	20,6	83,5
		(Laying Hens, 000)		
Karak	5	5,3	1,1	17,2
Tafila	2	1,2	0,6	4,0
Maan	7	1,6	0,2	20,0
		(Local Type Cattle)		
Karak	-	-	-	-
Tafila	-	-	-	-
Maan	10	216	22	91,5
		(Friesians)		
Karak	3	43	14,3	28,7
Tafila	-	-	-	-
Maan	10	28	2,8	50,0

Note :- Sheep and goats are not reared in farms
- %Age computed in relation to annex table 3.3.
- Size of broiler farms computed by dividing number of birds by five cycles.

Source : Department of Veterenary Health and Animal Production, 1975 Report.

d - Sheep and goats are never kept in farms. These animals depend on communal grazing in range lands during spring and on crop residues which are supplemented by barley and hay during the rest of the year. According to the results of the 1975 census average holdings in Karak and Maan Provinces were 51 and 20 heads of sheep and goats respectively

4. Constraints Facing Animal Production

4.1. Husbandry Practices :

Productivity of animals is the product of gene-environment interaction. In Jordan animals had to adapt themselves to precarious seasonal natural grazing, and roughage - dominant supplementary feed coupled with shortage of water. The logical result of such a low plane of nutrition is the development of a small, slow growing animal which has a low productive potential.

Genetic improvement of animals kept under a system of transhumance or semi- nomadism is exceedingly difficult, since it is almost impossible to keep correct records and follow-up the results. Furthermore, improvement programmes are effective only if implemented in concomitance with improvements of the environment and in particular that which is connected with feeding. Transhumance also reduces the utilization of the available sedentary veterenary services. The development of animal production in Jordan, therefore, calls for the implimentation of integrated programmes which take in their stride all the related constraints.

Cattle pose different types of problems; they are raised in a very small scale which is not conducive to the adoption

of modern husbandry practices. Local cattle are low producers and as such they do not offer sufficient encouragement for improved husbandry.

4.2. Animal Feed :

Large animals in the two provinces require about 190 million MC of metabolizable energy and 4,030 tons of digestible crude protein for maintenance. An additional 16 million MC and 697 tons of crude protein are needed to support existing numbers of poultry. These estimates do not take account of production requirements nor do they include the wants of such animals as donkeys, horses, mules or camels. On the other hand, feeds produced in both provinces stand at an average of 42,156 tons made up as follows :-

Item	Quantity (1) tons	% Age
Barley grain	7251	17.2
Vetch grain	294	00.7
Total grain	7545	17.9
Wheat and Barley Straw	31238	74.1
Legume hay	3153	07.5
Other hay	220	00.5
Total straw and hay	34611	82.1
Grand total	42156	100.0

(1) Average for the period 1969 - 75.
Source : Agric. Atlas and Dept. Agric. Econ. Reports

These feed materials provide 58.2 million MC of energy and 1,053 tons of DCP (Annex table 5.3.) which constitute only 28% and 22% of the respective maintenance requirements of the existing animal populations. The deficiency is

ANNEX TABLE 5.3

Feed Production and Nutritional Value in Karak & Maa'n Provinces and in Project Area Before and After The Implimentation of the Project

(Tons)

Item	Present Karak & Maan	Present Project Area	Future Project Area	Future Karak & Maa'n
Barley Grain	7251	3081	3434	7604
Vetch Grain	294	239	1120	1175
Wheat & Barley Straw	31238	17005	22055	36288
Legume Hay	3153	2234	10118	11037
Other Hay	220	149	1058	1129
Metabolizable Energy (Million MC.)	58,2	34,8	58,4	81,9
Digestible crude protein (Tons)	1052,9	522,0	1057,8	1588,7

Note :

1. Future Karak and Ma'an Production = Present Production of the two provinces less present production of project area plus future production of project area.
2. Nutritional values computed according to Morrison 1959; Feeds and Feeding.

Source : Present production of feed extracted from Agricultural Atlas, 1975, and Department of Agricultural Economics Reports, 1974 and 1975.

hopefully made good for sheep and goats by natural grazing. The actual contribution of pastures is, however, unpredicable and suffers from extreme annual variability resulting from variable rainfall. Consequently, supplementary feeding is always necessary ; hays, straws, barley and bran are usually imported into the two provinces from other parts of the country.

It is pertenant to mention in this connection that natural pastures have not as yet been subjected to serious study and no development policy has been formulated. Overgrazing and usurp encroachment of field crops are resulting in progressive deterioration of pastures, thus gradually dwindling their contribution as an important source of cheap animal feed.

4.3. Nutrient Value of Feed Material

Feed intake is a function of crude protein content, and the efficiency of utilization of feed depends upon the roughage : concentrate ratio. In general low protein content follows high roughage percentages, a combination which is not conducive to neither intake nor utilization. The data displayed in the preceding chapters show that feed produced in the two provinces is made up of 82% roughage and 18% grain, with an estimated overall crude protein content of 2.5%. This is a very low ratio compared to the recommended world standard for ruminants feed which should contain 9% of DCP. The detrimental effects of the low quality fodder available to animals in the project area are manifested in low growth and birth rates, delayed maturity and unsatisfactory production norms.

5. The Impact of the Proposed Project on Animal Production

5.1. In view of the dependence of animals on both communal grazing and arable land it is prudent to adjudge that the best animal production pattern is one which aims at using the resources of both environments in a complementary manner. For the prime purpose of reducing costs natural pastures should be utilized for breeding and rearing of animals to the weaning stage. Young animals are subsequently taken for finishing to economic weights in feed lots utilizing high quality feed produced in arable lands. It is therefore needful to have a close look at the influence of the project on the feed situation after completion of development.

5.2. Annex table 5.3 shows existing and expected production of animal feeds in the two provinces as well as in the project area. Presently, the area selected for the project contributes 54% to the total feed produced in the two provinces. Development works are expected to bring about (1) minor increases in the production of barley and white straw, 4% and 16% respectively. Significantly higher production is expected to be attained with respect to vetch grain (300%) legume hays (215%) and other straws (413%) . Overall, fodder production in the two provinces will increase from 42,156 tons to 57,223 tons. However, the increase in quantity is not accompanied by any appreciable improvent in nutritional value since low quality straws and hays remain predominant as shown below :-

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(1) Wheat and barley straw.

Item	Quantity (tons)	% Age
Barley grain	7604	13.3
Vetch grain	1175	02.1
Total grain	8779	15.4
Wheat & Barley Straw	36288	63.4
Legume straw	11037	19.3
Other straw	1129	02.0
Total Straw	48454	84.7

At full development the estimated fodder production will provide 82 million MC of energy and 1,589 tons of digestible crude protein, adding respectively 41% and 51% to existing production. Assuming the numbers of animals will remain at the existing level, fodder production will supply only 43% and 39% of their respective energy and protein requirements. Some 108 million MC & 2,441 tons of DCP will have to be made available from natural pastures and other sources to satisfy maintenance requirements. Additional quantities are needed to cover production requirements and to cater for the anticipated development in poultry industry. It is, therefore, concluded that at this stage of the country's development the improvement in feed production accruing from the project alone does not justify a recommendation for the inclusion of an investment component within the present project. However, the project as it stands will bring about substantial increases in feed production which, in turn, will help to raise the plane of nutrition of animals raised by traditional methods.

1 - SOIL SURVEY :

This programme required 5 motor vehicles , and equipment for drawing, photographing and for strengthening existing laboratories. Personnel needed are :-

5	Soil specialists
2	Soil surveyors
2	Soil analysts
1	Soil correlator
4	Draftsmen
5	Drivers
1	Typist
2	Technical Assistants
10	Labourers.

Total costs phased over the first four years are shown in annex table 1.4.

ANNEX TABLE 1.4.

COST OF SOIL SURVEY & CLASSIFICATION

(JD'000)

Item	Year				Total
	1	2	3	4	
Capital Costs :					
A. Drawing Equipment	20.0	3.0	2.0	-	25.0
B. Vehicles	7.5	-	-	-	7.5
Sub Total	27.5	3.0	2.0	-	32.5
Operational Costs :					
A. Salaries & Wages	51.7	51.7	51.7	25.9	181.0
B. Maintenance & Fuels	5.8	5.8	5.8	2.9	20.3
C. Others	1.5	1.5	1.5	0.8	5.3
Sub Total	59.0	59.0	59.0	29.6	206.6
Grand Total	86.5	62.0	61.0	29.6	239.1

Note : Costs are based on 42 working months.

2 - Soil Conservation Works

The objectives of the proposed soil conservation works are :-

i - To reduce the speed of run-off rainwater and ultimately keep it as long as possible on the surface to allow maximum absorption into the soil.

ii - Drainage of water in excess of soil ability to absorb it in a manner which reduces soil erosion to the minimum.

For the purpose of soil conservation works, land is classified into seven classes(1) on which cost estimates are based. These are :-

Class I : Level land on which no soil conservation works are necessary. This class does not exist in the project area.

Class II : Gently sloping land, 0 - 3% slope, such land requires simple soil conservation works such as widely spaced (200 - 300m) earth banks. There are 96,000 dunums of this class in Karak and the estimated cost is .54 JD per dunum (2).

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(1) Report for soil Conservation Works for the Integrated Agricultural Development Project - Irbid - May 1976.

(2) Cost estimates are based on actual costs incurred at Irbid in 1976 plus 20% added in view of the remoteness of the project area.

Class III : Land on slopes ranging from 3 - 8% which requires fairly intensive soil conservation works. Earth banks must be close and gully control structures and water disposal areas are necessary. There are 373,500 dunums of these lands, inclusive of 19,500 dunums of land on 8 - 12% slopes allotted to seasonal cropping in Shobak. The estimated cost is 2.16 JD per dunum.

Class IV : Level or low sloping lands with shallow soil and abundant surface rocks which do not allow cropping. Such areas were excluded from the project area as unsuitable for utilization.

Class V : This class includes lands with more than 8% slope which requires intensive soil conservation practices. Contour ripping, gradoni or contour stone terracing, gully control structures and water disposal areas are all needed. About 80,000 dunums of such lands have been allotted to fruit tree culture. The cost of soil conservation works is estimated at 26.4 JD per dunum.

Class VI : Land too steep or otherwise unsuitable for cropping and is usually graded as forest land.

Class VII : This class includes public utilities areas, towns, villages etc.

Soil conservation works are estimated to take five years, one fifth of the land to be covered annually, annex table 2.4.

ANNEX TABLE 2.4

PROJECTED CROP AREAS AND SOIL CONSERVATION WORKS
(DUNUMS)

I t e m	Karak	Tafila	Shobak	All Project Areas
Area allotted for seasonal crops	410,000	20,000	49,500	479,500
Seasonal crop area already covered by earth banks	10,000	-	-	10,000
Seasonal crop area requiring earth banking	400,000	20,000	49,500	469,500
Area allotted to fruit trees	105,482	45,000	11,520	162,002
Area presently under fruit trees	26,028	9,115	1,520	36,663
Area already stone-terraced	29,454	15,885	-	45,339
Fruit crop area requiring stone-terracing	50,000	20,000	10,000	80,000

This will require the provision of the following equipment :-

5	Graders
5	Scrapers
5	Deep ploughs
5	Tine cultivators
5	Disc harrows
4	Trailers
1	Large tractor
10	Wheeled tractors (70 - 80 HP)
4	Stone pickers
5	Pick-up vehicles
3	Micro-buses
3	Mobile workshops
	Survey and drawing equipment.

Personnel requirements are :-

5	Soil conservation engineers.
5	Technical Assistants
5	Surveyors
10	Chain-men
3	Draftsmen
5	Grader drivers
5	Assistant grader drivers
5	Scraper drivers
5	Assistant scraper driver
10	Tractor drivers
3	Bus drivers
1	Transport officer
20	Labourers.

It is assumed that the engineers will drive the pickups

themselves and that the equipment shall be distributed over the three project areas in proportion to their respective areas. Headquarters shall be at Karak. Total cost amounting to JD2.971 million is detailed in annex table 3.4.

It is proposed that a small soil conservation unit be retained within the project administration for ten years after the original soil conservation works have been completed. This is considered as a necessary measure to ensure follow-up and improvement of soil conservation practices. For this purpose the following equipment should be retained :-

1	Grader
1	Scraper
4	Wheeled tractors
1	Deep plough
1	Tyre cultivator
1	Stone picker
1	Large trailer
2	Pick-up vehicles.

The following personnel should also be retained in addition to machine drivers :-

2	Soil conservation engineers
2	Technical assistants
2	Surveyors
2	Chain - men
4	Labourers.

This establishment is estimated to cost 386,000 JD over ten years, annex table 4.4.

ANNEX TABLE 3.4.

PHASED COST OF ORIGINAL SOIL CONSERVATION WORKS

District	Year 1		2		3		4		5		Total
	Earth Banks	Stone Terraces	Earth Banks	Stone Terraces	Earth Banks	Stone Terraces	Earth Banks	Stone Terraces	Earth Banks	Stone Terraces	
Karak	141,696	264,000	141,696	264,000	141,696	264,000	141,696	264,000	141,696	264,000	2028480
Tafila	8,640	105,600	8,640	105,600	8,640	105,600	8,640	105,600	8,640	105,600	571,200
Shobak	21,384	52,800	21,384	52,800	21,384	52,800	21,384	52,800	21,384	52,800	370920
All Project Areas	171,720	422,400	171,720	422,400	171,720	422,400	171,720	422,400	171720	422,400	2970600

ANNEX TABLE 4.4

PHASED COSTS OF SOIL CONSERVATION AFTER YEAR 5

(JD'000)

Item	Years				Total
	6	7	8	9-15	
Capital Costs					
Equipment	-	-	26	-	26
Operational Costs					
Maintenance & Fuel	22	22	22	22	220
Salaries & Wages	13	13	13	13	130
Others	1	1	1	1	10
Total	36	36	62	36	386

ANNEX IV

3 - Recommended Practices for Fruit Tree Culture

1. Planting :

1.1. Land should be deep ploughed during September. Demarcation along the contour lines should fallow in October according to the spacing and tree population shown below :-

Tree	Distance between trees (m)	No. of trees per dunum
Olives	10 X 10	10
Grapes	3 X 3	100
Grapes mixed with olives	10 X 3 in one direction + one tree between olives in the other direction	50
Other fruits	5 X 5	40

1.2. Planting must take place during January and February. Nut trees should preferably be planted in early January. Earth banks should be raised round the plants to help retention and increase of soil moisture.

2. Cultural Operations :

2.1. It is recommended to water trees at least three times in each of the first two years. 40 litres per tree per watering are required. Best watering dates are early May, mid June and early August. A soil mulch made by adding loose soil or by stirring top soil will help to minimise water loss.

2.2. Three contour cultivations are necessary :-

- Deep ploughing in early autumn helps the soil to absorb the maximum amount of rain water,
- medium ploughing during spring helps to control weeds

and - light ploughing in summer for weed control and soil moisture conservation.

2.3. Pruning starts in the second year after planting with the aim of cup-shaping stone fruits and nut trees. Grapes are best when allowed to develop as bushes except near the stone terraces where they should be pruned in such a manner which allows them to grow over the terraces. When fruiting commences trees are pruned in accordance with their respective nature of bearing. Olives do not require any pruning after they start fruiting.

3. 2.4. Annex table 5.4 displays the recommended quantities and types of fertilizers to be used for each type of fruit tree. Phosphatic fertilizers (and organic manure when available) should be put in treches about 30 cms deep round the trees during November or December. Nitrogenous fertilizers may be broadcast near the stems during February or March. Top soil must be stirred to incorportate the fertilizer into the soil.

4. The following practices are recommended for pest and disease control :-

4.1. Olive fruit fly, olive kernel borer and scale insects on olive trees ; control by systemic organophosphorous compounds once before flowering and once during July or August.

ANNEX TABLE 5.4.

RECOMMENDED FERTILIZER APPLICATIONS FOR FRUIT TREES

(Grams per tree)

Tree Age (Years)	Grapes		Alives		Others	
	Sulphate of Ammonia	Triple super phos-phate	Sulphate of Ammonia	Triple super phos-phate	Sulphate of Ammonia	Triple Super phos-phate
1	-	-	-	-	-	-
2	100	-	200	-	200	-
3	150	-	300	-	300	-
4	200	100	400	-	400	-
5	200	100	500	-	500	250
6	300	150	600	300	600	300
7	400	200	750	375	800	400
8	400	200	750	375	800	400
9	400	200	900	450	800	400
10	400	200	1500	750	800	400
11	400	200	1500	750	800	400
12 & after	400	200	2000	1000	800	400

4.2. Removal and burning of infested parts is necessary to control olive bark beetle.

4.3. The berry moth is the most serious pest attacking grapes. Effective control necessitates spraying by organo-phosphorous compounds once before flowering and any number of times whenever need arises.

4.4. Infestations of powdery mildew, the most serious disease of grapes in Jordan, should be controlled by any of the known sulphur or systemic fungicides.

4.5. Nut-trees should be sprayed by winter oils for control of scale insects. Spraying with organo-phosphorous compounds is necessary for controlling aphids and fruit worms. It is advisable to spray trees with a copper containing fungicide before buds start growth as a protective measure against dormant fungal diseases. Spraying with effective fungicides may be necessary at a later date in case of mildew attack.

4.6. Apples are subject to attack by many pests which are controlled as follows :-

- winter spraying by winter oils for general pest control
- spraying of organo-phosphorous compounds against aphids, spiders and fruit worms.
- spraying of chlorinated compounds to control stem borers.

5. Taking all the foregoing recommendations the cost of production has been estimated and included in annex tables 6.4 to 9.4.

ANNEX TABLE 6.4.

ESTIMATED COST OF PRODUCTION OF OLIVES PER DUNUM

(JD)

I T E M	Year 1	2	3	4	5	6	7	8	9	10-12	13-30
Digging of holes & Planting (1)	3.5	0.4	-	-	-	-	-	-	-	-	-
Ploughing	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Watering	3.0	3.0	3.0	-	-	-	-	-	-	-	-
Cost of supports	0.5	-	-	-	-	-	-	-	-	-	-
Other establishment cost	-	0.2	0.8	-	-	-	-	-	-	-	-
Ring Ridging (2)	-	0.5	0.5	-	-	-	-	-	-	-	-
Plant protection	-	1.0	1.0	1.0	1.0	1.5	1.5	1.5	1.5	1.5	1.5
Fertilization	-	0.1	0.2	0.3	0.3	0.5	0.7	0.8	1.0	1.5	1.8
Weeding	0.5	0.5	0.6	0.7	0.7	1.0	1.0	1.0	1.0	1.0	1.0
Harvesting & transport	-	-	-	-	-	-	1.1	-	3.2	4.0	4.0
Sub Total	8.5	6.7	7.1	3.0	3.0	4.0	5.3	4.3	7.7	9.0	9.3
Stone terracing	26.4	-	-	-	-	-	-	-	-	-	-
Cost of transplants (3)	3.0	0.3	-	-	-	-	-	-	-	-	-
Grand total	37.9	7.0	7.1	3.0	3.0	4.0	5.3	4.3	7.7	9.0	9.3

(1) Assuming a 10% replanting in year 2.

(2) Included with planting cost in first year.

(3) Based on prices charged by government nurseries in 1976.

ANNEX TABLE 7.4.

ESTIMATED COST OF PRODUCTION OF GRAPES PER DUNUM

(JD)

I t e m	Year 1	2	3	4	5- 15
Digging of holes & Planting (1)	15.0	1.5	-	-	-
Ploughing	1.0	1.0	1.00	1.0	1.0
Cost of supports	5.0	-	-	-	-
Pruning	-	2.0	2.25	3.3	3.3
Watering	6.0	7.0	8.00	-	-
Ring ridging (2)	-	5.0	5.00	5.0	5.0
Plant protection	0.5	2.0	3.00	3.0	3.0
Fertilizer	-	0.5	0.75	1.7	1.7
Weed control	3.0	3.0	3.00	4.0	5.0
Harvesting & transport	-	-	-	1.0	5.0
Sub total	30.5	22.0	23.00	19.0	24.0
Stone terracing	26.4	-	-	-	-
Cost of transplants (3)	5.0	0.5	-	-	-
Grand total	61.9	22.5	23.00	19.0	24.0

(1) Assuming 10% replanting in year 2.

(2) Included with planting costs in first year.

(3) Based on prices charged by government nurseries in 1976.

ANNEX TABLE 8.4.

ESTIMATED COST OF PRODUCTION OF ONE DUNUM OF MIXED OLIVES & GRAPES (1)

(JD)

Item	Year 1	2	3	4	5	6	7	8	9	10	11	12
Digging of holes & planting (2)	11.00	1.15	-	-	-	-	-		-	-	-	-
Ploughing	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Watering	6.00	6.50	7.00	-	-	-	-	-	-	-	-	-
Supports	3.00	-	-	-	-	-	-	-	-	-	-	-
Pruning	-	1.50	2.00	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
Ring Ridging (3)	-	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Plant protection	0.85	2.00	2.50	2.50	2.50	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Fertilizers	-	0.35	0.50	1.80	1.115	1.40	1.55	1.55	1.85	2.35	2.35	2.65
Weeding	3.00	2.25	2.20	3.00	3.20	3.20	3.45	3.45	3.45	3.45	3.45	3.00
Harvest	-	-	1.20	2.00	2.00	3.00	2.00	5.00	2.00	5.00	2.25	6.00
Transport	-	-	0.50	0.50	1.485	1.10	1.00	1.20	0.75	1.45	1.00	1.70
Sub Total	24.85	17.75	19.90	15.50	16.00	17.40	16.70	19.90	16.75	20.95	17.75	22.05
Stone-terracing	26.40	-	-	-	-	-	-	-	-	-	-	-
Cost of transplants (4)	8.00	0.80	-	-	-	-	-	-	-	-	-	-
Grand total	59.25	18.55	19.90	15.50	16.00	17.40	16.70	19.90	16.75	20.95	17.75	22.05

(1) Planting rate at 10 olive trees and fifty grapes. Grape trees to be removed in year fifteen
(2) Assuming 10% replanting in year 2.
(3) Included with planting costs in first year.
(4) Based on prices charged by government nurseries in 1976.

ANNEX TABLE 10.4.
RECOMMENDED FERTILIZERS FOR SEASONAL CROPS
(Kg/Dunum)

Crop	Karak		Tafila		Shobak	
	S.A.(1)	T.S.P.(2)	S.A.	T.S.P.	S.A.	T.S.P.
Wheat	12	6	8	4	8	4
Barley	8	4	6	3	6	3
Lentils	-	5	-	5	x	x
Other field crops	-	5	-	5	-	5
Tomato	20	10	x	x	x	x
Melons	20	10	20	10	x	x
Onions	22	10	22	10	x	x
Other Veg. crops	20	10	20	10	x	x

(1) Sulphate of Ammonia (20.5% N)

(2) Triple superphosphate (45% $P_2 O_5$)

\- Fertilizers not recommended

x Crop not grown

apart at a depth of 15 cms. Fertilizers are then applied into the furrow and coverage effected by splitting the ridges.

4.3. Tomato transplants should be treated against nematodes. Planting is proposed at 100 cms spacing in furrows 150 cms apart. A nitrogen - phosphorous starter solution should be added.

4.4. Cucurbit seed, soaked in water for 12 hours should be sown in furrows at the following range of spacing :-

Crop	Spacing (cm) Between furrows	Between Plants
Water melon	175 - 200	120 - 150
Melon	120 - 150	100 - 120
Cucumber	100 - 120	80 - 100

5. Weed Control :

For wheat and barley 2-4D compounds are recommended at the rate of 100 - 120 ml per dunum. The practice of hand weeding is to continue for other crops since chemical and mechanical methods known elsewhere in the world have not, as yet, been proved applicable in Jordan. However, modern techniques could be adopted as soon as they are recommended by the appropriate government departments.

6. Crop Protection :

The following common pests and diseases are controlled by the following methods :-

Mildews in onions - Spraying by diathin M 45, manet or ultracal.

Fruit worms in tomatoes - spraying by ogsathion
Mildew in tomatoes and
Cucurbits - dusting with sulphur.

7. Wheat and barley should be combine-harvested. Lentils, vetches and chick peas are to be harvested by hand and threshed mechanically.

8. Costs of production are based on 1976 prices and are detailed in annex tables 11.4 and 12.4.

ANNEX TABLE 11.4
ESTIMATED COST OF PRODUCTION OF VEGETABLE CROPS
(JD PER DUNUM)

Item	Tomato		Onions		Melon		Cucurbits		Others	
	Karak	Tafila	Karak	Tafila	Karak	Tafila	Karak	Tafila	Karak	Tafila
Land Preparation	1.00	-	0.50	0.50	1.00	1.00	1.00	-	1.00	1.00
Seeds & seedlings	2.00	-	8.00	8.00	1.50	1.50	1.00	-	1.00	1.00
Sowing	1.50	-	1.00	1.00	0.50	0.50	0.50	-	1.00	1.00
Nitrogenous Fertilizer	0.90	-	1.00	1.00	0.90	0.90	0.90	-	0.90	0.90
Triple superphosphate	0.80	-	0.80	0.80	0.80	0.80	0.80	-	0.80	0.80
Fertilizer application	0.25	-	0.25	0.25	0.25	0.25	0.25	-	0.25	0.25
Crop husbandry	0.50	-	1.00	1.00	0.50	0.50	0.50	-	1.50	1.50
Chemicals for crop protection	1.00	-	0.35	0.35	1.00	1.00	1.00	-	-	-
Application of chemicals	0.50	-	0.25	0.25	0.50	0.50	0.50	-	-	-
Harvest	4.00	-	4.50	4.50	2.50	2.50	2.00	-	2.00	2.00
Packing and transport	0.80	-	2.00	2.00	0.80	0.80	0.50	-	0.50	0.50
Total	13.25	-	19.65	19.65	10.25	10.25	8.95	-	8.95	8.95

ANNEX TABLE 12.4
ESTIMATED COST OF PRODUCTION OF FIELD CROPS
(JD PER DUNUM)

Item	Wheat			Barley			Lentils			Vetch			Chick peas			Others		
	Karak	Tafila	Shobak	Karak	Tafila	Shobak	Karak	Tafila	Shobak	Karak	Tafila	Shobak	Karak	Tafila	Shobak	Karak	Tafila	Shobak
Land preparation	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	-	0.05	-	-	0.65	-	-	0.65	0.65	0.65
Seeds	0.84	0.74	0.63	0.67	0.57	0.57	0.84	0.84	-	0.51	-	-	0.90	-	-	0.90	0.90	0.90
Seeding & Fertilizer application	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	-	0.15	-	-	0.15	-	-	0.15	0.15	0.15
Nitrogenous fertilizer	0.54	0.36	0.36	0.36	0.27	0.27	-	-	-	-	-	-	-	-	-	-	-	-
Triple superphosphate	0.48	0.32	0.32	0.32	0.24	0.24	0.40	0.40	-	0.40	-	-	0.40	-	-	0.40	0.40	0.40
Weedicides	0.15	0.15	0.15	0.15	0.15	0.15	-	-	-	-	-	-	-	-	-	-	-	-
Weedicide application	0.15	0.15	0.15	0.15	0.15	0.15	-	-	-	-	-	-	-	-	-	-	-	-
Harvest & threshing	0.60	0.60	0.60	0.60	0.60	0.60	2.40	2.40	-	2.40	-	-	2.00	-	-	2.00	2.00	2.00
Sacks	0.20	0.15	0.15	0.15	0.15	0.15	0.15	0.15	-	0.15	-	-	0.25	-	-	0.25	0.25	0.25
Transport	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-	0.05	-	-	0.05	-	-	0.05	0.05	0.05
Collection of Straw & hay	0.90	0.85	0.85	0.85	0.85	0.85	0.60	0.60	-	0.60	-	-	0.60	-	-	0.60	0.60	0.60
Total	4.560	4.025	3.91	3.945	3.680	3.68	5.09	5.09	-	4.76	-	-	5.00	-	-	5.00	5.00	5.00

ANNEX IV

5. Proposed Crop Rotations

1. Karak Area :

1.1. Part receiving annual rainfall between 250-300 mm.

Total area is estimated at 62,000 dunums. Only barley is recommended for cropping in a two - course rotation. The crop will alternate with fallow which should be worked with a view of controlling weeds and conserving soil moisture. Thus only one crop will be produced by water gained from two rainy seasons.

1.2. Part receiving more than 300 mm :

The main considerations on which the rotation in this area (348,000 dunums) was based are :-

- reduction of the fallow to the maximum possible extent,
- suitability of the area for seasonal crops,
- exclusion of barley in favour of wheat,
- limiting vegetable production to the needs of the area and the neighbouring arid parts.

A two - course rotation in which wheat occupies half the land and alternates with other crops and fallow is proposed. Areas allotted to each crop are as fallows :-

		000 dunums
Wheat (174,000 dunums)	Lentils	50
	Chickpea	25
	Vetches	20
	Other field crops	5
	Onions	10
	Cucurbits	5
	Tomatoes	4
	Melon	3
	Other Veg. crops	2
	Fallow	20
	Total	174

2. Tafila Area :

2.1. Section receiving 250 - 300 mm.

Of the 16,000 dunums occuring in this section it is estimated that 25% (4,000 dunums) are located in favourable sites close to the 300 mm isohyet. In this part wheat is proposed to alternate with other crops i.e. the whole area will be cropped annually. In the remaining part, wheat and barley will alternate with a cultivated fallow as shown below :-

Wheat 2,000 (d)	Other crops 2,000 (d)
2,000 (d)	Fallow 6,000 (d)
Barley 4,000 (d)	

2.2. Section receiving more than 300 mm :

Includes 4,000 dunums of land. It is proposed that half the area be put under wheat which will alternate with lentils ($\frac{1}{4}$) and vegetables ($\frac{1}{4}$) : Crop areas would be :

Wheat 2,000 (d)	Lentils	1,000 (d)
	Onions	300
	Melon	300
	Other Veg.	400
	Total	2,000

3. Shobak :

All the 49,500 dunums in this location fall within the annual rainfall range of 250 - 300 mm. In areas close to the 300 mm isohyet, estimated at 6,000 dunums, wheat will alternate with other crops. In the remaining part wheat and barley will occupy half the land ; the other half will be a cultivated fallow. Proposed crop areas are :-

<table>
<tr><td>Wheat
3,000 (d)</td><td rowspan="2">3,000 (d)
Other crops</td></tr>
<tr><td>Wheat
7,000 (d)</td></tr>
<tr><td>Barley
14,750 (d)</td><td>Fallow
21,750 (d)</td></tr>
</table>

APPENDIX TABLE 1.2

AREAS OF LAND CLASSES IN VILLAGES INCLUDED IN THE PROJECT AREA IN KARAK DISTRICT

(Dunums)

	Village	No. of Blocks	Area Settled	Public Utilities	Wells & Buildings	Unsettled land	Forest	Govt. Land	Total	Land suitable for cropping	Rainfed Land	Irrigated Land
1	Imric'	33	25876	785	77	89	15813	583	43223	17818	17797	21
2	Sirfa	11	9332	289	24	74	11539	13	21271	7839	7531	308
3	Magdoline	7	13661	206	14	639	-	12	14532	11844	11844	-
4	Elkasr	15	30302	496	112	366	445	2092	33813	28655	28655	-
5	Elzigeiba	6	2945	77	2	96	1339	821	5280	2931	2931	-
6	Wadi Bin Hammad	10	10487	312	2	-	2428	-	13229	7941	5876	2065
7	El Yarout	6	4827	130	6	202	776	45	5986	4560	4560	-
8	Dimnah	6	2227	58	1	196	-	1016	3498	1930	1930	-
9	Humoud	27	22714	410	76	615	107	1338	25260	20170	20170	-
10	El Rabba	28	22118	451	79	310	-	1532	24490	20601	20547	54
11	El Gadidah	7	22088	459	63	561	3301	1514	27986	20828	20828	-
12	Bitteir	10	13100	381	157	220	3201	6	17065	8030	8030	-
13	El Hadeib	7	5504	177	12	16	7759	14	13482	2323	2249	74
14	Um Rumana					INCLUDED WITH RAKIN						
15	El Rodah	6	4267	43	2	-	-		4312	3682	3682	-
16	Adir	15	36665	761	55	1511	1998	22553	53543	34269	34269	-
17	Rakin	29	25435	895	142	210	16094	26	42802	22060	22001	59
18	Bathan					A BLOCK IN SAMRA						
19	Sakka					A BLOCK IN SAMRA						
20	Samra	34	19115	653	15	113	2269	194	22359	16648	13036	3612
21	El Kanar	8	6975	161	23	217	1194	-	8570	5864	5864	-
22	El Karak	53	7269	388	84	540	800	52	9133	6638	6127	511
23	El Shihabiya	29	12330	384	83	391	312	4	13504	10726	10651	75
24	Joz El Amyan					A BLOCK IN AAY						
25	Mumya					A BLOCK IN SAMRA						

APPENDIX TABLE 1.2 (CONT)

	Village	No. of Blocks	Area Settled	Public Utilities	Wells & Buildings	Unsettled land	Forest	Govt. Land	Total	Land Suitable for cropping	Rainfed Land	Irrigated Land
26	Azra	6	2026	86	25	64	84	-	2285	1770	1770	-
27	Ghayoun	10	4411	227	16	376	233	1	5264	3785	3785	-
28	El Marrad	20	10537	228	25	104	198	15	11107	8607	8607	-
29	El Thaniya	22	27656	774	119	375	2896	2581	34401	21995	21995	-
30	El Ghuweir				A BLOCK IN ELTHANIYA							
31	Zahoum				A BLOCK IN ELTHANIYA							
32	El Mireigha	14	8691	144	8	685	438	4972	14938	8688	8688	-
33	Maddin	23	20692	550	68	551	1199	4248	27308	19302	19302	-
34	Mihna	14	11131	289	39	261	89	52	11861	10566	10566	-
35	A'Ay	37	29776	98	86	250	-	2391	32601	26593	25483	1110
36	Mirwid	18	15131	334	63	174	-	3917	19629	13908	13908	-
37	Mawta	11	7051	194	62	132	-	23	7462	6919	6919	-
38	El Iraq	18	13586	404	8	182	-	5302	19482	14372	10759	3613
39	El Mazar	27	20716	518	109	170	-	259	21772	20066	20066	-
40	Sul	14	12985	342	77	210	-	1587	15201	12176	12176	-
41	El Amirya	5	2632	65	18	125	29	4	2873	2469	2469	-
42	El Amagha	14	8583	190	23	76	-	58	8930	8349	8349	-
43	Rugm Alanda				A BLOCK IN MIRWID AND MAZAR							
44	Um Hmat	18	14630	284	67	218	58	168	15425	14467	14467	-
45	Magra	7	6007	86	5	82	-	-	6180	5648	5648	-
46	El Hashimiyah	6	3282	99	12	192	707	-	4292	3104	3104	-
47	El Hussayniyah	9	9119	199	39	82	579	1	10019	7767	7767	-
	Total	640	525879	12627	1898	10675	75885	47394	674358	465908	454406	11502
	% Age		0,78	1,1	0,1	1,6	11,2	7,0	100,0	69,1	67,4	1,7

Source : Department of Land and Survey

APPENDIX TABLE 2.2

AREAS OF LAND CLASSES IN VILLAGES INCLUDED IN THE PROJECT IN TAFILA DISTRICT

(Dunums)

	Village	No. of Blocks	Area Settled	Public Utilities	Wells & Buildings	Unsettled Land	Forest	Govt. Land	Total	Land Suitable for cropping	Rainfed land	Irrigated land
1	Klaila'	1	665	23	3	-	125	-	816	655	555	100
2	Klmitan	1	350	1	32	-	119	-	502	350	290	60
3	Saawa	1	2629	8	-	-	43	-	2680	2629	2604	25
4	Biseira (Gharandal)	20	44009	1285	29	391	12861	114	58689	38213	37181	1032
5	Dana (½)	27	27115	567	16	200	7763	410	36071	18422	18108	314
6	Elrashadia (Lahtha)	3	10073	196	7	54	1295	42	11667	7844	7785	59
	Total	53	84841	2080	87	645	22206	566	110425	68113	66523	1590
	% Age		76,8	1,9	0,1	0,6	20,1	0,5	100,0	61,7	60,2	1,4

Source Department of Lands and Survey

APPENDIX TABLE 3.2

AREAS OF LAND CLASSES IN VILLAGES INCLUDED IN THE PROJECT IN SHOBAK DISTRICT

(Dunums)

	Village	No. of Blocks	Area Settled	Public utilities	Wells & Buildings	Unsettled Land	Forest	Govt. Land	Total	Land Suitable for cropping
1	El Gaya	1								
2	Nigil	1								
3	Shmakh	1	El Shobak			66090	22285	47653	136028	50667
4	El Migariya	1	Group							
5	Abu Maktoub									
6	Elzubieriya	1								
7	Elgiheir									
8	Bierkhidad	13	22075	461	12	156		21762	44466	11645
9	Rimielat	5	16637	289	26	32		6196	23180	6007
10	Makdis & Um Sowana	8	14852	407	33	33	48	3241	18614	3193
	Total	26	53564	1157	71	66311	22333	78852	222288	71512
	% Age		24,10	0,52	0,03	29,83	10,05	35,47	100,00	32,2

N. B. : Areas under irrigation not available

Source : Department of Lands and Survey.

APPENDIX TABLE 4.2

ANNUAL AND MONTHLY RAINFALL IN RABBA

1967 - 1975

(mm)

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1967	54,6	32,9	111,9	0,0	12,4	0,0	0,0	0,0	0,0	0,0	46,1	29,5	287,4
1968	158,0	24,8	18,5	41,5	3,5	0,0	0,0	0,0	0,0	8,0	36,9	94,8	386,0
1969	61,5	2,1	112,8	14,0	0,0	0,0	0,0	0,0	0,0	0,0	20,8	25,0	236,2
1970	55,9	17,1	128,8	20,0	0,0	0,0	0,0	0,0	0,0	0,0	2,5	47,0	271,3
1971	64,5	16,7	27,0	238,5	0,0	0,0	0,0	0,0	0,0	0,0	24,5	210,8	582,0
1972	27,5	79,0	114,2	13,0	0,0	0,0	0,0	0,0	0,0	3,6	53,4	30,1	320,8
1973	93,4	14,0	18,9	0,0	0,0	0,0	0,0	0,0	0,0	1,6	57,6	21,8	207,3
1974	191,3	80,6	30,0	37,9	0,0	0,0	0,0	0,0	0,0	0,0	24,9	73,3	438,0
1975	18,0	145,3	52,2	0,5	0,0	0,0	0,0	0,0	0,0	0,3	32,7	32,2	281,2
67-75	80,5	45,8	68,3	40,6	1,8	0,0	0,0	0,0	0,0	1,5	33,3	62,7	334,5

Source : Department of Meteorology - Amman

APPENDIX TABLE 5.2

ANNUAL AND MONTHLY RAINFALL IN TALIFA

1967 - 1975

(mm)

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1967	0,0	0,0	0,0	x	35,1	0,0	0,0	0,0	0,0	5,2	45,5	15,3	101,1
1968	79,7	69,7	19,0	40,3	5,4	0,0	0,0	0,0	0,0	15,6	26,5	66,3	322,5
1969	52,1	5,0	105,7	29,1	0,1	0,0	0,0	0,0	0,0	0,4	26,5	0,5	219,4
1970	47,4	2,1	71,6	7,4	0,0	0,0	0,0	0,0	0,0	0,0	9,9	63,5	201,9
1971	37,0	16,6	9,7	171,5	0,0	0,0	0,0	0,0	0,0	0,2	4,4	232,0	471,4
1972	10,8	69,9	239,4	16,3	4,0	0,0	0,0	0,0	0,0	3,4	21,2	10,8	375,8
1973	93,4	0,0	2,6	0, 4	0,0	0,0	0,0	0,0	0,0	10,5	82,6	61,7	251,2
1974	395,5	174,3	20,9	36,0	0,0	0,0	0,0	0,0	0,0	0,0	4,7	163,9	745,3
1975	60,5	162,0	18,9	10,8	1,7	0,0	0,0	0,0	0,0	0,0	3,6	19,1	276,6
67-75	86,3	55,5	54,2	34,6	5,1	0,0	0,0	0,0	0,0	3,9	25,0	70,3	335,0

N.B. :- x Data not available

Source : Department of Meteorology - Amman.

APPENDIX TABLE 6.2

ANNUAL AND MONTHLY RAINFALL IN SHOBAK

1967 - 1975

(mm)

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1967	85,0	82,0	99,9	1,6	59,5	0,0	0,0	0,0	0,0	8,7	38,9	16,2	391,8
1968	92,9	61,5	27,7	22,3	16,4	0,0	0,0	0,0	0,0	15,7	45,3	61,6	343,4
1969	55,8	5,2	120,9	51,7	3,2	0,0	0,0	0,0	0,0	2,5	22,7	0,2	262,2
1970	45,5	2,0	95,9	8,2	0,0	0,0	0,0	0,0	0,0	0,3	4,4	71,7	228,0
1971	56,7	22,5	5,7	98,2	0,0	0,0	0,0	0,0	0,0	0,0	5,0	200,8	388,9
1972	10,3	77,0	143,0	21,6	0,5	0,0	0,0	0,0	0,0	18,0	43,3	16,0	329,7
1973	57,2	0,5	2,0	1,1	0,0	0,0	0,0	0,0	0,0	0,0	11,9	16,0	88,7
1974	238,0	107,0	22,0	15,2	0,0	0,0	0,0	0,0	0,0	0,0	13,0	77,4	472,6
1975	35,2	159,3	23,0	2,0	0,2	2,3	0,0	0,0	0,0	0,0	2,1	64,7	288,8
67-75	75,2	57,4	60,0	24,6	8,9	0,2	0,0	0,0	0,0	5,0	20,7	58,3	310,3

Source : Department of Meteorology - Amman

APPENDIX TABLE 7.2

MINIMUM & MAXIMUM MONTHLY TEMPERATURES AT RABBA

1967 - 1975

(°C)

Year		Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1967	Max.	20,5	18,5	21,0	27,0	35,0	36,0	37,0	32,0	34,0	30,0	27,0	21,0
	Min.	0,0	- 2,5	1,0	3,0	8,0	9,0	13,0	13,0	11,0	8,0	3,0	0,0
1968	Max.	19,0	24,0	24,0	32,7	35,0	33,0	37,6	37,7	35,8	33,0	25,5	22,6
	Min.	2,0	0,0	1,0	3,0	8,0	9,4	14,0	12,8	11,0	8,2	4,0	4,0
1969	Max.	20,0	25,0	28,7	27,5	36,7	38,7	37,4	37,4	38,5	33,8	24,3	25,3
	Min.	3,0	0,0	1,0	1,5	7,5	11,0	12,0	15,5	12,0	8,0	5,5	2,5
1970	Max.	20,5	23,7	27,3	33,8	39,0	33,5	22,0	33,5	35,5	20,5	27,3	18,5
	Min.	1,0	2,0	2,0	4,0	3,0	9,0	13,0	12,3	11,9	7,0	3,0	- 2,5
1971	Max.	26,4	21,4	27,5	29,6	35,4	35,0	31,6	35,0	36,5	31,0	24,5	24,3
	Min.	0,0	- 0,5	3,5	1,0	7,0	8,0	12,0	12,5	10,5	6,0	2,0	- 0,8
1972	Max.	15,0	20,0	27,5	31,5	30,6	33,9	32,8	33,5	37,5	36,0	26,4	18,5
	Min.	- 0.3	- 1.2	1,0	3,2	5,0	8,0	12,0	13,0	12,0	7,0	3,5	- 4,8
1973	Max.	20,6	28,0	31,6	33,5	33,3	36,0	36,2	32,0	36,0	30,5	25,5	21,5
	Min.	- 5.1	2,0	1,0	4,0	6.0	8,0	13,5	15,9	11,5	10,5	2,0	2,0
1974	Max.	16,2	20,5	26,0	30,0	31,0	36,0	33,5	33,7	32,0	31,0	28,0	18,5
	Min.	0,0	0,0	2,5	2,0	5,0	11,0	14,8	12,7	11,0	10,0	5,0	0,5
1975	Max.	15,5	21,6	25,0	28,0	35,5	33,5	35,2	34,0	31,0	29,5	25,0	17,5
	Min.	1,0	- 3,0	2,0	5,0	5,0	10,5	12,0	14,3	11,5	8,2	5,0	- 0,5
Average	Max.	17,2	22,5	26,5	30,4	34,6	35,1	34,4	34,4	35,2	31,7	25,9	20,8
	Min.	- 1,1	- 0,4	0,9	3,0	6,1	9,3	12,9	13,5	11,4	8,1	3,7	0,3

Source :- Department of Meteorology - Amman

APPENDIX TABLE 8.2

MINIMUM AND MAXIMUM MONTHLY TEMPERATURES AT TAFILA

1967 - 1975

(°C)

		Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1967	Max.	x	x	x	27,4	33,4	33,7	32,9	30,8	32,4	27,5	24,9	21,9
	Min.	x	x	x	6,3	8,2	11,6	15,0	17,0	13,6	10,9	2,3	0,0
1968	Max.	18,4	22,5	27,1	31,1	34,1	32,5	35,4	35,2	33,9	31,9	24,2	22,0
	Min.	-2,1	-2,0	2,8	5,6	12,3	13,6	15,6	14,2	12,8	11,3	6,3	4,9
1969	Max.	19,6	24,4	29,7	26,6	35,0	36,4	32,6	32,4	35,6	31,0	22,9	25,2
	Min.	1,0	3,8	4,0	4,0	8,0	14,5	13,8	14,5	15,3	11,0	7,6	4,2
1970	Max.	20,6	21,6	27,0	34,2	37,3	32,4	31,4	32,8	32,6	28,8	27,0	18,8
	Min.	1,0	2,8	4,5	4,8	8,0	11,4	14,0	14,8	12,3	9,3	6,0	0,3
1971	Max.	25,6	20,4	26,4	29,8	33,2	33,4	30,6	32,8	32,8	29,2	24,2	23,4
	Min.	- 2,8	0,5	- 0,1	4,2	10,4	10,6	14,2	15,5	13,7	10,0	5,4	0,0
1972	Max.	17,8	19,0	26,9	30,2	28,3	33,2	32,3	33,2	36,4	32,4	24,2	17,8
	Min.	- 2,0	1,5	- 2,1	7,0	7,5	11,8	14,0	14,8	14,6	9,7	3,8	0,0
1973	Max.	21,4	25,3	29,4	28,2	30,5	33,0	35,0	32,0	33,8	30,1	23,0	20,5
	Min.	- 6,8	0,2	- 1,0	2,4	7,5	7,8	12,6	15,0	11,5	8,0	0,7	- 0,3
1974	Max.	15,2	19,4	23,5	30,0	31,0	35,7	33,8	35,7	30,2	30,1	26,8	16,6
	Min.	- 2,3	3,7	- 1,0	3,4	5,0	10,4	13,1	11,0	11,8	9,0	2,5	- 0,6
1975	Max.	14,6	21,0	25,0	28,1	33,4	32,0	34,4	35,1	31,1	28,8	23,7	19,4
	Min.	- 1,6	5,5	- 0,4	4,3	3,0	8,6	10,9	13,4	10,1	6,6	3,4	- 2,1
Average	Max.	19,2	21,7	26,9	29,5	32,9	33,6	33,2	33,3	33,2	30,0	24,5	20,6
	Min.	- 0,8	- 0,8	- 1,4	4,7	7,8	11,1	13,7	14,5	12,8	9,5	4,3	0,7

N. B. :-

x Information not available

Source :- Department of Meteorology. Amman

APPENDIX TABLE 9.2

MINIMUM AND MAXIMUM MONTHLY TEMPERATURES AT SHOBAK

1967 - 1975

(°C)

Year		Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1967	Max.	17,5	14,2	17,0	24,2	30,3	31,0	34,5	27,4	30,0	25,2	22,0	19,0
	Min.	- 8,0	-12.0	- 5,3	-6.0	1,5	2,6	6,1	5,2	1,0	0,2	- 0,5	- 5,5
1968	Max.	16,2	21,0	27,0	27,5	30,4	29,0	35,8	32,8	31,0	28,0	21,5	19,0
	Min.	- 6,5	- 6,6	- 5,4	- 2,4	- 2,0	3,0	7,6	7,3	4,4	1,0	- 1,4	- 3,3
1969	Max.	16,2	21,4	27,2	24,0	31,6	32,5	31,4	33,0	33,0	31,7	20,0	22,5
	Min.	- 5,0	- 4,0	- 3,5	8,0	1,7	7,4	6,5	8,2	5,0	1,5	0,5	- 6,8
1970	Max.	18,0	19,2	23,5	30,5	35,0	29,4	30,6	31,3	30,8	26,0	24,0	16,5
	Min.	- 4,8	- 6,4	- 3,0	-0,6	0,5	4,8	7,0	4,2	7,0	1,5	- 4,8	- 8,5
1971	Max.	21,8	19,0	24,0	26,3	30,5	30,5	31,5	31,4	32,0	27,5	21,0	20,5
	Min.	- 5,2	- 6,5	- 5,5	5,2	2,5	6,4	9,0	6,5	4,5	0,0	- 4,3	- 8,5
1972	Max.	14,0	17,5	23,6	27,0	26,4	29,5	31,0	30,5	32,6	30,0	20,6	16,6
	Min.	- 7,5	- 9,0	- 5,0	1,0	1,0	5,0	6,2	9,4	5,0	1,0	- 2,5	- 8,0
1973	Max.	19,5	24,3	28,5	27,4	29,5	32,0	32,8	30,5	32,8	28,7	22,5	19,4
	Min.	- 7,0	- 5,0	- 5,5	-1.5	0,5	1,8	5,4	8,5	3,2	3,0	- 6,0	- 5,5
1974	Max.	14,5	18,8	24,0	28,6	29,1	33,5	32,0	35,4	29,0	28,5	26,0	16,4
	Min.	- 6,5	- 9,0	- 2,0	- 0,5	- 1,0	3,6	7,2	4,0	5,2	2,0	- 3,2	- 6,5
1975	Max.	13,4	22,0	23,2	26,5	31,1	30,2	32,0	32,0	30,2	25,8	22,2	16,8
	Min.	- 7,8	-11,0	- 4,5	- 2,0	- 0,5	3,5	7,0	7,5	2,2	- 0.2	- 4,6	- 6,8
Average	Max.	16,8	19,7	24,2	26,9	30,4	30,8	32,4	31,6	31,3	27,9	22,2	18,5
	Min.	- 6,5	- 7,7	- 4,4	-2.8	0,6	4,2	6,9	6,7	4,2	0,6	- 3,0	- 6,6

Source : Department of Meteorology

APPENDIX TABLE 10.2.

LAND AREAS IN DIFFERENT SLOPE CLASSES & PROPOSED ALLOTMENT TO SEASONAL AND PERENNIAL CROPPING IN KARAK DISTRICT

Item slope	0-3%	3-8%	8-15%	15-25%	25-45%	above 45%	Total
1. Areas in Different slope Classes							
a) Area in dunums	101154	370897	101154	67436	20231	13487	674358
b) Percent of total	15	55	15	10	3	2	100
2. Areas allotted to Seasonal Crops							
a) Area in dunums	96000	314000	-	-	-	-	410000
b) Percent of area in the same slope class	95	85	-	-	-	-	61
3. Areas allotted to Fruit Trees							
a) Area in dunums	-	-	70500	33500	1482	-	105482
b) Percent of area in the same slope class	-	-	70	50	7	-	16
4. Total cropable area	96000	314000	70500	33500	1482	-	515482
5. Percentage							77

Source : Team Estimates.

APPENDIX TABLE 11.2.

LAND AREAS IN DIFFERENT SLOPE CLASSES & PROPOSED ALLOTMENT TO SEASONAL AND PERENNIAL CROPPING IN TAFILA DISTRICT

Item	slope	0 - 8%	8 - 15%	15 - 25%	above 25%	Total
1. Area in Different slope Classes :						
a) Area in dunums		22085	22085	44170	22085	110425
b) Percent of total		20	20	40		100
2. Areas allotted to seasonal crops :						
a) Area in dunums		20000	-	-	-	20000
b) Percent of area in the same slope class		90	-	-	-	18
3. Areas allotted to fruit trees :						
a) Area in dunums		-	16500	26300	2200	45000
b) Percent of area in the same slope class		-	75	60	10	41
4. Total cropable area		20000	16500	26300	2200	65000
5. Percentage						59

Source : Team Estimates.

APPENDIX TABLE 12.2.

LAND AREAS IN DIFFERENT SLOPE CLASSES & PROPOSED ALLOTMENT TO SEASONAL AND PERENNIAL CROPPING IN SHOBAK DISTRICT

Item	Slope	0 – 8%	8 –15%	15–25%	above 25%	Total
1. Areas in Different slope Classes :						
A) Area in dunums		33343	55573	66686	66686	222288
B) Percent of total		15	25	30	30	100
2. Areas allotted to seasonal crops :						
A) Area in dunums		30000	19500	-	-	49500
B) Percent of area in the same slope class		90	35	-	-	22
3. Areas Allotted to Fruit Trees :						
A) Area in dunums		-	8200	3320	-	11520
B) Percent of area in the same slope class		-	15	5	-	5
4. Total Cropable Area		30000	27700	3320	-	61020
5. Percentage						27

Source :- Team Estimates

APPENDIX TABLE 13.2

LAND AREAS IN DIFFERENT SLOPE CLASSES AND PROPOSED ALLOTMENT TO SEASONAL AND PERENNIAL CROPPING IN ALL PROJECT DISTRICTS

I t e m Slope	0 -8%	8-15%	15-25%	More than 25%	Total
1. Areas in different slope Classes :					
A- Area in dunums	527,479	178,812	178,292	122,488	1,007,071
B- Percent of total	52	18	18	12	100
2. Areas allotted to Seasonal Crops:					
A- Area in dunums	460,000	19,500	-	-	479,500
B- Percent of area in the same slope class	87	11	-	-	48
3. Areas allotted to fruit trees :					
A- Area in dunums	-	95,200	63,120	3,682	162,002
B- Percent of area in the same slope class	-	53	35	3	16
4. Total cropable area	460,000	114,700	63,120	3,682	641,502
5. % age of total	-	-	-	-	64

APPENDIX TABLE 1.3.

WHEAT

AREA AND PRODUCTION IN PROJECT AREA

(1969 - 1975)

(1) Area in Dunums (2) Production in M. Tons (3) Average Yield ; Kg/Dunums

District		69	70	71	72	73	74	75	Average
Karak	(1)	230400	121150	242610	229167	126850	254400	177000	197368
	(2)	17915	4571	10522	12948	2117	18379	11830	11185
	(3)	78	38	43	56	17	72	67	57
Tafila	(1)	22000	8000	20700	18800	11300	11300	20100	16028
	(2)	1143	-	574	954	-	565	1253	641
	(3)	52	-	28	51	-	50	62	40
Shobak	(1)	23700	20200	65000	51500	22200	77500	63500	46229
	(2)	2126	450	2870	4890	-	1760	2590	2098
	(3)	90	22	44	95	-	23	41	45
Project Area	(1)	276100	149350	328310	299467	160350	343200	260600	259625
	(2)	21184	5021	13966	18795	2117	20717	15673	13924
	(3)	77	34	43	63	13	60	60	54

Source : Computed from original village Statistics, Department of Agricultural Economics, Ministry of Agriculture, Amman.

APPENDIX TABLE 2.3.

BARLEY

AREA & PRODUCTION IN PROJECT AREA (1969 - 75)

(1) Area in Dunums (2) Production in M/tons (3) Average in Yield Kg/Dunum

District		69	70	71	72	73	74	75	Average
Karak	(1)	58560	33600	60570	107450	60650	86300	53750	65840
	(2)	3692	1133	2188	2617	761	5094	2852	2619
	(3)	63	34	36	24	13	59	54	40
Tafila	(1)	9200	4350	8250	7500	3900	3900	7600	6257
	(2)	572	-	225	375	-	217	228	231
	(3)	62	-	27	50	-	56	34	37
Shobak	(1)	3600	4700	4600	6300	1500	6900	13600	5886
	(2)	290	56	276	441	-	276	275	231
	(3)	81	12	60	70	-	40	20	39
Project Area	(1)	71360	42650	73420	121250	66050	97100	74050	77983
	(2)	4554	1189	2689	3433	761	5587	3355	3081
	(3)	64	28	37	28	12	58	45	40

Source : Computed from original village statistics, Department of Agricultural Economics, Ministry of Agriculture, Amman

APPENDIX TABLE 3.3.

LENTILS

AREA AND PRODUCTION IN PROJECT AREA

(1969-75)

(1) Area in dunums (2) Production in M. Tons (3) Average Yield in Kg/dunum

District		69	70	71	72	73	74	75	Average
Karak	(1)	11650	10550	7120	30713	25310	30200	32050	21084
	(2)	768	395	377	491	280	1882	2114	901
	(3)	66	37	53	16	11	62	66	43
Tafila	(1)	540	170	280	600	240	260	2950	720
	(2)	36	-	17	30	-	13	204	43
	(3)	67	-	61	50	-	50	69	60
Shobak	(1)	1020	465	1450	1420	290	1800	2250	1242
	(2)	78	21	49	85	-	108	67	58
	(3)	76	45	34	60	-	60	30	47
Project Area	(1)	13210	11185	8850	32733	25840	32260	37250	23046
	(2)	882	416	443	606	280	2003	2385	1002
	(3)	67	37	50	19	11	62	64	43

Source : Computed from original village statistics, Department of Agricultural Economics, Ministry of Agriculture - Amman

APPENDIX TABLE 4.3.

VETCHES

AREA AND PRODUCTION IN PROJECT AREA

(1969 - 75)

(1) Area in dunums (2) Production in M. Tons (3) Average Yield in Kg/Dunum

District		69	70	71	72	73	74	75	Average
Karak	(1)	5290	4520	700	12400	11050	9810	7860	7376
	(2)	351	169	35	52	-	597	449	236
	(3)	66	37	50	4	-	61	57	32
Tafila	(1)	50	20	20	70	10	14	-	26
	(2)	4	-	1	5	-	3	-	2
	(3)	80	-	50	71	-	214	-	77
Shobak	(1)	-	-	-	75	-	-	-	11
	(2)	-	-	-	6	-	-	-	0,85
	(3)	-	-	-	80	-	-	-	77
Project Area	(1)	5340	4540	720	12545	11060	9824	7860	7413
	(2)	355	169	36	63	-	600	449	239
	(3)	66	37	50	5	-	61	57	32

Source : Computed from Original Village Statistics, Department of Agricultural Economics, Ministry of Agriculture - Amman.

APPENDIX TABLE 5.3.

CHICK PEAS

AREA AND PRODUCTION IN PROJECT AREA

(1969 - 75)

(1) Area in dunums (2) Production in M. Tons (3) Average yield in Kg/dunum

District		69	70	71	72	73	74	75	Average
Karak	(1)	2440	1040	2705	3250	1300	11050	3580	3624
	(2)	160	22	138	184	37	731	213	212
	(3)	65	21	51	57	28	66	59	59
Tafila	(1)	210	170	-	370	180	340	144	202
	(2)	13	1	-	24	-	26	10	11
	(3)	62	6	-	65	-	77	69	54
Shobak	(1)	630	190	415	620	-	1350	1350	651
	(2)	51	-	17	31	-	54	22	25
	(3)	81	-	41	50	-	40	16	38
Project Area	(1)	3280	1400	3120	4240	1480	12740	5074	4477
	(2)	224	23	155	239	37	811	245	248
	(3)	73	16	50	56	25	64	48	55

Source : Computed from Original Village Statistics, Department of Agricultural Economics, Ministry of Agriculture - Amman

APPENDIX TABLE 6.3.
OTHER FIELD CROPS(1)
AREA AND PRODUCTION IN PROJECT AREA (1969 - 75)

(1) Area in dunums (2) Production in M. Tons (3) Average Yield in kg/dunum

District		69	70	71	72	73	74	75	Average
Karak	(1)	3355	1140	2890	3310	-	1130	1820	1821
	(2)	2130.0	25,0	120,0	182,0	-	64,0	35,0	91,0
	(3)	63	22	42	55	-	52	43	50
Tafila	(1)	60	10	-	25	-	-	4	14
	(2)	3,4	0,2	-	1,3	-	-	0,3	0,7
	(3)	57	20	-	52	-	-	75	50
Shobak	(1)	400	79	165	170	17	210	210	179
	(2)	29,0	-	6,0	6,0	-	6,0	5,0	7,0
	(3)	73	-	36	35	-	29	24	39
Project Area	(1)	3815	1229	3055	3505	17	1440	1034	2014
	(2)	245,4	25,2	126,0	189,3	-	70,0	40,3	99,0
	(3)	64	20	41	54	-	48	39	49

Note: (1) Other crops include sorghum broom corn and sesame.

Source : Computed from original village Statistics, Department of Agricultural Economics, Ministry of Agriculture - Amman.

APPENDIX TABLE 7.3.

AVERAGE AREA AND PRODUCTION OF FIELD CROPS IN PROJECT AREA

1969 - 1975

(1) Area in dunums (2) Production in M/Tons (3) Average yield/kg/dunum

District		Wheat	Barley	Lentils	Vetches	Chickpeas	Others	Total
Karak	(1)	197368	65840	21084	7376	3624	1821	297113
	(2)	11185	2619	901	236	212	91	15247
	(3)	57	40	43	32	59	50	51
Tafila	(1)	16028	6257	720	26	202	14	23247
	(2)	641	231	43	2	11	0,7	929
	(3)	40	37	60	77	54	50	40
Shobak	(1)	46229	5886	1242	11	650	179	54198
	(2)	2098	231	58	0,85	25	7	2420
	(3)	45	39	47	77	38	39	45
Project Area	(1)	259625	77983	23046	7413	4477	2014	374558
	(2)	13924	3081	1002	239	248	99	18598
	(3)	54	40	43	32	55	49	50

Source : Extracted from Appendix tables 1.3. - 6.3.

APPENDIX TABLE 8.3

VARIATION OF AREA AND PRODUCTION IN PROJECT AREA

1969 - 1975

Crop		Year	Area (Dunum)	Year	Production (M. Tons)	Year	Average Yield (kg/Dunum)
Wheat	Max.	74	343200	74	20717	69	77
	Min.	70	149350	73	2117	73	13
Barley	Max.	72	121250	74	5587	69	64
	Min.	70	42650	73	761	73	12
Lentils	Max.	75	37250	75	2385	69	67
	Min.	71	8850	73	280	73	11
Vetches	Max.	72	12545	74	600	69	66
	Min.	71	720	73	-	73	-
Chick-	Max.	74	12740	74	811	69	73
peas	Min.	70	1400	70	23	70	16
Others	Max.	69	3815	69	245	69	64
	Min.	73	17	73	-	73	-

Source : Extracted from appendix tables 1.3. - 6.3.

APPENDIX TABLE 9.3.

VARIATION OF AREA AND PRODUCTION IN KARAK

1969 - 1975

Crop		Year	Area (Dunum)	Year	Production (M.Tons)	Year	Average Yield (Kg/ Dunum)
Wheat	Max.	74	25400	74	18392	74	72
	Min.	70	121150	73	2117	73	17
Barley	Max.	72	107450	74	5094	69	63
	Min.	70	33600	73	761	73	13
Lentils	Max.	75	32050	75	2114	69 & 75	66
	Min.	71	7120	73	280	73	11
Vetches	Max.	72	12400	74	597	69	66
	Min.	71	700	73	NIL	73	NIL
Chickpeas	Max.	74	11050	74	731	74	66
	Min.	70	1040	70	22	70	21
Others	Max.	69	3355	69	213	69	63
	Min.	73	NIL	73	NIL	73	NIL

Source : Extracted from appendix tables 1.3. - 6.3.

APPENDIX TABLE 12.3.

TOMATO

AREA AND PRODUCTION IN PROJECT AREA

(1969-75)

(1) Area in dunums (2) Production in M. Tons (3) Average Yield in kg / dunum

District		69	70	71	72	73	74	75	Average
Karak	(1)	610	267	454	1420	260	433	975	631
	(2)	244	107	197	152	-	438	883	289
	(3)	400	401	434	107	-	1012	906	458
Tafila	(1)	280	55	805	135	-	365	41	240
	(2)	139	20	402	21	-	166	38	112
	(3)	496	364	499	156	-	455	927	467
Shobak	(1)	-	-	-	-	-	-	-	-
Project Area	(1)	890	322	1259	1555	260	798	1016	871
	(2)	383	127	599	173	-	604	921	401
	(3)	430	394	476	111	-	757	906	460

Note : (1) Small areas in Shobak District are irrigated.

Source : Computed from Original Village Statistics, Department of Agricultural Economics, Ministry of Agriculture - Amman

APPENDIX TABLE 13.3

ONION

AREA AND PRODUCTION IN PROJECT AREA

(1969 - 75)

(1) Area in dunum (2) Production in M. Ton (3) Average Yield in Kg/dunum

District		69	70	71	72	73	74	75	Average
Karak	(1)	43	10	110	640	65	117	425	201
	(2)	30	7	38	43	-	73	221	59
	(3)	698	700	345	67	-	624	520	294
Tafila	(1)	23	5	102	7	-	27	35	28
	(2)	15	2	61	4	-	8	25	16
	(3)	652	400	598	571	-	296	714	571
Shobak(1)		-	-	-	-	-	-	-	-
Project Area	(1)	66	15	212	647	65	144	460	229
	(2)	45	9	99	47	-	81	246	75
	(3)	682	600	467	73	-	563	535	328

Note : (1) Small areas in Shobak District are irrigated.

Source : Computed from Original Village Statistics, Department of Agricultural Economics, Ministry of Agriculture - Amman

APPENDIX TABLE 14.3.

MELONS

AREA AND PRODUCTION IN PROJECT AREA

(1969-75)

(1) Area in dunums (2) Production in M.Tons (3) Average Yield in Kg/dunum

District		69	70	71	72	73	74	75	Average
Karak	(1)	210	84	369	1440	156	480	.403	449
	(2)	148	60	166	179	-	502	481	219
	(3)	705	714	450	124	-	1046	1194	488
Tafila	(1)			91	115	-	105	-	44
	(2)	NIL	NIL	60	58	-	82	-	29
	(3)			659	504	-	781	-	659
Shobak (x)	(1)	31	19	-	15	-	11	-	11
	(2)	35	-	-	15	-	11	-	9
	(3)	1129	-	-	1000	-	1000	-	818
Project Area	(1)	241	103	460	1570	156	596	403	504
	(2)	183	60	226	252	-	595	481	257
	(3)	759	583	491	161	-	998	1194	510

Note : (x) Some areas of melons receive partial irrigation in Tafila and Shobak districts

Source : Computed from Original Village Statistics, Department of Agricultural Economics, Ministry of Agriculture - Amman

APPENDIX TABLE 15.3.

CURURBITS
AREA AND PRODUCTION IN PROJECT AREA
(1969 - 1975)

(1) Area in dunums (2) Production in M. Tons (3) Average Yield in kg/dunum

District		69	70	71	72	73	74	75	Average
Karak	(1)	670	358	667	2447	306	456	516	774
	(2)	449	215	326	232	-	406	301	276
	(3)	670	601	489	95	-	890	583	357
Tafila (x)	(1)	44	-	97	120	-	95	18	53
	(2)	22	-	38	43	-	53	11	24
	(3)	500	-	392	358	-	558	611	453
Shobak (x)	(1)	67	51	-	25	-	33	-	25
	(2)	65	-	-	14	-	15	-	13
	(3)	970	-	-	560	-	455	-	520
Project Area	(1)	781	409	764	2592	306	584	534	852
	(2)	536	215	364	289	-	474	312	313
	(3)	686	526	476	111	-	812	584	367

Note : (x) Cucurbits in Tafila and Shobak districts receive supplementary irrigation.

Source : Computed from Original Village Statistics, Department of Agricultural Economics, Ministry of Agriculture - Amman

APPENDIX TABLE 16.3.

OTHER VEGETABLES(1)

AREA AND PRODUCTION IN PROJECT AREA

(1969 - 75)

(1) Area in dunums (2) Production in M. Tons (3) Average Yield in kg/ dunum

District		69	70	71	72	73	74	75	Average
Karak	(1)	118	47	77	434	53	45	97	124
	(2)	46	20	13	18	-	13	17	18
	(3)	390	426	169	41	-	289	175	145
Tafila	(1) (2) (3)	-	-	-	-	-	-	-	-
Shobak	(1)	7	50	-	7	-	4	-	10
	(2)	3	-	-	3	-	2	-	1
	(3)	429	-	-	429	-	500	-	100
Project Area	(1)	125	97	77	441	53	49	97	134
	(2)	49	20	-	21	-	15	17	17
	(3)	392	206	-	48	-	306	175	127

Note : (1) Other Vegetables include Okra, Peas, broad bean

Source : Computed from Original Village Statistics, Department of Agricultural Economics, Ministry of Agriculture - Amman

APPENDIX TABLE 17.3.

AREA AND PRODUCTION OF VEGETABLE CROPS IN PROJECT AREA (1969 - 75)

(1) Area in dunums (2) Production in M/Tons (3) Average yield, kg/dunum

District		Tomato	Onion	Melons	Cucurbits	Others	Total
Karak	(1)	631	201	449	774	124	2179
	(2)	289	59	219	276	18	861
	(3)	458	294	388	357	145	395
Tafila	(1)	240	28	44	53		365
	(2)	112	16	29	24	NIL	181
	(3)	467	571	659	453		496
Shobak	(1)			11	25	10	46
	(2)	NIL	NIL	9	13	1	23
	(3)			818	520	100	500
Project Area	(1)	871	229	504	852	134	2590
	(2)	401	75	257	313	17	1063
	(3)	460	328	510	367	127	410

Source : Extracted from Appx. tables 12.3. - 16.3.

APPENDIX TABLE 18.3.

VARIATION OF AREA AND PRODUCTION IN TAFILA

1969 - 1975

Crop		YEAR	AREA (DUNUM)	YEAR	PRODUCTION (M. TONS)	YEAR	AVERAGE YIELD (Kg/ DUNUM)
Tomato	Max.	72	1420	75	883	74	1012
	Min.	73	260	70	107	72	107
Onion	Max.	72	640	75	221	69	698
	Min.	70	10	73	-	73	-
Melons	Max.	72	1440	74	502	75	1194
	Min.	73	84	73	-	73	-
Cucurbits	Max.	72	2447	69	449	74	890
	Min.	73	306	73	-	73	-
Others	Max.	72	434	69	46	70	426
	Min.	70	47	73	-	73	-

Source : Extracted from appx. Tables 12.3. - 12.6.

APPENDIX TABLE 19.3.

VARIATION OF AREA AND PRODUCTION IN TAFILA

1969 - 1975

Crop		YEAR	AREA (DUNUM)	YEAR	PRODUCTION (M.TONS)	YEAR	AVERAGE YIELD (KG/ DUNUM)
Tomato	Max.	72	1555	75	921	75	906
	Min.	73	260	73	-	73	-
Onion	Max.	72	647	75	246	69	682
	Min.	70	15	73	-	73	-
Melons	Max.	72	1570	74	595	74	1194
	Min.	70	103	73	-	73	-
Cucurbits	Max.	72	2592	69	536	74	812
	Min.	73	306	73	-	73	-
Others	Max.	72	441	69	49	69	392
	Min.	74	49	71 & 73	-	71 & 73	-

Source : Extracted from Appx. tables 12.3. - 12.6.

APPENDIX TABLE 20.3.

VARIATION OF AREA AND PRODUCTION IN TAFILA

1969 - 1975

Crop		YEAR	AREA (DUNUM)	YEAR	PRODUCTION (M. TONS)	YEAR	AVERAGE YIELD (Kg/DUNUM)
Tomato	Max.	71	805	71	402	75	927
	Min.	75	41	70	20	72	156
Onion	Max.	71	102	71	61	75	714
	Min.	73	NIL	73	NIL	73	NIL
Melons	Max.	72	115	74	82	74	781
	Min.	69,70,73,75	NIL	69,70,73,75	NIL	69,70,73,75	NIL
Cucurbits	Max.	72	120	74	53	75	611
	Min.	70,73	NIL	70,73	NIL	70,73	NIL
Others	Max.	-	NIL	-	NIL	-	NIL
	Min.	-					

Source : Extracted from appx. tables 12.3. - 16.3.

APPENDIX TABLE 21.3.

VARIATION OF AREA AND PRODUCTION IN SHOBAK
1969 - 1975

Crop		YEAR	AREA (DUNUM)	YEAR	PRODUCTION (M.TONS)	YEAR	AVERAGE YIELD (KG/DUNUM)
Tomato	Max.	-	NIL	-	NIL	-	NIL
	Min.						
Onion	Max.	-	NIL	-	NIL	-	NIL
	Min.						
Melons	Max.	69	31	69	35	69	1129
	Min.	71,73,75	NIL	70,71,73,75	-	70,71,73,75	NIL
Cucurbits	Max.	69	67	69	65	69	970
	Min.	71,73,75	NIL	70,71,73,75	NIL	70,71,73,75	NIL
Others	Max.	70	50	69,72	3	74	500
	Min.	71,73,75	NIL	70,71,73,75	NIL	70,71,73,75	NIL

Source : Extracted from appx. tables 12.3. - 16.3.

APPENDIX TABLE 22.3.

AREAS OF OLIVE-TREES IN PROJECT AREA

1969 - 1975

(1) Area of rainfed and irrigated young trees (2) Area of fruiting irrigated trees
(3) Area of fruiting irrigated trees (4) Total area

(Area in Dunums)

District		69	70	71	72	73	74	75	Average
Karak	(1)	4079	4079	4112	3816	3398	3031	3488	3715
	(2)	775	775	806	860	790	1112	1387	929
	(3)	812	812	865	822	896	2043	1589	1120
	(4)	5666	5666	5783	5498	5084	6186	6464	5764
Tafila	(1)	431	455	850	225	225	312	225	389
	(2)	501	535	545	590	590	534	540	548
	(3)	241	254	304	49	49	54	-	136
	(4)	1172	1244	1699	864	864	900	765	1073
Shobak	(1)	118	125	141	157	156	138	x	119
	(2)	908	594	547	552	553	569	x	532
	(3)	-	61	66	141	141	147	x	79
	(4)	1026	780	754	850	850	854	x	731
Project Area	(1)	4627	4659	5103	4198	3779	3481	3713 xx	4223
	(2)	2184	1904	1898	2002	1933	2215	1927 xx	2009
	(3)	1053	1127	1235	1012	1086	2244	1589 xx	1335
	(4)	7864	7690	8236	7212	6798	7940	7229 xx	7567

Note : x = Information not available
xx = Excluding Shobak

Source : Computed from original village statistics,
Department of Agricultural Economics, Ministry of Agriculture, Amman

APPENDIX TABLE 23.3

AREA AND PRODUCTION OF RAINFED OLIVES IN PROJECT AREA
(1969 - 75)

(1) Area in dunums (2) Production in M.Tons (3) Average Yield, in Kg/Dunum

District		69	70	71	72	73	74	75	Average
Karak	(1)	812	812	865	822	896	2043	1589	1120
	(2)	72	68	65	90	52	645	169	166
	(3)	89	84	75	109	58	316	106	148
Tafila	(1)	241	254	304	49	49	54	x	136
	(2)	42	27	43	40	25	18	x	28
	(3)	174	106	141	816	510	333	x	206
Shobak	(1)	-	61	66	141	141	147	x	79
	(2)	-	25	24	32	17	49	x	21
	(3)	-	410	364	227	121	333	x	266
Project Area	(1)	1053	1127	1235	1012	1086	2244	1589 xx	1335
	(2)	114	120	132	162	94	712	169 xx	215
	(3)	108	106	107	160	87	317	106 xx	161

Note : x : Information not available.
xx : Excluding Tafila and Shobak districts.

Source : Computed from Original Village Statistics, Department of Agricultural Economics, Ministry of Agriculture, Amman

APPENDIX TABLE 24.3

GRAPES

AREAS OF RAINFED AND IRRIGATED GRAPES

1969 - 1975

(1) Irrigated area (2) Rainfed area (3) Total area

District		69	70	71	72	73	74	75	Average
Karak	(1)	4630	4900	4920	5310	5330	3940	6000	5004
	(2)	1914	1826	1851	2090	2140	2401	3371	2228
	(3)	6544	6726	6771	7400	7470	6341	9371	7232
Tafila	(1)	523	538	596	305	572	420	260	459
	(2)	132	132	158	33	140	420	160	168
	(3)	655	670	754	338	712	840	420	627
Shobak	(1)	392	150	153	157	158	158	x	167
	(2)	120	30	67	70	40	40	x	62
	(3)	512	180	220	227	198	198	x	219
Project Area	(1)	5545	5588	5669	5772	6060	4518	6260 xx	5630
	(2)	2166	1988	2076	2193	2320	2861	3531 xx	2448
	(3)	7711	7676	7745	7965	8380	7379	9791 xx	8078

Note : x : Information not available,
xx : Excludes Shobak

Source : Computed from Original Village Statistics, Department of Agricultural Economics, Ministry of Agriculture - Amman.

APPENDIX TABLE 25.3.

AREA AND PRODUCTION OF RAINFED GRAPES IN PROJECT AREA

(1) Area in Dunums (2) Production in M.Tons (3) Average Yield in Kg/Dunum

District		69	70	71	72	73	74	75		Average
Karak	(1)	1914	1826	1851	2090	2140	2401	3371		2228
	(2)	691	633	612	730	631	652	1118		724
	(3)	361	347	331	349	295	272	332		325
Tafila	(1)	132	132	158	33	140	420	160		168
	(2)	-	40	51	31	38	42	42		42
	(3)	371	303	323	939	271	100	263		250
Shobak	(1)	120	30	67	70	40	40	x		52
	(2)	40	7	25	7	7	7	x		13
	(3)	333	233	373	100	175	175	x		250
Project Area	(1)	2166	1988	2076	2193	2320	2861	3531	xx	2448
	(2)	780	680	688	768	676	701	1160	xx	779
	(3)	360	342	331	350	240	245	329	xx	718

Note : x : Information not available
xx : Excluding Shobak district

Source : Computed from Original Village Statistics, Department of Agricultural Economics, Ministry of Agriculture, Amman

APPENDIX TABLE 26.3.

AREA OF FRUITING AND NON-FRUITING STONE FRUIT TREES IN PROJECT AREA 1969 - 1975 (1)

(1) Area of non-fruiting trees (2) Area of fruiting trees (3) Total areas of trees in dunums

District		69	70	71	72	73	74	75	Average
Karak	(1)	206	214	204	205	92	77	94	156
	(2)	447	449	465	418	528	402	629	477
	(3)	653	663	669	623	620	479	723	633
Tafila	(1)	84	81	68	17	17	18	-	41
	(2)	154	164	179	76	76	83	45	111
	(3)	238	245	247	93	93	101	45	152
Shobak	(1)	178	35	51	58	68	40	x	61
	(2)	309	99	103	110	145	157	x	132
	(3)	487	134	154	168	213	197	x	193
Project Area	(1)	468	330	323	280	177	135	94 xx	258
	(2)	910	712	747	604	749	642	674 xx	720
	(3)	1378	1042	1070	884	926	777	768 xx	978

Note : x : Information not available

xx : Excluding Shobak district

(1) Information not available for areas receiving supplementary irrigation.

Source : Computed from Original Village Statistics, Department of Agricultural Economics, Ministry of Agriculture - Amman.

APPENDIX TABLE 27.3.

AREA AND PRODUCTION OF STONE FRUIT TREES IN PROJECT AREA 1969 - 1975 (1)

(1) Area in dunums (2) Production in M.Tons (3) Average Yield in Kg/dunum

District		69	70	71	72	73	74	75	Average
Karak	(1)	447	449	465	418	528	402	629	477
	(2)	115	90	96	106	68	210	215	129
	(3)	257	200	206	254	129	522	342	270
Tafila	(1)	154	164	179	76	76	83	45	111
	(2)	29	17	23	18	18	20	17	20
	(3)	188	104	128	237	237	241	378	180
Shobak	(1)	309	99	103	110	145	157	x	132
	(2)	48	15	24	90	94	108	x	57
	(3)	155	152	233	818	648	688	x	409
Project Area	(1)	910	712	747	604	749	642	674 xx	720
	(2)	192	122	143	214	180	338	232 xx	203
	(3)	211	171	191	354	240	526	344 xx	282

Note : x: Information not available
xx: Excluding Shobak district.

(1) Information not available for areas receiving supplementary irrigation.

Source : Computed from Original Village Statistics, Department of Agricultural Economics, Ministry of Agriculture - Amman.

APPENDIX TABLE 28.3.

AREA OF FRUITING AND NON-FRUITING NUT TREES IN PROJECT AREA

1969 - 1975 (1)

(1) Area of non-fruiting trees (2) Area of fruiting trees (3) Total areas of trees in dunums

District		69	70	71	72	73	74	75	Average
Karak	(1)	336	335	365	360	151	175	200	275
	(2)	442	442	480	476	672	737	1085	619
	(3)	778	777	845	836	823	912	1285	894
Tafila	(1)	107	87	79	13	13	17	6	46
	(2)	285	314	329	74	74	77	28	169
	(3)	392	401	408	87	87	94	34	215
Shobak	(1)	16	11	30	27	25	25	x	19
	(2)	127	73	69	85	73	73	x	71
	(3)	143	84	99	112	98	98	x	91
Project Area	(1)	459	433	474	400	189	217	206 xx	340
	(2)	854	829	878	635	819	887	1113 xx	859
	(3)	1861	1915	1852	1588	4333	4088	5403 xx	2526

Note : x : Information not available
xx : Excluding Shobak district.

(1) Information not available for areas receiving supplementary irrigation.

Source : Computed from Original Village Statistics, Department of Agricultural Economics Ministry of Agriculture - Amman.

APPENDIX TABLE 29.3

AREA AND PRODUCTION OF FUITING NUT TREES IN PROJECT AREA

1969 - 1975 (1)

(1) Area in Dunums (2) Production in M. Tons (3) Average Yield in /kg/Dunum

District		69	70	71	72	73	74	75		Average
Karak	(1)	442	442	480	476	672	737	1085		619
	(2)	130	88	103	117	114	365	352		181
	(3)	294	199	215	246	170	495	324		292
Tafila	(1)	285	314	329	74	74	77	28		169
	(2)	50	31	37	21	19	20	21		28
	(3)	175	99	112	284	257	260	750		166
Shobak	(1)	127	73	69	85	73	73	x		71
	(2)	66	16	6	39	20	33	x		26
	(3)	520	219	87	459	274	452	x		366
Project Area	(1)	854	829	878	635	819	887	1113	xx	859
	(2)	246	135	146	177	153	418	373	xx	235
	(3)	288	163	166	279	187	471	335	xx	274

Note : x : Information not available.
xx : Excluding shobak district.

(1) Information not available for areas receiving supplementary irrigation.

Source : Computed from Original Village Statistics, Department of Agricultural Economics, Ministry of Agriculture - Amman.

APPENDIX TABLE 30.3.

AREAS OF FRUITING AND NON-FRUITING OTHER FRUIT TREES IN PROJECT AREA 1969 - 1975

(1) Area of non-fruiting trees (2) Area of fruiting trees (3) Total Area in Dunums

District		69	70	71	72	73	74	75	Average
Karak	(1)	144	141	142	120	53	58	84	106
	(2)	638	638	653	425	490	566	601	573
	(3)	782	779	795	545	543	624	685	679
Tafila	(1)	24	27	20	38	35	31	13	27
	(2)	367	375	373	143	133	149	134	239
	(3)	391	402	393	181	168	180	147	266
Shobak	(1)	26	15	23	26	24	14	x	18
	(2)	328	105	133	145	144	159	x	145
	(3)	354	120	156	171	168	173	x	163
Project Area	(1)	194	183	185	184	112	103	97 xx	151
	(2)	1333	1118	1159	713	767	874	735 xx	957
	(3)	1527	1301	1344	897	879	977	832 xx	1108

Note : (x) Information not available
(xx) Information not available for areas receiving supplementary irrigation

Source : Computed from Original Village Statistics, Department of Agricultural Economics, Ministry of Agriculture - Amman.

APPENDIX TABLE 31.3

AREAS AND PRODUCTION OF OTHER FRUIT CROPS IN PROJECT AREA 1969-1975 (1)

(1) Area in Dunum (2) Production in M. Tons (3) Average Yield in kg / Dunum

District		69	70	71	72	73	74	75	Average
Karak	(1)	638	638	653	425	490	566	601	573
	(2)	191	158	154	139	88	476	413	231
	(3)	299	248	236	327	180	841	687	403
Tafila	(1)	367	375	373	143	132	149	134	239
	(2)	105	54	94	29	19	28	132	66
	(3)	286	144	252	203	143	188	985	276
Shobak	(1)	328	105	133	145	144	159	x	145
	(2)	384	50	62	69	71	90	x	104
	(3)	1171	476	466	476	493	566	x	717
Project Area	(1)	1333	1118	1159	713	767	874	735 xx	957
	(2)	680	262	310	237	178	585	545 xx	400
	(3)	510	234	267	332	232	669	741 xx	418

Note : (1) Information not available for areas receiving supplementary irrigation
(x) Information not available
(xx) Excluding Shobak zone

Source :- Computed from original village Statistics, Department of Agricultural Economics, Ministry of Agriculture, Amman

APPENDIX TABLE 32.3

AREAS AND PRODUCTION OF FRUIT CROPS IN PROJECT AREA

1969 - 1975

(1) Area in Dunums (2) Production in M. Tons (3) Average Yield in kg/Dunum

DISTRICT		OLIVES	GRAPES	STONE FRUITS	NUTS	OTHERS	TOTAL
Karak	(1)	1120	2228	477	619	573	5017
	(2)	166	724	129	181	231	1431
	(3)	148	325	270	292	403	285
Tafila	(1)	136	168	111	169	239	823
	(2)	28	42	20	28	66	184
	(3)	206	250	180	166	276	224
Shobak	(1)	79	52	132	71	145	479
	(2)	21	13	54	26	104	218
	(3)	266	250	409	366	717	455
Project Area	(1)	1335	2448	720	859	957	6319
	(2)	215	779	203	235	400	1832
	(3)	161	318	282	274	418	290

Source :- Compiled from Appx. tables 22.3. - 31.3.

APPENDIX TABLE 33.3

PATTERN OF LAND USE IN PROJECT AREA

1969 - 1975

(AREA 000 DUNUMS)

Variable Year	69	70	71	72	73	74	75	Average 69-75
1. Area suitable for cropping	641,5	641,5	641,5	641,5	641,5	641,5	641,5	641,5
2. Fruit-trees area	19,7	18,9	18,9	18,0	17,9	18,1	19,9	18,9
3. % age (2/1)	3,1%	2,9%	3,1%	2,8%	2,8%	2,8%	3,1%	2,9%
4. Area available for seasonal crops	634,5	622,6	621,7	623,5	623,6	623,4	621,6	622,6
5. Area used for seasonal crops	375,2	211,3	420,3	480,6	265,6	498,8	388,4	377,1
6. % age (5/4)	59,1%	33,9%	67,6%	77,1%	42,6%	80,0%	62,5%	60,6%
7. Fallow land (% of 4)	40,9%	66,1%	42,4%	22,9%	57,4%	20,0%	37,5%	39,4%
8. Area used for field crops	373,2	210,3	417,5	473,7	264,8	486,6	385,9	374,5
9. % age (8/5)	99,5%	99,5%	99,3%	98,6%	99,7%	99,6%	99,4%	99,3%
10. Wheat area	376,1	149,4	328,3	299,5	160,4	343,2	260,6	259,6
11. % age (10/5)	73,6%	70,7%	78,1%	62,3%	60,4%	68,8%	67,1%	68,8%
12. Barley area	71,4	42,7	73,5	121,3	66,1	96,1	74,1	78,0
13. % age (12/5)	19,0%	20,2%	17,5%	25,2%	24,9%	19,5%	19,1%	20,7%
14. Area put under wheat &barley	347,5	192,1	401,8	420,8	226,5	440,3	334,7	337,6
15. % age (14/5)	92,6%	90,9%	95,6%	87,6%	85,3%	88,3%	86,2%	89,5%
16. Lentils area	13,2	11,3	8,9	32,7	25,8	32,3	37,4	23,0
17. Vetches area	5,4	4,5	0,7	12,6	11,1	9,8	7,9	7,4
18. Chick peas area	3,2	1,4	3,1	4,3	1,5	12,8	5,1	4,5
19. Area put under legumes	21,3	17,2	12,7	49,2	38,4	54,9	50,4	35,0
20. % age (19/5)	5,8%	8,1%	3,0%	10,3%	14,5%	11,0%	13,0%	9,3%
21. Area put under other field crops	3,9	1,2	3,1	3,5	0,02	1,4	1,0	2,0
22. % age (21/5)	1,0%	0,6%	0,7%	0,7%	0,01%	0,01%	0,3%	0,5%
23. Area put under vegetables	2,2	1,0	2,8	2,1	0,4	1,1	1,0	2,6
24 % age (23/5)	0,6%	0,5%	0,7%	0,4%	0,2%	0,2%	0,3%	0,7%

Source : Computed from appx. tables 1.3 - 32.3.

APPENDIX TABLE 34.3

PATTERN OF LAND USE IN KARAK 1969-1975

(AREA 000 DUNUMS)

Variable / Year	69	70	71	72	73	74	75	Average 69-75
1. Area suitable for cropping	515,5	515,5	515,5	515,5	515,5	515,5	515,5	515,2
2. Fruit trees areas	14,4	14,6	14,9	14,9	14,5	14,5	18,5	15,2
3. % age (2/1)	2,8%	2,8%	2,9%	2,9%	2,8%	2,8%	3,6%	2,9%
4. Area available for seasonal crops	501,1	500,9	500,6	500,6	501,0	501,0	493,0	500,3
5. Area used for seasonal crops	313,3	172,8	318,3	392,7	226,0	394,5	277,5	299,3
6. % age (5/4)	62,5%	34,5%	63,5%	78,4%	45,1%	78,7%	56,3%	59,8%
7. Fallow land (% of 4)	37,5%	65,5%	36,5%	21,6%	54,9%	21,3%	43,7%	40,2%
8. Area used for field crops	311,7	172,0	316,6	386,3	225,2	393,0	275,1	297,1
9. % age (8/5)	99,50%	99,50%	99,50%	98,4%	99,6%	99,6%	99,1%	99,3%
10. Wheat area	230,4	121,2	242,6	229,2	126,9	254,4	177	197,4
11. % age (10/5)	73,5%	70,1%	76,2%	58,4%	56,2%	64,5%	63,8%	65,9%
12. Barley area	58,6	33,6	60,6	107,5	60,7	86,3	53,8	65,8
13. % age (12/5)	18,7%	19,4%	19,00%	27,4%	26,9%	21,9%	19,4%	22,0%
14. Area put under wheat &barley	289,0	154,8	303,2	336,7	187,6	340,7	230,8	263,2
15. % age (14/5)	92,2%	89,6%	95,3%	85,7%	83,0%	77,2%	83,2%	87,9%
16. Lentils area	11,7	10,6	7,1	30,7	25,3	30,2	32,1	21,1
17. Vetches area	5,3	9,5	0,7	12,4	11,1	9,8	7,9	7,4
18. Chick peas area	2,4	1,0	2,7	3,3	1,3	11,1	3,6	3,6
19. Area put under legumes	19,4	16,1	10,5	46,4	37,7	51,1	43,6	32,1
20. %Age (19/5)	6,2%	9,3%	3,3%	11,8%	16,7%	12,9%	15,7%	10,7%
21. Area put under other field crops	3,4	1,1	2,9	3,3	-	1,2	0,8	1,8
22. % age (21/5)	1,1%	0,6%	0,9%	0,8%	-	0,3%	0,3%	0,6%
23. Area put under vegetables	1,7	0,8	1,7	6,4	0,8	1,5	2,4	2,2
24. % age (23/5)	0,5%	0,5%	0,5%	1,6%	0,4%	0,4%	0,9%	0,7%

Sources :- Computed from appx. tables. 1.3 - 32.3.

APPENDIX TABLE 35. 3

PATTERN OF LAND USE IN TAFILA 1969 - 1975

(AREA 000 DUNUMS)

Variable / Year	69	70	71	72	73	74	75	Average 69-75
1. Area Suitable for cropping	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
2. Fruit trees areas	2.8	3.0	3.5	1.6	1.9	2.1	1.4	2.3
3. % Age (2/1)	4.3%	4.6%	5.4%	2.5%	2.9%	3,2%	2.2%	3.5%
4. Area available for seasonal crops	62,2	62,0	61,5	63,4	63,1	62,9	63,6	62,7
5. Area used for seasonal crops	32,4	12,8	30,4	27,8	15,6	16,4	30,0	23,6
6. % Age (5/4)	52,1%	20,6%	49,4%	43,8%	24,7%	26,1%	47,2%	37,6%
7. Fallow land (% of 4)	47,9%	79,4%	50,6%	56,2%	75,3%	73,9%	52,8%	62,4%
8. Area used for field crops	32,1	12,7	29,3	27,4	15,6	15,8	29,9	23,2
9. % Age (8/5)	99,1%	99,2%	96,4%	98,6%	100%	96,3%	99,7%	98,3%
10. Wheat area	22,0	8,0	20,7	18,8	11,3	11,3	20,1	16,0
11. % Age (10/5)	67,9%	62,5%	68,1%	67,6%	72,4%	68,9%	67,0%	67,8%
12. Barley area	9,2	4,4	8,3	7,5	3,9	3,9	6,7	6,3
13. % Age(12/5)	28,4%	34,4%	27,3%	26,9%	25,0%	23,8%	22,3%	25,7%
14. Area put under wheat & barley	31,2	12,4	29,0	26,3	15,2	15,2	26,8	22,3
15. % Age (14/5)	96,3%	96,9%	95,4%	94,6%	97,4%	92,7%	89,3%	94,5%
16. Lentils area	0,5	0,2	0,3	0,6	0,2	0,3	3,0	0,7
17. Vetches area	0,05	0,02	,02	0,07	0,01	0,01	0,01	0,03
18. Chick peas area	0,2	0,2	-	0,4	0,2	0,3	0,1	0,2
19. Area put under legumes	0,75	0,42	,32	1,07	0,61	0,61	3,1	0,93
20. % Age (1 9/5)	2,3%	3,3%	,1%	3,8%	2,6%	3,7%	10,3%	3,9%
21. Area put under other field crops	0,00	0,0	-	0,03	-	-	0,004	0,01
22. % Age (21/5)	0,2%	0,1%	-%	0,1%	-	0,6 %	0,01%	0,04 %
23. Area put under vegetables	0,4	0,06	1,1	0,4	-	0,6	0,09	0,4
24. % Age (23/5)	1,2%	0,5%	3,6%	1,4%	-	3,7%	0,3%	1,7%

Source : Computed from appx. tables 1-3 - 32-3.

APPENDIX TABLE 36. 3

PATTERN OF LAND USE IN SHOBAK 1969 - 1975

(AREA 000 DUNUMS)

Variable Year	69	70	71	72	73	74	75	Average 69 - 75
1. Area suitable for cropping	61.0	61,0	61,0	61,0	61,0	61,0	61,0	61,0
2. Fruit trees area	2.5	1,3	1,4	1,5	1,5	1,5	x	1,4
3. % Age (2/1)	4.1%	2,1%	2,3%	2,5%	2.5%	2,5	-	2,3%
4. Area available for seasonal crops	58,5	59,7	59,6	59,5	59,5	59,5	61,0	59,6
5. Area used for seasonal crops	29.5	25,7	71,6	60,1	24,0	87,9	80,9	54,2
6. % Age (5/4)	50.4%	43,0%	120,0%	120,0%	40,3%	147,7%	132,6%	90,9%
7. Fallow land (% of 4)	49,6%	50,7%	x%	-x%	-x%	-x%	-x%	9,1%
8. Area used for field crops	29.4	25,6	71,6	60,0	24,0	87,8	80,9	54,2
9. % Age (8/5)	99.7%	99,6%	100%	99,8%	100,0%	99,9%	100,0%	100,0%
10. Wheat area	23.7	20,2	65,0	51,5	22,2	77,5	63,5	46,2
11. % Age (10/5)	80.3%	78,6%	90.8%	85,7%	92,5%	88,2%	78,5%	84,9%
12. Barley area	3,6	4,7	4,6	6,3	1,5	6,9	13,6	5,9
13. % Age (12/5)	12.2%	18,3%	6,4%	10,5%	6,25%	7,9%	16,8%	10,9%
14. Area put under wheat &barley	27,3	24,9	69,6	57,8	13,7	84,4	77,1	51,9
15. % Age (14/5)	92,5%	69,9%	97,2%	96,2%	98,8%	96,0%	95,3%	95,8%
16. Lentils area	1.0	0,5	1,5	1,4	0,3	1,8	2,3	1,2
17. Vetches area	-	-	-	0,08	-	-	-	0,01
18. Chick peas area	0.6	0,2	0,4	0,6	-	1,4	1,4	0,7
19. Area put under legumes	1.6	0,7	1,9	2,07	0,3	3,2	3,7	1,9
20. % Age (19/5)	5.4%	2,7%	2,7%	3,5%	1,3%	3,6%	4,6%	3,5%
21. Area put under other field crops	0.4	0,08	0,2	0,02	0,02	0,2	0,2	0,2
22. % Age (21/5)	1,4%	0,3%	0,3%	0,3%	0,1%	0,2%	0,3%	0,4%
23. Area put under vegetable	0,1	0,1	-	0,05	-	0,05	-	0,05
24. % Age (23/5)	0,3%	0,4%	-	0,1%	-	0,1%	-	0,1%

Sources : Computed from Appx. tables 1,3 - 32,3.

Note : Areas of wheat and barley include unregistered drylands away from villages hence but under wheat and barley appears in certain years greater than the area suitable for cropping.

APPENDIX TABLE 37.3

AREAS OF FRUIT TREES 1977

(DUNUMS)

Type of Tree	Karak	Tafila	Shobak	Total
1. Olives :				
A- Fruiting	1,589	366	285	2,240
B- Four years old	3,488	-	-	3,488
2. Mixed Olives and Grapes :				
A- Four years old	5,000	-	-	5,000
B- Planted 1977	2,500	2,500	-	5,000
3. Fruiting Grapes	3,371	420	40	3,831
4. Other Fruits :				
A- Five years old	2,693	375	100	3,168
B- Planted 1977	-	4,500	-	4,500
5. Total area of rainfed trees	18,641	8,161	425	27,227
6. Area of irrigated trees	7,387	954	1,095	9,436
7. Area prepared for planting (as at 1977)				
A- Mixed grapes & olives	20,000	10,000	-	30,000
B- Grapes	5,000	2,000	-	7,000
C- Others	4,454	3,885	-	8,339
D- Sub-total	29,454	15,885	-	45,339
8. Grand Total	55,482	25,000	1,520	82,002

Source : Department of Project Implimentation - Amman

APPENDIX TABLE 38.3

AREAS PUT UNDER WHEAT AND BARLEY IN PROJECT AREA

(AVERAGE 1969 - 1975)

District	Wheat		Barley		Wheat and Barley	
	Area (000 dunum)	% age (1)	Area (000 dunum)	% age (1)	Area (000 dunum)	% age (1)
Karak	197	66	66	22	263	88
Tafila	16	68	6	27	22	95
Shobak	46	85	6	11	52	96
All Project Areas	259	69	78	22	337	90

(1) As percentage of total area put under seasonal crops.

Source : Computed from appx. tables 33.3 - 36.3

APPENDIX TABLE 39.3

COMPARISON OF NATIONAL PER-DUNUM YIELDS WITH YIELDS OBTAINED IN PROJECT AREA

(AVERAGE FOR 1969 - 75)

(Yields in Kg per Dunum)

Crop	National Average	Project Area Average	Project Average as percent of National Average
Wheat	70	54	77
Barley	67	40	60
Lentils	71	43	61
Vetches	63	32	51
Chick peas	65	55	85
Others	76	49	64

Source : Department of Agricultural Economics, Amman

APPENDIX TABLE 1.4

AREAS OF EXISTING FRUIT TREES INCLUDED IN THE PROJECT

(Dunums)

District	Olives	Grapes	Mixed Olives Grapes	Others	Total
Karak	5,077	3,371	7,500	2,693	18,641
Tafila	366	420	2,500	4,875	8,161
Shobak	285	40	-	100	425
Total	5,728	3,831	10,000	7,668	27,227

APPENDIX TABLE 24.

PHASING OF FRUIT TREE PLANTING

(DUNUMS)

	Year 1	2	3	4	5	6	Total
KARAK							
Olives	-	2,000	2,000	2,000	2,000	2,000	10,000
Mixed Olives & Grapes	1,000	14,000	4,000	4,000	4,000	4,000	40,000
Grapes	2,500	3,500	1,000	1,000	1,000	1,000	10,000
Others	2,227	5,227	3,000	3,000	3,000	3,000	19,504
TAFILA							
Olives	-	-	-	-	-	-	-
Mixed Olives & Grapes	5,000	7,000	2,000	2,000	2,000	2,000	20,000
Grapes	1,000	1,600	600	600	600	600	5,000
Others	1,942	3,343	1,400	1,400	1,400	1,400	10,885
SHOBAK							
Olives	-	-	-	-	-	-	-
Mixed Olives & Grapes	-	-	-	-	-	-	-
Grapes	-	1,000	1,000	1,000	1,000	1,000	5,000
Others	-	1,000	1,000	1,000	1,000	1,000	5,000
ALL PROJECT AREAS							
Olives	-	2,000	2,000	2,000	2,000	2,000	10,000
Mixed Olives & Grapes	15,000	21,000	6,000	6,000	6,000	6,000	60,000
Grapes	3,500	6,100	2,600	2,600	2,600	2,600	20,000
Others	4,169	9,570	5,400	5,400	5,400	5,400	35,339
Total	22,669	38,670	16,000	16,000	16,000	16,000	125,339

APPENDIX TABLE 3.4.

COMPARISON OF PRESENT (1) AND PROJECTED PATTERN OF LAND USE

(AREAS IN 000 DUNUMS)

VARIABLE	KARAK			TAFILA			SHOBAK			ALL PROJECT AREAS		
	Present	Projected	±	Present	Projected	±	Present	Projected	±	Present	Projected	±
1. Area suitable for cropping	515.5	515.5	0.0	65.0	65.0	0.0	61.1	61.0	0.0	641.5	641.5	0.0
2. Area of fruit trees (2)	15.2	105.5	90.3	2.3	45.0	42.7	1.4	11.5	10.1	18.9	162.0	143.1
3. Area of fruit trees as %age of area suitable for cropping	2.9	20.5	17.6	3.5	69.0	65.5	2.3	18.9	16.6	2.9	25.3	22.4
4. Area available for seasonal crops	500.3	410.0	(90.3)	62.7	20.0	(42.7)	59.6	49.5	(10.1)	622.6	479.5	(143.1)
5. Field Crops :-												
a. Wheat	197.4	174.0	(23.4)	16.0	6.0	(10.0)	46.2	10.0	(36.2)	259.6	190.0	(69.6)
b. Barley	65.8	31.0	(34.8)	6.3	4.0	(2.3)	5.9	14.8	8.9	78.0	49.8	(28.2)
c. Lentils	21.1	50.0	29.0	0.7	1.0	0.3	1.2	-	(1.2)	23.0	51.0	28.0
d. Vetch	7.4	20.0	12.6	-	-	0.0	x	-	(x)	7.4	20.0	12.6
e. Chick peas	3.6	25.0	21.4	0.2	-	(0.2)	0.7	-	(0.7)	4.5	25.0	20.5
f. Others	1.8	5.0	3.2	-	2.0	2.0	0.2	3.0	2.8	2.0	10.0	8.0
g. Total	297.1	305.0	8.0	23.2	13.0	(10.2)	54.2	27.8	26.4	374.5	345.8	(28.7)
6. Vegetable crops :-												
a. Tomato	0.6	4.0	3.4	0.2	-	(0.2)	-	-	-	0.9	4.0	3.1
b. Onions	0.2	10.0	9.8	x	0.3	0.3	-	-	-	0.2	10.3	10.1
c. Melon	0.5	3.0	2.5	x	0.3	0.3	x	-	(x)	0.5	3.3	2.8
d. Cucurbits	0.8	5.0	4.2	x	-	(x)	x	-	(x)	0.9	5.0	4.1
e. Others	0.1	2.0	1.9	-	0.4	0.4	x	-	(x)	0.1	2.4	2.3
f. Total	2.2	24.0	21.1	0.4	1.0	0.6	x	-	(x)	2.6	25.0	22.4
7. Total area of seasonal crops	299.3	329.0	29.8	23.6	14.0	(9.6)	54.2	27.8	(26.4)	377.1	370.8	(6.3)
8. Cropping intensity (%age)	59.8	80.2	20.4	37.6	70.9	32.4	90.9	56.2	(34.7)	60.6	77.3	16.7
9. Total cropped area	314.5	435.5	120.0	25.9	59.9	33.1	55.6	39.3	(16.3)	396.0	532.8	136.8
10. Cropped area as a %age of area suitable for cropping	61.0	84.3	23.3	39.8	90.8	51.0	91.1	64.4	(26.7)	61.7	83.1	21.4
Area of fruit trees in 1977	26.0	-	-	9.1	-	-	1.5	-	-	36.6	-	-
Area terraced for the purpose of planting fruits trees	29.5	-	-	15.9	-	-	-	-	-	45.4	-	-
Area allotted for fruit trees (3)	55.5	105.5		25.0	45.0		1.5	11.5	10.0	82.0	162.0	80.0
Total cropped area (4)	354.7	434.5		48.6	59.0		55.6	39.3	(16.3)	459.1	532.8	73.7

(1) Average for 1969 - 75.

(2) Area in 1977

(3) Fruit area in 1977 and average area of seasonal crops 1969 - 75

(x) 50 dunums.

APPENDIX TABLE 4. 4

FIELD CROP AREAS COVERED BY PROJECT

(DUNUMS)

District & crops	Year 1	2	3	4	5 - 30
Karak :					
Wheat	34,800	69,900	104,400	139,200	179,000
Barley	6,200	12,400	18,600	24,800	31,000
Lentils	10,000	20,000	30,000	40,000	50,000
Vetch	4,000	8,000	12,000	16,000	20,000
Chick Peas	5,000	10,000	15,000	20,000	25,000
Others	1,000	2,000	3,000	4,000	5,000
Sub Total	61,000	122,000	183,000	244,000	305,000
Tafila :					
Wheat	1,200	2,400	3,600	4,800	6,000
Barley	800	1,600	2,400	3,200	4,000
Lentil	200	400	600	800	1,000
Others	400	800	1,200	1,600	2,000
Sub Total	2,600	5,200	7,800	10,400	13,000
Shobak :					
Wheat	2,000	4,000	6,000	8,000	10,000
Barley	2,950	5,900	8,850	11,800	14,750
Others	600	1,200	1,800	2,400	3,000
Sub Total	5,550	11,100	16,650	22,200	27,750
Grand Total	69,150	138,300	207,450	276,600	345,750

APPENDIX TABLE 5. 4

VEGETABLE CROP AREAS COVERED BY PROJECT

(DUNUMS)

District & Crop	Year 1	2	3	4	5 - 30
KARAK					
Tomato	800	1600	2400	3200	4000
Onions	2000	4000	6000	8000	10000
Melon	600	1200	1800	2400	3000
Cucurbits	1000	2000	3000	4000	5000
Others	400	800	1200	1600	2000
Sub Total	4800	9600	14400	19200	24000
TAFILA					
Onions	60	120	180	240	300
Melon	60	120	180	240	300
Others	80	160	240	320	400
Sub Total	200	400	600	800	1000
Grand Total	5000	10000	15000	20000	25000

APPENDIX TABLE 6. 4

PROJECTED ANNUAL FRUIT PRODUCTION - BY PROJECT DISTRICT

(TONS)

Year	Olives			Grapes			Others		
	Karak	Tafila	Shobak	Karak	Tafila	Shobak	Karak	Tafila	Shobak
1	175	37	31.1	3,287	235	22.4	2,154	-	80
2	175	37	31.1	3,324	235	22.4	2,154	56	80
3	725	37	31.1	3,461	235	22.4	2,154	56	80
4	725	37	31.1	4,062	578	22.4	2,154	300	80
5	725	37	31.1	6,222	1,277	92.4	2,154	591	80
6	1,000	312	31.1	9,867	3,521	232.4	2,479	1767	23
7	1,360	462	31.1	14,726	6,787	792.4	3,263	3,223	38
8	1,480	522	31.1	16447	7,638	1,352.4	5,161	8,531	118
9	1,660	572	31.1	18,127	8,579	1,912.4	9,009	9,651	198
10	1,820	652	31.1	19,147	9,027	2,402.4	13,809	10,571	270
11	2,020	702	31.1	17,500	9,800	2,880.0	13,614	11,381	335
12	2,160	802	31.1	17,500	9,800	2,800.0	15,564	12,291	400
13	2,860	1,242	31.1	17,500	9,800	2,800.0	15,564	12,291	400
14	3,340	1,812	31.1	17,736	9,829	2,800.0	15,564	12,291	401
15	5,040	1,952	31.1	17,272	8,459	2,802.8	15,968	8,691	401
16	5,600	2,172	31.1	21,937	6,524	2,805.6	14,186	7,210	328
17	6,060	2,292	31.1	9,727	3,819	2,248	11,754	4,536	248
18	6,500	2,512	31.1	6,927	2,923	2,602.4	7,354	3,630	168
19	6,500	2,512	31.1	5,422	2,097	1,042.4	6,954	2,540	88
20	6,500	2,512	31.1	4,162	1,383	652.4	4,888	1,711	23
21	6,500	2,512	31.1	3,847	1,061	232.4	3,272	1,092	38
22	6,500	2,512	31.1	5,457	1,817	792.4	5,170	2,548	118
23	6,500	2,512	31.1	6,017	2,153	1,352.4	9,018	4,931	198
24	6,500	2,512	31.1	6,577	2,489	1,912.4	11,418	6,051	278
25	6,500	2,512	31.1	7,067	2,783	2,402.4	13,818	6,971	338
26	6,500	2,512	31.1	5,600	2,800	2,822.4	13,614	7,781	408
27	6,500	2,512	31.1	5,600	2,800	2,800.0	15,564	8,690	400
28	6,500	2,512	31.1	5,600	2,800	2,800.0	15,564	8,690	400
29	6,500	2,512	31.1	5,600	2,800	2,800.0	15,564	8,690	400
30	6,500	2,512	31.1	5,600	2,800	2,800.0	15,564	8,690	400

APPENDIX TABLE 7.4.

PROJECTED ANNUAL PRODUCTION OF SEASONAL CROPS GROWN IN KARAK AREA
(TONS)

Crop	Year 1	2	3	4	5	6	7	8	9-30	Total for 30 years
Wheat	2,227	4,698	7,482	10,614	14,094	15,347	16,356	17,052	17,400	470,670
Wheat Straw	2,227	4,698	7,482	10,614	14,094	15,347	16,356	17,052	17,400	470,670
Barley	279	589	936	1,327	1,761	1,916	2,040	2,127	2,170	58,715
Barley Straw	279	589	936	1,327	1,761	1,916	2,040	2,127	2,170	58,715
Lentils	450	950	1,510	2,140	2,840	3,090	3,290	3,430	3,500	94,700
Lentils Hay	675	1,425	2,265	3,210	4,260	4,635	4,935	5,145	5,250	142,050
Vetches	144	304	484	684	908	988	1,052	1,096	1,120	30,300
Vetch Hay	216	456	726	1,026	1,362	1,482	1,578	1,644	1,680	45,450
Chick Peas	320	680	1,040	1,425	1,840	1,915	1,990	2,045	2,075	56,905
Chick peas Hay	480	1,020	1,560	2,138	2,760	2,873	2,985	3,068	3,113	85,356
other Field crops	59	122	189	260	335	351	363	371	375	10,300
Other Field Crops Hay	89	183	284	390	503	527	545	557	563	3,641
Tomato	408	876	1,404	2,000	2,680	2,952	3,146	3,316	3,400	91,182
Onions	680	1,460	2,360	3,380	4,580	5,100	5,520	5,820	6,000	160,900
Melons	327	693	1,104	1,566	2,076	2,259	2,403	2,502	2,550	69,030
Cucurbits	400	840	1,330	1,870	2,470	2,670	2,830	2,940	3,000	81,350
Other Veg.	64	136	216	308	408	444	472	492	500	13,540

APPENDIX TABLE 8. 4

PROJECTED ANNUAL PRODUCTION OF SEASONAL CROPS GROWN IN TAFILA AREA

(TONS)

Crop	Year 1	2	3	4	5	6	7	8	9-30	Total for 30 years
Wheat	54	114	181	257	341	371	395	412	420	11365
Wheat Straw	54	114	181	257	341	371	395	412	420	11365
Barley	33	70	112	158	210	229	244	254	260	7030
Barley Straw	33	70	112	158	210	229	244	254	260	7030
Lentils	13	27	42	58	75	79	82	84	85	3330
Lentils Hay	20	41	63	87	113	119	123	126	128	3495
Other field crops	23	48	74	102	132	139	144	148	150	4110
Other Field crops Straw	35	72	112	154	199	209	217	222	225	6165
Onions	20	43	70	101	137	153	166	175	180	4825
Melon	33	69	110	157	208	226	240	250	255	6903
Other Veg. Crops	13	27	43	61	81	88	94	98	100	2705

APPENDIX TABLE 9 . 4

PROJECTED ANNUAL PRODUCTION OF SEASONAL CROPS GROWN IN SHOBAK AREA

(TONS)

Crop	Year 1	2	3	4	5	6	7	8	9-30	Total 30 years
Wheat	100.0	212.0	338.0	480.0	640.0	700.0	748.0	782.0	800.0	21620
Wheat Straw	100.0	212.0	338.0	480.0	640.0	700.0	748.0	782.0	800.0	21620
Barley	129.8	274.4	436.7	616.7	817.3	888.1	944.1	982.4	1003.0	27156
Barley Straw	129.8	274.4	437.7	616.7	817.3	888.1	944.1	982.4	1003.0	27156
Other Field Crops	24.0	51.0	81.0	114.0	150.0	162.0	171.0	177.0	180.0	4890
Other Field Crops Straw	36.0	76.5	121.5	171.0	225.0	243.0	256.5	265.5	270.0	5868

APPENDIX TABLE 10. 4

COMPARISON OF ANNUAL FRUIT PRODUCTION BEFORE AND AFTER DEVELOPMENT

(TONS)

Crop and District	Before	After	Difference	% Age ±
OLIVES :				
Karak	166	4,000	3,834	2,309
Tafila	28	1,533	1,505	5,375
Shobak	21	33	12	57
Total	215	5,566	5,351	2,489
GRAPES :				
Karak	724	9,700	8,976	1,340
Tafila	42	4,233	4,191	9,978
Shobak	13	1,700	1,687	12,977
Total	779	15,633	14,854	1,907
OTHERS :				
Karak	541	9,500	8,959	1,656
Tafila	114	5,833	5,719	5,017
Shobak	184	2,433	2,249	1,222
Total	839	17,766	16,927	2,017

APPENDIX TABLE 11. 4

COMPARISON OF ANNUAL PRODUCTION OF SEASONAL CROPS BEFORE AND AFTER DEVELOPMENT IN KARAK

(TONS)

Crop	Before	After	Difference	% Age ±
Wheat	11,185	17,400	+ 6,215	56
Wheat Straw	11,185	17,400	+ 6,215	5
Barley	2,619	2,170	- 449	(17)
Barley Straw	2,619	2,170	- 449	(17)
Lentils	901	3,500	+ 2,599	288
Lentils Hay	1,351	5,250	+ 3,899	288
Vetch	236	1,120	+ 884	375
Vetch Hay	354	1,680	+ 1,326	375
Chick Peas	212	2,075	+ 1,863	879
Chick Pea Hay	318	3,113	+ 2,795	879
other field crops	91	375	+ 284	312
Other Field crops straw	136	563	+ 427	312
Tomato	289	3,400	+ 3,111	1,076
Onions	59	6,000	+,5,940	10,069
Melon	219	2,550	+ 2,331	1,064
Cucurbits	276	3,000	+ 2,724	987
Other Veg. Crops	18	500	+ 482	2,678

APPENDIX TABLE 12. 4

COMPARISON OF ANNUAL PRODUCTION OF SEASONAL CROPS BEFORE AND AFTER DEVELOPMENT IN TAFILA

(TONS)

Crop	Before	After	Diff.	% Age ±
Wheat	641	420	-221	(34)
Wheat Straw	641	420	-221	(34)
Barley	231	260	+ 29	13
Barley Straw	231	260	+ 29	13
Lentils	43	85	+ 42	98
Lentil Straw	65	128	+ 63	97
Vetch	2	-	- 2	(100)
Vetch Hay	3	-	- 3	(100)
Chick peas	11	-	- 11	(100)
Chick Pea Hay	16	-	- 16	(100)
Other Field Crops	1	150	+149	14,900
Other Field Crops Straw	2	225	+223	14,900
Tomato	112	-	-112	(100)
Onions	16	180	+164	1,025
Melon	29	255	+226	779
Cucurbits	24	-	- 24	(100)
Other Veg. Crops	-	100	+100	All produce

APPENDIX TABLE 13. 4

COMPARISON OF ANNUAL PRODUCTION OF SEASONAL CROPS BEFORE AND AFTER DEVELOPMENT IN SHOBAK

(TONS)

Crop	Before	After	Diff.	% Age ±
Wheat	2,098.0	800	-1,298.0	(62)
Wheat Straw	2,098.0	800	-1,298.0	(62)
Barley	231.0	1,003	+ 772.0	334
Barley Straw	231.0	1,003	+ 772.0	334
Lentils	58.0	-	- 58.0	(100)
Lentil Hay	87.0	-	- 87.0	(100)
Vetch	1.0	-	- 1.0	(100)
Vetch Hay	1.5	-	- 1.5	(100)
Chick Peas	25.0	-	- 25.0	(100)
Chick Pea Hay	38.0	-	- 38.0	(100)
Other Field Crops	7.0	180	+ 173.0	2471
Other Field crop Straw	10.5	270	+ 259.5	2471
Melons	9	-	- 9	(100)
Cucurbits	13	-	-13	(100)
Other Veg. Crops	1	-	- 1	(100)

APPENDIX TABLE 14.4

COMPARISON OF ANNUAL PRODUCTION OF SEASONAL CROPS BEFORE AND AFTER DEVELOPMENT IN ALL PROJECT AREAS.

(TONS)

Crop	Before	After	Diff.	% Age + −
Wheat	13,924	18,620	+ 4,696	34
Wheat Straw	13,924	18,620	+ 4,696	34
Barley	3,081	3,433	+ 352	11
Barley Straw	3,081	3,433	+ 352	11
Lentils	1,002	3,585	+ 2,583	258
Lentil Straw	1,503	5,378	+ 3,875	258
Vetch	239	1,120	+ 881	368
Vetch Hay	359	1,680	+ 1,321	368
Chick peas	248	2,075	+ 1,827	737
Chick Pea Hay	372	3,113	+ 2,741	737
Other Field Crops	99	705	+ 606	612
Other Field Crops Straw	149	1,058	+ 909	612
Tomato	401	3,400	+ 2,999	748
Onions	75	6,360	+ 6,285	8,380
Melon	257	2,890	+ 2,633	1,025
Cucurbits	313	3,000	+ 2,687	859
Other Veg. Crops	19	632	+ 613	3,411

APPENDIX TABLE 15.4.

ADMINISTRATION REQUIREMENTS OF CAPITAL COSTS

JD

I t e m	Cost
1. Office Buildings (1)	30,000
2. Houses	50,000
3. Vehicles	7,500
4. Laboratory Equip., and office furniture	10,000
TOTAL	97,500

(1) Estimates are for additions to existing Dryland Project HQ at Rabba and new offices at Tafila and Shobak.

APPENDIX TABLE 16.4.

ADMINISTRATION OPERATING COSTS

Personnel	No.	Annual Salary	Housing & Transport allowances	Annual Cost per Head	Total annual cost
Project Manager	1	3,000	-	3,000	3,000
Assistant Project Manager	1	2,400	-	2,400	2,400
Head, Administration & Accounts Div.	1	2,000	600	2,600	2,600
Head, Planning & Control Div.	1	2,000	600	2,600	2,600
Head, Ext. Inf. & Coop. Division	1	2,000	600	2,600	2,600
Senior Cooperatives Officer	1	1,800	600	2,400	2,400
Senior Extension Officer	1	1,800	600	2,400	2,400
Head, Research & Development Div. (1)	1	2,000	600	2,600	2,600
Specialists (1)	3	1,800	600	2,400	7,200
Research Assistants	4	1,200	240	1,440	5,760
Head, Agric.Eng.Div.	1	2,000	600	2,600	2,600
Agricultural Engineer	2	1,800	600	2,400	4,800
Clerks	5	960	-	960	4,800
Drivers	5	960	-	960	4,800
Porters	5	600	-	600	3,000
Extension & Coop. Officers	20	1,500	500	2,000	40,000
Labourers	10	720	-	720	7,200
Reserve for salaries & wages					10,000
Miscellaneous Costs (2)					8,000
Board of Directors Remunerations					2,000
Training					5,000
Total					125,760

(1) Includes specialists in field crops, vegetables and fruit trees

(2) Includes fuels, electricity, telephones etc.

APPENDIX TABLE 1.5

FARM GATE PRICES IN PROJECT AREA

(JD PER TON)

Item	Price	Item	Price
Wheat	90	Wheat Straw	50
Barley	80	Barley Straw	30
Lentils	110	Lentils Straw	70
Vetch	90	Vetch Straw	70
Chick peas	120	Chick peas straw	40
Other Seeds	100	Other Straws	40
Olives	180	Grapes	90
Tomatoes	45	Melons	50
Onions	65	Cucurbits	100
Other Veg.	100	Other Fruits	100

Source : Department of Agricultural Economics and Ministry of Supply

APPENDIX TABLE 2.5

PRICES OF INPUTS PREVAILING DURING 1976

(JD)

Item	Unit	Unit Price	Item	Unit	Unit Price
Wheat seed	Ton	100	Sacks	One	0.300
Barley seed	"	80	Tractor (wheeled)	"	3500
Lentil seed	"	140	Combine harvester	"	10000
Vetch seed	"	90	Seed drill	"	1000
Chick pea seed	"	120	Local Thresher	"	300
Tomato seed	Kg	5	Sprayer	"	300
Melon seed	"	4	Weedicide sprayer	"	700
Cucurbit seed	"	0.200	Hand sprayer	"	17
Other Veg. Seed	kg	5.0	Dozer	"	20000
Olive transplants	One	0.300	Plough	"	250
Grapes transplants	One	0.050	Stone picker	"	150
Other fruit tree transplants	One	0.150	Chisel plough	"	300
Farmyard manure	Ton	8	Dozer	"	28000
Sulphate of amonia	"	45	Land Rover	"	1500
Superphosphate single	"	25	Microbus	"	6000
Triple superphosphate	"	80	Water tank	"	250
Compound fertilizer	"	100	Trailer	"	500
Herbicide (2-4D)	Kg	2.5	Tractor (chain)	"	3000
Pesticides	Kg	4	Light disc harrow	"	100
Earth banks (1)	Dunum	0.540	Wooden supports	Thousand	5,0
Earth banks (2)	"	2.16			
Stone terraces	"	26.4			
Manday	One	2			

(1) In slopes 0 - 3%

(2) In slopes 3 - 8%

APPENDIX TABLE 3.5.

TOTAL PROJECTED PRODUCTION

(000' TON)

Product	Location			Total
	Karak	Tafila	Shobak	
Field Crops :				
Wheat	471	11	22	504
Barley	59	7	27	93
Lentils	94	3	-	97
Vetch	30	-	-	30
Chickpea	57	-	-	57
Others	10	4	5	19
Total	721	25	54	800
Vegetables :				
Tomatoes	92	-	-	92
Onions	166	5	-	171
Melons	69	9	-	78
Cucurbits	81	-	-	81
Others	14	3	-	17
Total	422	17	-	439
Fruits :				
Olives	120	46	1	167
Grapes	291	127	51	469
Others	285	175	73	533
Total	696	348	125	1,169
Straws :				
Wheat	471	11	22	504
Barley	59	7	27	93
Lentils	142	3	-	145
Vetches	45	-	-	45
Chick pea	85	-	-	85
Others	-	6	6	12
Total	802	27	55	884

APPENDIX TABLE 4.5.

GROSS REVENUE PROJECTIONS FROM ALL PROJECT AREAS

Year	JD'000	Year	JD'000	Year	JD'000
1	1,300	11	11,509	21	8,025
2	2,147	12	11,903	22	8,704
3	3,061	13	12,136	23	9,538
4	4,171	14	12,323	24	10,101
5	5,378	15	12,118	25	10,608
6	6,749	16	12,107	26	10,646
7	7,567	17	10,279	27	10,921
8	9,402	18	9,485	28	11,921
9	10,517	19	8,825	29	11,921
10	11,280	20	8,438	30	11,921
Total					273,174

APPENDIX TABLE 5.5.

PROJECTED TOTAL ANNUAL REVENUES FROM SEASONAL CROPS PRODUCED IN KARAK

(J D)

Crop	Year 1	2	3	4	5	6	7	8	9 - 30
Wheat	200430	422820	673380	955260	268460	1381140	1472040	1534680	1566000
Wheat Straw	111350	234900	374100	530700	704700	767300	817800	852600	870000
Barley	22320	47120	74880	106160	140880	153280	163200	170160	173600
Barley Straw	8370	17670	28080	39810	52830	57480	61200	63810	65100
Lentils	49500	104500	166100	235400	132400	339900	361900	377300	385000
Lentils Hay	47250	99750	158550	224700	298200	324450	345450	360150	367500
Vetch	12960	27360	34560	61560	81720	88920	94680	98640	100800
Vetch Hay	15120	31920	50820	71820	95340	103740	110460	115080	117600
Chick Peas	38400	81600	124800	171000	220800	229800	238800	245400	249000
Chick Peas Hay	19200	40800	62400	85520	110400	114920	119400	122720	124520
Other crops	2360	48800	7560	10400	13400	14040	14520	14840	15000
Total- field crops	527260	1156940	1755230	2492330	3119130	3574970	3799450	3955380	4034120
Tomato	18360	39424	63184	90008	120608	132848	142384	149224	153000
Onions	44200	64900	153400	219700	297700	331500	358800	378300	390000
Melons	16350	34650	55200	78300	103800	112950	120150	125100	127500
Cucurbits	40000	84000	133000	187000	247000	267000	283000	294000	300000
Others	6400	13600	21600	30800	40800	44400	47200	49200	50000
Total Veg. crops	125310	266574	426384	605808	809908	888698	951534	995124	1020500
Grand Total	652570	1423514	2181614	3098138	3929038	4463668	4750984	4951204	5054620

APPENDIX TABLE 6.5

PROJECTED TOTAL ANNUAL REVENUES FROM SEASONAL CROPS GROWN IN TAFILA

(J D)

Crop	Year 1	2	3	4	5	6	7	8	9-30
Wheat	4860	10260	16290	23130	30690	33390	35550	37080	37800
Wheat Straw	2700	5700	9050	12850	17050	18550	19750	20600	21000
Barley	2640	5600	8960	12640	16800	18320	19520	20320	20800
Barley Straw	990	2100	3360	4740	6300	6870	7320	7620	7800
Lentils	1430	2970	4620	6380	8250	8690	9020	9240	9350
Lentils Hay	1400	2870	4410	6090	7910	8330	8610	8820	8960
Others	920	1920	2960	4180	5280	5560	5760	5920	6000
Others' Straw	1400	2880	4480	6160	7960	8360	8680	8880	9000
Total Field Crops	16430	34300	45140	73470	100240	108070	114210	118480	120710
Onions	1300	2795	4550	6565	8905	9945	10790	11375	11700
Melons	1650	3450	5500	7850	10400	11300	12000	12500	12750
Others	1300	2700	4300	6100	8100	8800	9400	9800	10000
Total - Veg. crops	4250	8945	14350	20515	27405	30045	32390	33675	34450
Grand Total	20680	43245	18864	93985	127605	138115	146400	152155	155160

APPENDIX TABLE 7.5.

PROJECTED ANNUAL REVENUES FROM SEASONAL CROPS GROWN IN SHOBAK

(J D)

Crop	Year 1	2	3	4	5	6	7	8	9-30
Wheat	90000	19080	30420	34200	27600	63000	67320	70380	72000
Wheat Straw	500	10600	16900	24000	32000	35000	37400	39100	40000
Barley	10384	21952	34936	49335	65384	71048	75528	78592	80240
Barley Straw	3894	8232	13101	18501	24519	26643	28323	29472	30090
Other Crops	2400	5100	8100	11400	15000	16200	17100	17700	18000
Other crops' Straw	1440	3060	4850	6840	9000	9720	10260	10620	10800
Total	32118	68024	108317	153277	203503	221611	235931	245864	251130

APPENDIX TABLE 8.5.

PROJECTED ANNUAL REVENUES FROM FRUIT CROPS GROWN IN PROJECT AREAS

(JD'000)

Year	Olives			Grapes			Other Fruits			Total
	Karak	Tafila	Shobak	Karak	Tafila	Shobak	Karak	Tafila	Shobak	
1	31,5	7	5,5	295,8	21	2	215,4	5,6	8	592
2	31,5	7	5,5	303,9	21	2	215,4	5,6	8	600
3	130,5	7	5,5	307,4	21	2	215,4	30,0	8	827
4	130,5	7	5,5	365,5	52	2	215,4	59,0	8	845
5	130,5	7	5,5	559,9	115	8	215,4	177,0	8	1226
6	180,0	56	5,5	888,0	317	21	247,9	322,0	23	2060
7	244,8	83	5,5	1325,3	611	71	326,3	853,0	38	3558
8	266,4	94	5,5	1480,2	687	121	516,1	965,0	118	4253
9	298,8	103	5,5	1631,4	772	172	900,9	1057,0	198	5139
10	327,6	117	5,5	1723,2	812	216	1380,9	1138,0	270	5990
11	363,6	126	5,5	1575,0	882	252	1361,4	1229,0	335	6130
12	388,8	144	5,5	1575,0	882	252	1556,4	1229,0	400	6433
13	514,8	224	5,5	1575,0	882	252	1556,4	1229,0	400	6639
14	601,2	326	5,5	1596,2	885	252	1556,4	869,0	401	6492
15	907,2	351	5,5	1554,4	761	252	1596,8	721,0	401	6531
16	1008,0	391	5,5	1974,3	587	253	1418,6	454,0	328	6419
17	1091,0	413	5,5	875,4	344	202	1175,4	363,0	248	4717
18	1170,0	452	5,5	623,4	263	234	735,4	254,0	168	3905
19	1170,0	452	5,5	406,9	189	94	695,4	171,0	88	3272
20	1170,0	452	5,5	474,5	124	59	488,8	209,0	23	3006
21	1170,0	452	5,5	346,2	95	21	327,2	255,0	38	2710
22	1170,0	452	5,5	491,1	164	71	517,0	493,0	118	3482
23	1170,0	452	5,5	541,5	194	122	901,8	605,0	198	4190
24	1170,0	452	5,5	591,9	224	172	1141,8	697,0	278	4732
25	1170,0	452	5,5	636,6	250	216	1381,8	778,0	338	5227
26	1170,0	452	5,5	504,0	252	254	1361,4	869,0	408	4776
27	1170,0	452	5,5	504,0	252	252	1556,4	869,0	400	5462
28	1170,0	452	5,5	504,0	252	252	1556,4	869,0	400	5461
29	1170,0	452	5,5	504,0	252	252	1556,4	869,0	400	5461
30	1170,0	452	5,5	504,0	252	252	1556,4	869,0	400	5461
Total	21856,7	8339	165,0	26237,2	11415	4583	28446,7	18513,2	6357	125912,8

APPENDIX TABLE 9.5.

ALL PROJECT AREAS

FINANCIAL ANALYSIS

(JD'000)

Year	Capital Costs	Operational Costs	Total Costs	Gross Revenues	Net Revenues	Net Present Value (Dis. 30%)	Net Present Value (Dis. 40%)
1	914.4	1605	2519	1048	(1471)	(1131)	(1050)
2	865.4	2736	3602	1895	(1707)	(1011)	(871)
3	716.4	3271	3988	2809	(1179)	(536)	(429)
4	667.4	3937	4604	3919	(685)	(240)	(178)
5	667.4	4334	5001	5126	125	31	23
6	73.0	4545	4618	6497	1879	389	250
7	6.0	4601	4607	7315	2708	431	162
8	26.0	4634	4660	9150	4490	552	305
9	-	4711	4711	10265	5554	522	266
10	-	4707	4707	11028	6321	461	221
11	33.0	4959	4992	11257	6265	351	156
12	32.0	4697	4729	11651	6924	298	124
13	14.0	4915	4929	11884	6955	230	90
14	5.0	4948	4953	12071	7118	178	64
15	33.0	4982	5015	11866	6851	138	41
16	68.0	4744	4812	11855	7043	106	35
17	41.0	4746	4787	10027	5240	63	16
18	39.0	4502	4541	9233	4692	43	9
19	39.0	4491	4530	8573	4043	28	6
20	39.0	4494	4533	8186	3653	18	4
21-30	3.0	42581	42584	109779	67195	80	14
	4282.0	129140	133422	266334	132912	99	(743)

Financial rate of return = $30 + 10 \left(\frac{99}{843} \right) = 31.17\%$

APPENDIX TABLE 10.5

ALL PROJECT AREA

FINANCIAL SENSITIVITY ANALYSIS

(AT 20% INCREASE IN COSTS)

(JD'000)

Year	Total Costs	Gross Revenue	Net Revenue	Net Present Value	
				Dis. 20%	Dis.30%
1	3023	1048	(1975)	(1645)	(1519)
2	4322	1895	(2427)	(1660)	(1437)
3	4785	2809	(1976)	(1144)	(900)
4	5525	3919	(1606)	(774)	(502)
5	6001	5126	(875)	(352)	(235)
6	5542	6497	955	320	198
7	5528	7315	1787	496	284
8	5592	9150	3558	829	437
9	5653	10265	4612	895	435
10	5648	11028	5380	872	393
11	5990	11257	5267	711	295
12	5675	11651	5976	669	257
13	5915	11884	5969	555	197
14	5944	12071	6127	478	153
15	6018	11866	5848	380	117
16	5774	11855	5821	315	88
17	5744	10027	4283	112	51
18	5449	9233	3784	143	34
19	5436	8573	3137	97	22
20	5441	8186	2746	71	14
				1368	(1687)

Financial Rate of return = $20 + 10 \left(\frac{1368}{3055} \right) = 24.48\%$

APPENDIX TABLE 11.5

ALL PROJECT AREAS
FINANCIAL SENSITIVITY ANALYSIS
(At 20% decrease in Value of Production)

(JD'000)

Year	Total Cost	Gross Revenue	Net Revenue	Net Present Value	
				Disc.30%	Disc.20%
1	2519	838	(1681)	(1293)	(1400)
2	3602	1516	(2086)	(1235)	(1448)
3	3988	2247	(1741)	(792)	(1008)
4	4604	3135	(1469)	(514)	(708)
5	5001	4001	(900)	(224)	(362)
6	4618	5198	580	120	194
7	4607	5852	1245	198	347
8	4660	7320	2660	327	620
9	4711	8212	3501	329	679
10	4707	8822	4115	300	167
11	4992	9006	4014	225	542
12	4729	9321	4592	197	514
13	4929	9507	4578	151	426
14	4953	9657	4704	118	267
15	5015	9493	4478	90	291
16	4812	9484	4672	70	252
17	4787	8022	3235	39	146
18	4541	7386	2845	26	108
19	4533	6858	2325	16	72
20	4533	6549	2016	10	52
				(1842)	251

Financial Rate of Return = $20 + 10 \left(\frac{251}{2093} \right) = 21.19\%$

APPENDIX TABLE 12.5

KARAK AREA
FINANCIAL ANALYSIS
(JD'000)

Year	Capital Costs	Operational Costs	Total Costs	Gross Revenues	Net Revenues	Net Present value (Dis .45%)	Net Present value (Dis .50%)
1	597	1209	1806	977	(829)	(572)	(553)
2	585	2034	2619	1758	(861)	(410)	(382)
3	482	2490	2972	2617	(355)	(116)	(105)
4	438	3035	3473	3592	118	27	24
5	438	3335	3773	4618	845	132	111
6	32	3412	3444	5563	2119	289	186
7	3	3398	3401	5830	2429	180	143
8	20	3450	3470	6997	3527	180	138
9	-	3497	3497	7669	4172	146	108
10	-	3450	3450	8180	4730	114	80
11	33	3672	3705	8138	4433	75	53
12	5	3409	3414	8358	4944	59	40
13	-	3608	3608	8511	4903	39	25
14	-	3641	3641	8592	4951	30	15
15	27	3677	3704	8846	5142	21	10
16	53	3388	3441	8189	5748	17	9
17	27	3440	3467	7980	4513	9	5
18	25	3293	3318	7367	4049	5	3
19	25	3328	3352	7110	3757	3	2
20	25	3378	3443	6971	3568	2	1
21-30	2	30171	30173	47029	16856	-	-
	2817	94315	97132	175892	78760	130	(92)

Financial Rate of Return = $45 + 5 \left(\frac{130}{222} \right)$ 47.92%

APPENDIX TABLE . 13.5

KARAK AREA

FINANCIAL SENSITIVITY ANALYSIS

(AT 20% INCREASE IN COSTS)

(JD'000)

Year	Total Cost	Gross Revenue	Net Revenue	Net Present Value	
				Dis .40%	Dis .30%
1	2167	977	(1190)	(850)	(915)
2	3155	1758	(1397)	(713)	(827)
3	3566	2617	(949)	(345)	(432)
4	4168	3592	(576)	(150)	(202)
5	4528	3618	90	17	24
6	4133	5563	1430	191	296
7	4081	5830	1749	166	278
8	4165	6990	2832	193	348
9	4196	7669	3473	167	326
10	4248	8180	3932	138	287
11	4446	8138	3692	92	207
12	4097	8358	4261	77	183
13	4330	8511	4181	54	138
14	4369	8592	4223	38	106
15	4445	8846	4401	26	88
16	4129	9189	5060	25	76
17	4160	7980	3820	12	46
18	4006	7367	3361	7	30
19	4024	7110	3086	5	22
20	3844	6971	3127	3	16
				(1297)	95

Financial Rate of Returns = $30 + 10 \left(\frac{95}{1392} \right) = 30.68\%$

APPENDIX TABLE 14.5

KARAK AREA

FINANCIAL SENSITIVITY ANALYSIS

(AT 20% DECREASE IN VALUE OF PRODUCTION)

(JD'000)

Year	Total Cost	Gross Revenue	Net Revenue	Net Present Value	
				Dis.20%	Dis. 30%
1	1806	782	(1024)	(853)	(788)
2	2629	1406	(1223)	(849)	(724)
3	2972	2094	(878)	(508)	(400)
4	3473	2874	(599)	(289)	(210)
5	3773	3694	79	32	21
6	3444	4450	1006	337	208
7	3401	4664	1263	352	201
8	3471	5598	2127	496	262
9	3497	6135	2638	512	248
10	3540	6544	3004	487	219
11	3705	6510	2805	379	157
12	3414	6686	3272	367	141
13	3608	6809	3201	298	106
14	3641	6874	3233	252	81
15	3704	7077	3373	219	68
16	3441	7351	3910	211	59
17	3467	6384	2917	131	35
18	3338	5894	2556	97	23
19	3353	5688	2335	72	16
20	3203	5577	2374	62	12
				1805	(265)

Financial Rate of Return = $20 + 10 \left(\frac{1805}{2070} \right) = 28.72\%$

APPENDIX TABLE 15.5

TAFILA AREA

FINANCIAL ANALYSIS

(JD'000)

Year	Capital Costs	Operational Costs	Total Costs	Gross Revenues	Net Revenues	Net Present Value (Dis .10%)	Net Present Value (Dis .20%)
1	232.9	338.4	571.3	78	(523)	(475)	(436)
2	195.4	579.7	775.1	78	(697)	(576)	(484)
3	149.4	601.6	751.0	93	(658)	(494)	(381)
4	144.4	668.4	812.8	183	(630)	(430)	(304)
5	144.4	719.5	863.9	308	(556)	(345)	(224)
6	30.0	821.2	851.2	688	(163)	(92)	(55)
7	2.0	695.2	697.2	1160	463	238	129
8	3.0	867.2	870.2	1786	916	428	213
9	0.0	889.2	889.2	1995	1106	469	215
10	0.0	916.2	916.2	2141	1225	473	198
11	0.0	938.2	938.2	2301	1363	477	184
12	27.0	942.2	969.2	2410	1431	456	160
13	14.0	961.2	975.2	2490	1515	439	140
14	5.0	960.2	965.2	2595	1630	428	127
15	6.0	957.9	963.9	2136	1172	280	76
16	4.0	1000.6	1004.6	1854	849	185	46
17	3.0	969.6	972.6	1366	393	78	18
18	3.0	882.6	885.6	1233	347	62	13
19	3.0	861.6	864.6	1050	185	30	6
20	3.0	812.6	815.6	902	86	13	2
21-30	-	9103.0	9103.0	13903	4800	-	-
Total	1969.5	25486.3	26455.8	40710	14254	1644	(110)

Financial Rate of Return = $10 + 10 \left(\frac{1644}{1763} \right) = 19.12\%$

APPENDIX TABLE 16.5.

TAFILA AREA

FINANCIAL SENSITIVITY ANALYSIS

(AT 20% INCREASE IN COSTS)

(JD'000)

Year	Total Cost	Gross Revenue	Net Revenue	Net Present Value	
				Dis.10%	Dis .20%
1	686	48	(638)	(580)	(531)
2	930	78	(852)	(704)	(591)
3	901	93	(808)	(607)	(468)
4	975	183	(792)	(540)	(382)
5	1037	308	(729)	(453)	(147)
6	1021	688	(333)	(188)	(112)
7	837	1160	323	166	90
8	1044	1786	742	347	173
9	1067	1995	928	393	180
10	1099	2141	1042	402	169
11	1126	2301	1175	411	159
12	1175	2410	1225	394	138
13	1170	2490	1320	383	123
14	1158	2595	1437	378	112
15	1150	2136	986	236	64
16	1201	1854	653	142	35
17	1164	1366	202	40	9
18	1059	1233	174	31	7
19	1034	1050	16	2	-
20	975	902	(73)	(11)	(2)
				242	(974)

Financial Rate of Return = $10 + 10 \left(\frac{242}{1216} \right) = 11,99\%$

APPENDIX TABLE 17.5

TAFILA AREA

FINANCIAL SENSITIVITY ANALYSIS

(AT 20% DECREASE IN VALUE OF PRODUCTION)

(JD'000)

Year	Total Cost	Gross Revenue	Net Revenue	Net Present Value	
				Dis .20%	Dis .10%
1	571,28	38	(533)	(447)	(484)
2	775,08	62	(713)	(495)	(589)
3	750,95	74	(677)	(392)	(508)
4	812,84	146	(667)	(321)	(406)
5	863,88	246	(618)	(248)	(384)
6	851,22	550	(301)	(101)	(170)
7	697,22	928	231	64	119
8	870,22	1429	559	130	261
9	889,22	1596	707	137	300
10	916,22	1713	797	129	308
11	938,22	1841	903	122	316
12	979,22	1928	949	106	303
13	975,22	1992	1017	95	295
14	965,22	2076	1111	87	292
15	957,92	1709	751	49	179
16	1000,62	1483	482	26	105
17	369,62	1093	723	33	143
18	882,62	986	103	4	19
19	861,62	840	(21)	(1)	(3)
20	812,62	722	(91)	(2)	(13)
				(1025)	33

Financial Rate of Return = $10 + 10 \left(\frac{33}{1058} \right) = 10.31\%$

APPENDIX TABLE 18.5

SHOBAK AREA

FINANCIAL ANALYSIS
(JD'000)

Year	Capital Costs	Operational Costs	Total Costs	Gross Revenues	Net Revenues	Net Present Value	
						Dis. 10%	Dis. 20%
1	84.5	57.4	142	23	(199)	(108)	(99)
2	85.0	122.7	208	59	(149)	(123)	(103)
3	85.0	179.6	265	99	(166)	(125)	(96)
4	85.0	233.4	318	144	(174)	(119)	(84)
5	85.0	279.5	365	200	(164)	(102)	(66)
6	11.0	312.2	323	246	(77)	(43)	(26)
7	1.0	508.2	509	325	(184)	(94)	(51)
8	3.0	317.2	320	367	47	22	11
9	0.0	325.2	325	601	276	117	54
10	0.0	341.2	341	707	666	257	108
11	0.0	349.2	349	818	469	164	63
12	0.0	346.2	346	883	537	171	60
13	0.0	346.2	346	883	537	156	50
14	0.0	347.2	347	884	537	141	47
15	0.0	347.2	347	884	537	128	35
16	11.0	355.6	367	812	445	97	24
17	11.0	336.6	348	681	333	66	15
18	11.0	326.2	338	633	295	53	11
19	11.0	301.6	313	413	100	16	3
20	11.0	303.6	315	313	(2)	-	-
21-30	1.0	330.7	3308	7232	3924	-	-
	495.5	9343.6	9839	17207	7368	474	(44)

Financial Rate of Return = $10 + 10 \left(\frac{474}{518} \right) = 19.15\%$

APPENDIX TABLE 19.5.
SHOBAK AREA
FINANCIAL SENSITIVITY ANALYSIS
(AT 20% INCREASE IN COSTS)
(JD' 000)

Year	Total Cost	Gross Revenue	Net Revenue	Net Present Value	
				Dis. 10%	Dis. 20%
1	170	23	(147)	(134)	(122)
2	250	59	(191)	(164)	(133)
3	318	99	(174)	(131)	(101)
4	382	144	(238)	(163)	(115)
5	437	200	(137)	(85)	(55)
6	388	246	(142)	(80)	(48)
7	611	325	(286)	(147)	(80)
8	384	367	17	8	4
9	390	601	211	89	41
10	409	707	298	115	48
11	419	818	399	140	54
12	415	883	468	149	52
13	415	883	468	136	44
14	416	884	468	123	37
15	416	884	468	112	30
16	439	812	373	81	20
17	418	681	263	52	12
18	406	633	227	41	9
19	376	413	37	6	1
20	409	313	(96)	(14)	(2)
				134	(304)

Financial Rate of Return = $10 + 10 \left(\frac{134}{438} \right) = 13.05\%$

APPENDIX TABLE 20.5.

SHOBAK AREA

FINANCIAL SENSITIVITY ANALYSIS

(AT 20% DECREASE IN VALUE OF PRODUCTION)

(JD000)

Year	Total Cost	Gross Revenue	Net Revenue	Net Present Value	
				Dis. 10%	Dis. 5%
1	142	18	(124)	(113)	(118)
2	208	47	(161)	(133)	(146)
3	165	79	(186)	(140)	(179)
4	318	115	(203)	(139)	(167)
5	364	160	(204)	(127)	(160)
6	323	197	(126)	(71)	(94)
7	509	260	(249)	(128)	(177)
8	320	294	(26)	(12)	(18)
9	325	481	156	66	101
10	341	566	225	87	138
11	349	654	305	107	178
12	346	706	360	115	201
13	346	706	360	104	191
14	347	707	360	95	182
15	347	707	360	86	173
16	367	650	283	62	130
17	348	545	197	39	86
18	338	506	168	30	70
19	313	330	17	3	7
20	315	250	65	(10)	(25)
				(110)	(473)

Financial Rate of Return = $5 + 5 \left(\frac{473}{583} \right) = 9.06\%$

APPENDIX TABLE 21.5.

KARAK AND TAFILA AREAS

FINANCIAL ANALYSIS

(JD'000)

Year	Total Costs	Gross Revenues	Net Revenues	Net Present Value	
				Dis. 40%	Dis. 30%
1	2377	1025	(1352)	(965)	(1040)
2	3404	1836	(1568)	(800)	(928)
3	3723	2710	(1013)	(369)	(461)
4	4286	3775	(511)	(133)	(179)
5	4637	4926	289	54	78
6	4295	6251	1956	260	405
7	4098	6990	2892	123	460
8	4340	8783	4443	302	546
9	4386	9664	5278	253	496
10	4456	10321	5865	205	428
11	4643	10439	5796	145	325
12	4383	10768	6385	115	275
13	4583	11001	6418	83	212
14	4600	11187	6581	59	164
15	4667	10982	6315	38	127
16	4446	11043	6597	33	99
17	4440	9346	4906	15	59
18	4224	8600	4376	9	39
19	4218	8160	3942	0.6	28
20	4069	7873	3804	0.3	19
21-30	39276	60931	21655	-	-
				(572)	1152

Financial Rate of Return = $30 + 10 \left(\frac{1152}{1724} \right) = 36.68\%$

APPENDIX TABLE 22.5.

KARAK AND TAFILA AREAS

FINANCIAL SENSITIVITY ANALYSIS

(AT 20% INCREASE IN COSTS)

(JD'000)

Year	Total Costs	Gross Revenues	Net Revenues	Net Present Value	
				Dis. 20%	Dis. 30%
1	2852	1025	(1827)	(1522)	(1405)
2	4085	1836	(2249)	(1561)	(1331)
3	4468	2710	(1758)	(1018)	(800)
4	5143	3775	(1368)	(659)	(479)
5	5564	4926	(638)	(256)	(172)
6	2154	6251	1097	367	227
7	4918	6990	2072	578	322
8	5208	8773	3565	831	438
9	5263	9664	4401	854	414
10	5347	10321	4974	806	363
11	5572	10439	4867	657	273
12	5260	10768	5508	617	237
13	5600	11001	5401	502	178
14	5527	11187	5660	441	142
15	5600	10982	5382	350	108
16	5335	11043	5708	308	86
17	5328	9342	4014	181	48
18	5069	8600	3531	134	32
19	5062	8160	3098	96	22
20	4883	7873	2990	77	15
21-30	47131	60931	13800	-	-
				1783	(1282)

Financial Rate of Return = $20 + 10 \left(\frac{1783}{3065}\right) = 25.82\%$

APPENDIX TABLE 23.5

KARAK AND TAFILA AREAS

FINANCIAL SENSITIVITY ANALYSIS

(AT 20% DECREASE IN VALUE OF PRODUCTION)

(JD'000)

Year	Total Cost	Gross Revenue	Net Revenue	Net Present value	
				Dis. 20%	Dis. 30%
1	2377	820	(1557)	(1297)	(1197)
2	3404	1469	(2935)	(2029)	(1738)
3	3723	2168	(1555)	(900)	(708)
4	4286	3020	(1246)	(601)	(436)
5	4637	3941	(696)	(280)	(187)
6	4295	5001	706	237	145
7	4098	5592	1494	417	238
8	4240	7014	2674	623	329
9	4386	7731	3345	649	314
10	4456	8257	4001	713	292
11	4643	8351	3708	501	208
12	4383	8614	4231	474	182
13	4583	8801	4218	392	139
14	4606	8950	4344	339	109
15	4667	8786	4119	268	82
16	4446	8834	4388	237	52
17	4440	7474	3034	137	36
18	4224	6880	2656	101	24
19	4218	6528	2310	72	16
20	4069	6298	2229	58	11
21-30	39276	48745	9469	-	-
				91	(2089)

Financial Rate of Return = $20 + 10 \left(\frac{91}{2180} \right) = 20.41\%$

APPENDIX TABLE 24.5.
COST BENEFIT RATIOS
(JD'000)

Year	Total Costs	Total Returns	Discounting factor (11%)	Present Value	
				Costs	Returns
1	2,519	1,048	0.901	2,269	944
2	3,602	1,895	0.812	2,925	1,539
3	3,988	2,809	0.731	2,915	2,053
4	4,604	3,919	0.659	3,034	2,583
5	5,001	5,126	0.593	2,966	3,040
6	4,618	6,497	0.535	2,471	3,476
7	4,607	7,315	0.482	2,221	3,526
8	4,660	9,150	0.434	2,022	3,971
9	4,711	10,265	0.391	1,842	4,010
10	4,707	11,028	0.352	1,657	3,882
11	4,992	11,257	0.317	1,582	3,568
12	4,729	11,651	0.286	1,352	3,332
13	4,929	11,884	0.258	1,272	3,066
14	4,953	12,071	0.232	1,149	2,800
15	5,015	11,866	0.209	1,048	2,480
16	4,812	11,855	0.188	905	2,229
17	4,782	10,027	0.170	814	1,705
18	4,541	9,233	0.153	695	1,413
19	4,530	8,573	0.138	625	1,183
20	4,533	8,186	0.124	562	1,012
21-30	42,584	68,164	-	3,852	1,012
	133,422	233,819		38,177	58,753

Benefit cost ratios

a - Present Value = $\frac{58753}{38177}$ = 1.53

b - Current prices = $\frac{233819}{133422}$ = 1.75

APPENDIX TABLE 25.5
ALL PROJECT AREAS
ECONOMIC ANALYSIS
(JD'000)

Year	Capital Costs	Operational Costs	Total Costs	Gross Revenues	Net Revenues	Net Present Value	
						Dis.20%	Dis.30%
1	3648	1605	5253	1048	(4205)	(3502)	(3234)
2	1464	2736	4200	1895	(2305)	(1600)	(1365)
3	716	3271	3987	2809	(1179)	(683)	(536)
4	667	3947	4604	3919	(685)	(330)	(240)
5	667	4334	5001	5126	125	50	31
6	73	4545	4618	6497	1879	629	389
7	6	4602	4608	7315	2708	756	431
8	26	4634	4660	9150	4490	1046	552
9	-	4711	4711	10265	5554	1077	522
10	-	4707	4707	11028	6321	1024	461
11	33	4959	4992	11257	6265	846	351
12	32	4697	4729	11651	6922	775	298
13	14	4915	4929	11884	6955	647	230
14	5	4948	4953	12071	7118	555	178
15	33	4932	5015	11866	6851	455	137
16	68	4744	4812	11855	7043	380	106
17	41	4746	4787	10027	5240	236	63
18	39	4502	4541	9133	4692	178	42
19	39	4491	4530	8573	4043	125	28
20	39	4294	4533	8186	4653	95	18
21-30	3	24581	34391	109779	67195	574	80
	7613	129140	136753	269334	129581	6533	(1485)

Economic Rate of Return = $20 + 10 \left(\frac{6533}{8018} \right) = 29.40\%$

APPENDIX TABLE 26.5.
ALL PROJECT AREAS
ECONOMIC SENSITIVITY ANALYSIS
(AT 20% INCREASE IN COSTS)
(JD' 000)

Year	Total Costs	Gross Revenues	Net Revenues	Net Present Value	
				Dis. 20%	Dis. 10%
1	6339	1048	(5291)	(4407)	(4810)
2	5040	1895	(3145)	(2151)	(2598)
3	4785	2809	(1976)	(1144)	(1485)
4	5525	3919	(1606)	(774)	(1097)
5	6001	5126	(875)	(352)	(543)
6	5542	6497	955	320	539
7	5528	7315	1787	496	917
8	5592	9150	3558	829	1662
9	5653	10265	4612	895	2955
10	5648	11028	5380	872	2077
11	5990	11257	5267	711	1843
12	5675	11651	5976	669	1906
13	5915	11884	5969	555	1731
14	5944	12071	6127	478	1611
15	6018	11866	5848	380	1397
16	5774	11855	5841	315	1273
17	5744	10027	4283	112	848
18	5449	9233	3784	143	681
19	5436	8573	3137	97	514
20	5439	8186	2746	71	409
				(885)	9830

Economic rate of Return = $10 + 10 \frac{(9830)}{11715} = 18.39\%$

APPENDIX TABLE 27.5.

ALL PROJECT AREAS

ECONOMIC SENSITIVITY ANALYSIS

(AT 20% DECREASE IN VALUE OF PRODUCTION)

(JD'000)

Year	Total Costs	Gross Revenues	Net Revenues	Net present value	
				Dis. 20%	Dis.10%
1	5253	838	(4415)	(3678)	(4013)
2	4200	1516	(2684)	(1863)	(1508)
3	3987	2247	(1741)	(1008)	(1307)
4	4604	3125	(1469)	(708)	(1003)
5	5001	4101	(900)	(362)	(559)
6	4618	5198	580	194	327
7	4608	5852	1245	347	639
8	4660	7320	2660	620	1242
9	4711	8212	3501	679	1484
10	4797	8822	4115	667	1588
11	4992	9006	4014	582	1405
12	4729	9320	4592	514	1465
13	4929	9507	4578	426	1328
14	4953	9657	4704	367	1237
15	5015	9493	4478	291	1070
16	4812	9484	4672	252	1018
17	4787	8022	3235	145	641
18	4541	7386	2845	108	512
19	4533	6858	2325	72	381
20	4323	6549	2016	52	300
				(3023)	6157

Economic Rate of return = $10 + 10 \left(\frac{6157}{9360} \right) = 16.58\%$

APPENDIX TABLE 28.5

KARAK AREA

ECONOMIC ANALYSIS

(JD'000)

Year	Capital Costs	Operational Costs	Total Costs	Gross Revenues	Net Revenues	Net present value	
						Dis. 30%	Dis. 35%
1	2591	1209	3800	977	(2823)	(2171)	(2091)
2	974	2034	3008	1768	(1250)	(740)	(686)
3	482	2490	2972	2617	(355)	(162)	(144)
4	438	3035	3473	3592	119	42	36
5	438	3335	3773	4618	845	227	188
6	32	3412	3444	5563	2119	438	350
7	3	3398	3401	5830	2429	386	296
8	20	3450	3470	6997	3547	436	323
9	-	3497	3497	7669	4172	392	280
10	-	3540	3540	8180	4640	338	232
11	33	3672	3705	8138	4433	248	164
12	5	3409	3414	8358	4944	213	133
13	-	3608	3608	8511	4903	162	98
14	-	3641	3641	8592	4951	124	74
15	37	3677	3704	8846	5142	103	57
16	53	3388	3441	9189	5748	86	46
17	27	3440	3467	7980	4517	54	27
18	25	3293	3338	7367	4029	36	20
19	25	3328	3353	7110	3757	26	11
20	25	3178	3203	6971	3768	19	8
21-30	2	30171	30173	47029			
	6149	94215	100364	175825	75461	257	(578)

Economic Rate of Return $= 30 + 5 \frac{(257)}{(855)} = 31.54\%$

APPENDIX TABLE 29.5.

KARAK AREA

ECONOMIC SENSITIVITY ANALYSIS

(AT 20% INCREASE IN COSTS)

(JD'000)

Year	Total Costs	Gross Revenues	Net Revenues	Net Present Value	
				Dis. 30%	Dis. 20%
1	4560	977	(3583)	(2755)	(2985)
2	3610	1758	(1852)	(1096)	(1285)
3	3566	2617	(949)	(432)	(549)
4	4168	3592	(576)	(202)	(278)
5	4528	4618	90	24	36
6	4133	5563	1430	296	479
7	4081	5830	1749	278	488
8	4165	6997	2832	348	660
9	4196	7669	3473	326	678
10	4248	8180	3932	287	637
11	4446	8138	3692	207	498
12	4097	8358	4261	183	477
13	4330	8511	4181	138	389
14	4369	8592	4223	106	329
15	4445	8846	4401	88	286
16	4129	9189	5060	76	273
17	4160	7980	3820	460	172
18	4006	7367	3361	30	128
19	4024	7110	3086	22	96
20	3844	6971	3127	16	81
				(2014)	(510)

Economic Rate of Return = $20 + 10 \left(\frac{610}{2624} \right) = 22.32\%$

APPENDIX TABLE 30.5

KARAK AREA

ECONOMIC SENSITIVITY ANALYSIS

(AT 20% DECREASE IN VALUE OF PRODUCTION)

(JD'000)

Year	Total Costs	Gross Revenue	Net Revenues	Net Present Value	
				Dis. 10%	Dis. 20%
1	3800	782	(1204)	(930)	(2513)
2	3008	1406	(1223)	(1010)	(1112)
3	2972	2094	(878)	(659)	(508)
4	3473	2874	(599)	(409)	(289)
5	3773	3694	79	49	32
6	3444	4450	1006	567	337
7	3401	4664	1263	934	359
8	3471	5598	2127	993	496
9	3497	6135	2638	1119	512
10	3540	6544	3004	1160	487
11	3705	6510	2805	982	379
12	3414	6686	3272	1044	367
13	3641	6809	3201	928	298
14	3704	6874	3233	850	252
15	3441	7077	3373	806	219
16	3467	7351	3910	852	211
17	3398	6384	2917	578	131
18	3353	5894	2556	460	97
19	3203	5688	2335	383	72
20	3100	5577	2374	354	62
				8751	(118)

Economic Rate of Return = $10 + 10 \left(\frac{8751}{8869} \right) = 19.87\%$

APPENDIX TABLE 31.5

TAFILA AREA

ECONOMIC ANALYSIS

(JD'000)

Year	Capital Costs	Operational Costs	Total Costs	Gross Revenues	Net Revenues	Net Present Value	
						Dis. 10%	Dis.20%
1	930.6	338.4	1269.0	48	(1221)	(1110)	(1117)
2	404.3	579.7	984.0	78	(906)	(748)	(629)
3	149.4	601.6	751.0	93	(658)	(494)	(381)
4	144.4	668.4	812.8	183	(630)	(430)	(304)
5	144.4	719.5	863.9	308	(556)	(345)	(224)
6	30.0	821.2	851.2	688	(163)	(92)	(55)
7	2.0	695.2	697.2	1160	1063	545	297
8	3.0	867.2	870.2	1786	916	428	213
9	-	889.2	889.2	1995	1106	469	215
10	-	916.2	916.2	2141	1225	473	198
11	-	938.2	938.2	2301	1263	477	184
12	27.0	942.2	969.2	2410	1431	456	160
13	14.0	961.2	975.2	2490	1505	439	140
14	5.0	960.2	965.2	2595	1630	428	127
15	6.0	957.9	963.9	2136	1178	282	77
16	4.0	1000.6	1004.6	1854	853	186	46
17	3.0	969.6	972.6	1366	396	78	18
18	3.0	882.6	885.6	1233	350	63	13
19	3.0	861.6	864.6	1050	188	30	6
20	3.0	812.6	815.6	902	89	13	2
21-30	-	9103.0	9103.0	13903	4800		
	1876.1	25481.3	27357.4	40720	13362.4	1148	(1017)

Economic Rate of Return = $10 + 10 \left(\frac{1148}{2165} \right) = 15.30\%$

APPENDIX TABLE 32.5.

TAFILA AREA

ECONOMIC SENSITIVITY ANALYSIS

(AT 20% INCREASE IN COSTS)

(JD' 000)

Year	Total Costs	Gross Revenues	Net Revenues	Net Present Value	
				Dis. 5%	Dis. 10%
1	1523	48	(1475)	(1404)	(1341)
2	1181	78	(1103)	(1000)	(911)
3	901	93	(808)	(698)	(607)
4	975	183	(792)	(652)	(540)
5	1037	308	(729)	(572)	(453)
6	1021	688	(333)	(248)	(188)
7	837	1160	323	229	166
8	1044	1786	742	503	347
9	1067	1995	928	599	393
10	1099	2141	1042	640	402
11	1126	2301	1175	687	411
12	1175	2410	1235	688	394
13	1170	2490	1320	700	383
14	1158	2595	1437	726	378
15	1150	2136	986	474	236
16	1201	1854	653	299	142
17	1164	1366	202	88	40
18	1059	1233	174	72	31
19	1034	1050	16	6	2
20	975	902	(73)	(27)	(11)
				1110	(726)

Economic Rate of Return = $5 + 5 \left(\frac{1110}{1836} \right) = 8.02\%$

TABLE 33.5.

TAFILA AREA

ECONOMIC SENSITIVITY ANALYSIS
(AT 20% DECREASE IN VALUE PRODUCTION)

(JD'000)

Year	Total Costs	Gross Revenues	Net Revenues	Net Present Value	
				Dis. 5%	Dis. 10%
1	1269	38	(1231)	(1172)	(1119)
2	984	62	(922)	(836)	(762)
3	751	74	(677)	(585)	(508)
4	813	146	(667)	(549)	(456)
5	864	246	(618)	(485)	(384)
6	851	550	(301)	(225)	(170)
7	697	928	231	164	119
8	870	1429	559	379	261
9	889	1596	707	456	300
10	916	1713	797	489	308
11	938	1841	903	528	316
12	919	1928	949	529	303
13	975	1992	1017	539	295
14	965	2076	1111	561	292
15	908	1709	751	361	179
16	1001	1483	482	221	105
17	370	1093	723	317	143
18	883	986	103	43	19
19	862	840	(21)	(8)	(3)
20	813	722	(91)	(34)	(13)
				693	(665)

Economic Rate of Return = $5 + 5 \left(\frac{693}{1358} \right) = 7.55\%$

APPENDIX TABLE 34.5.

SHOBAK AREA

ECONOMIC ANALYSIS

(JD'000)

Year	Capital Costs	Operational Costs	Total Costs	Gross Revenues	Net Revenues	Net Present Value	
						Dis. 20%	Dis. 10%
1	126.6	57.4	184	23	(161)	(134)	(146)
2	85.0	122.7	208	59	(149)	(103)	(123)
3	85.0	179.6	265	99	(166)	(96)	(125)
4	85.0	233.4	318	144	(174)	(84)	(119)
5	85.0	279.5	364	200	(164)	(66)	(102)
6	11.0	312.2	323	246	(77)	(26)	(43)
7	1.0	508.2	509	325	(184)	(51)	(94)
8	3.0	317.2	320	367	47	11	22
9	0.0	325.2	325	601	276	54	117
10	0.0	341.2	341	707	666	108	257
11	0.0	349.2	349	818	469	36	164
12	0.0	346.2	346	883	537	60	171
13	0.0	346.2	346	883	537	50	156
14	0.0	437.2	437	884	537	47	141
15	0.0	347.2	347	884	537	35	128
16	11.0	355.6	367	812	445	24	97
17	11.0	336.6	348	681	333	15	66
18	11.0	326.6	338	633	295	11	53
19	11.0	301.6	313	413	100	3	16
20	11.0	303.6	315	313	(2)	-	-
21-30	1.0	3307.0	3308	7232	3942	-	-
	537.5	**9343.6**	9881	**17207**	**7846**	(79)	436

Economic Rate of Return = $10 + 10 \left(\frac{436}{516} \right) = 18.44\%$

APPENDIX TABLE 35.5.

SHOBAK AREA

ECONOMIC SENSITIVITY ANALYSIS

(AT 20% INCREASE IN COSTS)

(JD'000)

Year	Total Costs	Gross Revenue	Net Revenue	Net Present Value	
				Dis. 10%	Dis. 5%
1	221	23	(198)	(180)	(188)
2	250	59	(191)	(158)	(173)
3	318	99	(219)	(164)	(189)
4	382	144	(238)	(163)	(196)
5	437	200	(237)	(147)	(186)
6	388	246	(142)	(80)	(106)
7	611	325	(286)	(147)	(203)
8	384	367	(17)	(8)	(12)
9	390	601	211	89	136
10	409	707	298	115	183
11	419	818	399	140	233
12	415	883	468	149	261
13	415	883	468	136	240
14	416	884	468	123	236
15	416	884	468	112	225
16	439	812	373	81	171
17	418	681	263	52	115
18	406	633	227	41	117
19	376	413	37	6	15
20	409	313	(96)	(14)	(36)
				(17)	(643)

Economic Rate of Return $= 5 + 5 \left(\frac{643}{660} \right) = 9.87\%$

APPENDIX TABLE 36.5.

SHOBAK AREA

ECONOMIC SENSITIVITY ANALYSIS

(AT 20% DECREASE IN VALUE OF PRODUCTION)

(JD'000)

Year	Total Costs	Gross Revenues	Net Revenues	Net Present Value	
				Dis. 10%	Dis. 5%
1	184	18	(166)	(151)	(158)
2	208	47	(161)	(133)	(146)
3	265	79	(186)	(140)	(179)
4	318	115	(203)	(139)	(167)
5	364	160	(204)	(127)	(160)
6	323	197	(126)	(71)	(94)
7	509	260	(249)	(128)	(177)
8	320	294	(26)	(12)	(18)
9	325	481	156	66	101
10	341	566	225	87	138
11	349	654	305	107	178
12	346	706	360	115	201
13	346	706	360	104	191
14	347	707	360	95	182
15	347	707	360	86	173
16	367	650	283	62	130
17	348	545	197	39	86
18	338	506	168	30	70
19	313	330	17	3	7
20	315	250	(65)	(10)	(25)
				(148)	(433)

Economic Rate of Return = $5 + 5 \left(\frac{433}{581} \right) = 8.73\%$

TABLE 37.5.

KARAK AND TAFILA AREAS

ECONOMIC ANALYSIS

(JD'000)

Year	Total Costs	Gross Revenues	Net Revenues	Net Present Value	
				Dis. 20%	Dis. 30%
1	5069	1025	(4044)	(3369)	(3110)
2	3092	1836	(1256)	(872)	(744)
3	3723	2710	(1013)	(283)	(461)
4	4286	3775	(511)	(246)	(179)
5	4637	4926	289	116	78
6	4295	6251	1956	255	405
7	4098	6990	2892	807	460
8	4340	8783	4443	1035	546
9	4386	9664	5278	1023	496
10	4456	10321	5865	930	428
11	4643	10439	5796	782	325
12	4383	10768	6385	715	275
13	4583	11001	6418	697	212
14	4606	11187	6581	513	164
15	4667	10982	6315	410	127
16	4446	11043	6597	356	99
17	4440	9346	4906	221	59
18	4224	8600	4376	166	39
19	4218	8160	3942	290	28
20	4069	7873	3804	290	19
21-30	39276	60931	21655	-	-
				3836	(734)

Economic Rate of Return = $20 + 10 \frac{(3836)}{(4570)} = 28.39\%$

APPENDIX TABLE 38.5.

KARAK AND TAFILA AREAS

ECONOMIC SENSITIVITY ANALYSIS

(AT 20% INCREASE IN COSTS)

(JD'000)

Year	Total Costs	Gross Revenues	Net Revenues	Net Present Value	
				Dis. 20%	Dis. 10%
1	6083	1025	(5058)	(4213)	(4598)
2	3780	1836	(1874)	(1301)	(1548)
3	4468	2710	(1758)	(1018)	(1320)
4	5143	3775	(1368)	(659)	(934)
5	5564	4926	(638)	(256)	(396)
6	5154	6251	1097	367	618
7	4918	6990	2072	578	1062
8	5208	8773	3565	831	1640
9	5263	9664	4401	854	1866
10	5347	10321	4974	806	1920
11	5572	10439	4867	657	1703
12	5260	10768	5508	617	1757
13	5600	11001	5401	502	1566
14	5527	11187	566	441	1488
15	5600	10982	5382	350	1286
16	5335	11043	5708	308	1244
17	5328	9342	4014	181	705
18	5069	8600	3531	134	636
19	5062	8160	3098	96	508
20	4883	7873	2990	77	466
21-30	47131	60931	13800	-	-
				(648)	

Economic Rate of Return = $10 + 10 \left(\frac{9649}{10307} \right) = 19.36\ \%$

APPENDIX TABLE 39.5.

KARAK AND TAFILA AREAS

ECONOMIC SENSITIVITY ANALYSIS

(AT 20% DECREASE IN VALUE OF PRODUCTION)

(JD'000)

Year	Total Costs	Gross Revenues	Net Revenues	Net Present Value	
				dis. 20%	Dis. 10%
1	5069	820	(4449)	(3706)	(4044)
2	3092	1469	(1623)	(1126)	(1341)
3	3723	2168	(1555)	(900)	(1168)
4	4286	3020	(1246)	(601)	(851)
5	4637	3941	(696)	(280)	(432)
6	4295	5001	706	237	398
7	4098	5592	1494	417	766
8	4340	7014	2674	623	1249
9	4386	7731	3345	649	1418
10	4456	8257	4001	713	1544
11	4643	8351	3708	501	1298
12	4383	8614	4231	474	1350
13	4583	8801	4218	392	1223
14	4606	8950	4344	339	1142
15	4667	8786	4119	268	984
16	4446	8834	4388	237	957
17	4440	7474	3034	137	601
18	4224	6880	2656	101	478
19	4218	6528	2310	72	379
20	4069	6298	2229	58	332
21-30	39276	48745	9469	-	-
				(1405)	6283

Economic Rate of Return = $10 + 10 \left(\frac{6283}{7688} \right) = 18.17\%$

APPENDIX TABLE 40.5.

ANNUAL VALUE ADDED TO NATIONAL INCOME

(JD'000)

Year	Operating costs	Labour Costs	Material Costs	Returns	Value added	Value added (11%)
1	1,065	763	786	1,048	262	236
2	2,736	1,356	1,292	1,895	603	490
3	3,271	1,762	1,284	2,809	1,525	1,114
4	3,937	2,021	561	3,919	358	236
5	4,334	2,500	1,552	5,126	3,674	2,181
6	4,545	2,686	1,629	6,497	4,868	2,604
7	4,602	2,755	1,608	7,315	5,707	2,751
8	4,634	2,892	1,563	9,150	7,587	3,293
9	7,711	3,012	1,394	10,265	8,971	3,508
10	4,797	3,050	1,412	11,028	9,616	3,385
11	4,959	3,218	1,378	11,257	9,879	3,132
12	4,697	3,273	1,046	11,651	10,605	3,033
13	4,915	3,367	1,160	11,884	10,724	2,767
14	4,918	3,364	1,196	12,071	10,875	2,523
15	4,983	3,161	1,433	11,866	10,433	2,180
16	4,744	2,828	1,539	11,855	10,316	1,939
17	4,746	2,749	1,645	10,027	8,382	1,090
18	4,502	2,623	1,560	9,233	7,673	1,173
19	4,491	2,544	1,676	8,573	6,897	951
20	4,494	2,603	1,423	8,186	6,763	838
21-30	42,581	29,216	13,080	83,664	-	-
Total	128,734	81,743	40,217	252,319	135,763	38,524

APPENDIX TABLE 41.5
PROPOSED COSTS TO BE BORNE BY THE GOVERNMENT
(JD'000)

Year	Stone Terrac-ing	Earth Banks	Buildings	Mach-inary & Equip-ment	Sub-Total (Capit-al Costs)	Salar-ies & Wages	Maint. & Fuels	Others	Sub-total (Opera-tional Costs)	Grand Total
1	126.7	51.6	80	25	283.3	258.5	13.8	21.5	293.8	577.1
2	126.7	51.6	-	-	178.3	258.5	13.8	4.5	276.8	455.1
3	126.7	51.6	-	-	178.3	258.5	13.8	3.2	275.5	453.8
4	126.7	51.6	-	-	178.3	232.7	10.9	0.8	244.4	422.7
5	126.7	51.6	-	-	178.3	206.8	8.0	-	214.8	393.1
6	-	-	-	-	-	131.2	30.0	1.0	162.2	162.2
7	-	-	-	-	-	131.2	30.0	1.0	162.2	162.2
8	-	-	-	26	26	131.2	30.0	1.0	162.2	162.2
9	-	-	-	-	-	131.2	30.0	1.0	162.2	162.2
10	-	-	-	-	-	131.2	30.0	1.0	162.2	162.2
11	-	-	-	-	-	131.2	30.0	1.0	162.2	162.2
12	-	-	-	-	-	131.2	30.0	1.0	162.2	162.2
13	-	-	-	-	-	131.2	30.0	1.0	162.2	162.2
14	-	-	-	-	-	131.2	30.0	1.0	162.2	162.2
15	-	-	-	-	-	131.2	30.0	1.0	162.2	162.2
16	-	-	-	-	-	118.2	8.0	-	162.2	162.2
17-30	-	-	-	-	-	1655.5	112.0	-	1,767.0	1,767.0
	633.5	258	80	51	1,022.5	4,300.2	480.3	40.0	4,820.5	5,843.1

APPENDIX TABLE 42.5.

CREDIT REQUIREMENTS OF FARMERS

(JD'000)

Year	Capital costs	Operational Costs	Total	Farmers share in operation-al costs	Values of Loan required
1	630.7	1,311.2	1,941.9	300	1,641.9
2	687.0	2,459.2	3,146.2	600	2,546.2
3	538.0	2,995.5	3,533.5	900	2,633.5
4	489.0	2,692.6	3,181.6	1,200	2,981.6
5	489.0	4,119.2	4,608.2	1,500	3,108.2
6	73.0	4,382.8	4,455.8	1,500	2,956.0
7	6.0	4,439.8	4,445.8	1,500	2,956.0
8	-	4,471.8	4,471.8	1,500	2,972.0
9	-	4,548.8	4,548.8	1,500	3,049.0
10	-	4,634.8	4,634.8	1,500	3,135.0
11	33.0	4,796.8	4,829.8	1,500	3,330.0
12	32.0	4,534.8	4,566.8	1,500	3,067.0
13	14.0	4,752.8	4,566.8	1,500	3,267.0
14	5.0	4,785.8	4,790.8	1,500	3,291.0
15	33.0	4,769.8	4,802.8	1,500	3,303.0
16	68.0	4,618.8	4,686.8	1,500	3,187.0
17	41.0	4,619.8	4,660.8	1,500	3,161.0
18	39.0	4,375.8	4,414.8	1,500	2,915.0
19	39.0	4,164.8	4,203.8	1,500	2,704.0
20	39.0	4,167.8	4,206.8	1,500	2,597.0
21-30	3.0	33,126.0	33,129.0	15,000	18,129.0
	3,258.7	114,768.7	118,027.4	28,800	89,222.4

Note : These computations are based on the assumptions that the government will bear 30% of the costs of soil conservation works, all the costs of soil survey, existing services and the soil conservation maintenance unit. Farmers are assumed to have the ability to cover the expenses of production at its present level.

APPENDIX TABLE 43.5.

FOREIGN CREDIT REQUIREMENTS

(JD'000)

Year	Capital Cost borne by the government	Operational cost borne by the government	Capital Costs borne by the government	Operational Costs borne by the farmers	Total
1	283.3	293.8	631.0	477.0	1,685.1
2	178.3	276.8	687.0	876.0	2,018.1
3	178.3	275.5	538.0	897.0	1,888.8
4	178.3	244.4	489.0	416.0	1,327.7
5	178.3	214.8	489.0	971.0	1,853.1
Total	996.5	1,305.3	2,834.0	3,637.0	8,772.8

APPENDIX TABLE 44.5.

PHASED LOAN PROGRAMME .

(JD'000)

Year	Loan	Annual Instal-ment	Interest	Interest + Instalment	Present Value of Interest (30%)	Present Value of Interest (40%)	Present Value of Interest (20%)
1	1,700	-	-	-	-	-	-
2	2,000	-	68	68	40	34	47
3	2,000	-	148	148	67	54	86
4	1,300	-	228	228	80	59	110
5	2,000	-	280	280	75	52	113
6	-	900	360	1,260	64	168	422
7	-	900	324	1,124	179	107	314
8	-	900	288	1,188	146	81	277
9	-	900	252	1,152	108	55	223
10	-	900	206	1,116	81	39	181
11	-	900	180	1,080	60	37	146
12	-	900	144	1,044	45	19	117
13	-	900	108	1,008	33	13	94
14	-	900	72	972	24	9	76
15	-	900	36	936	19	6	61
Total	9,000	9,000	2,704	11,704	1,021	723	2,267

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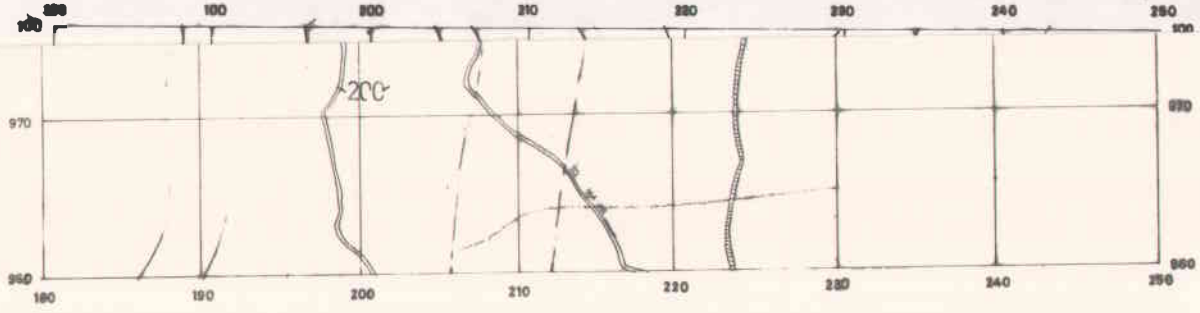
THE ARAB ORGANIZATION FOR AGRICULTURAL DEVELOPMENT

KHARTOUM

KARAK, TAFILA, AND SHAUBAK
PROJECT AREAS



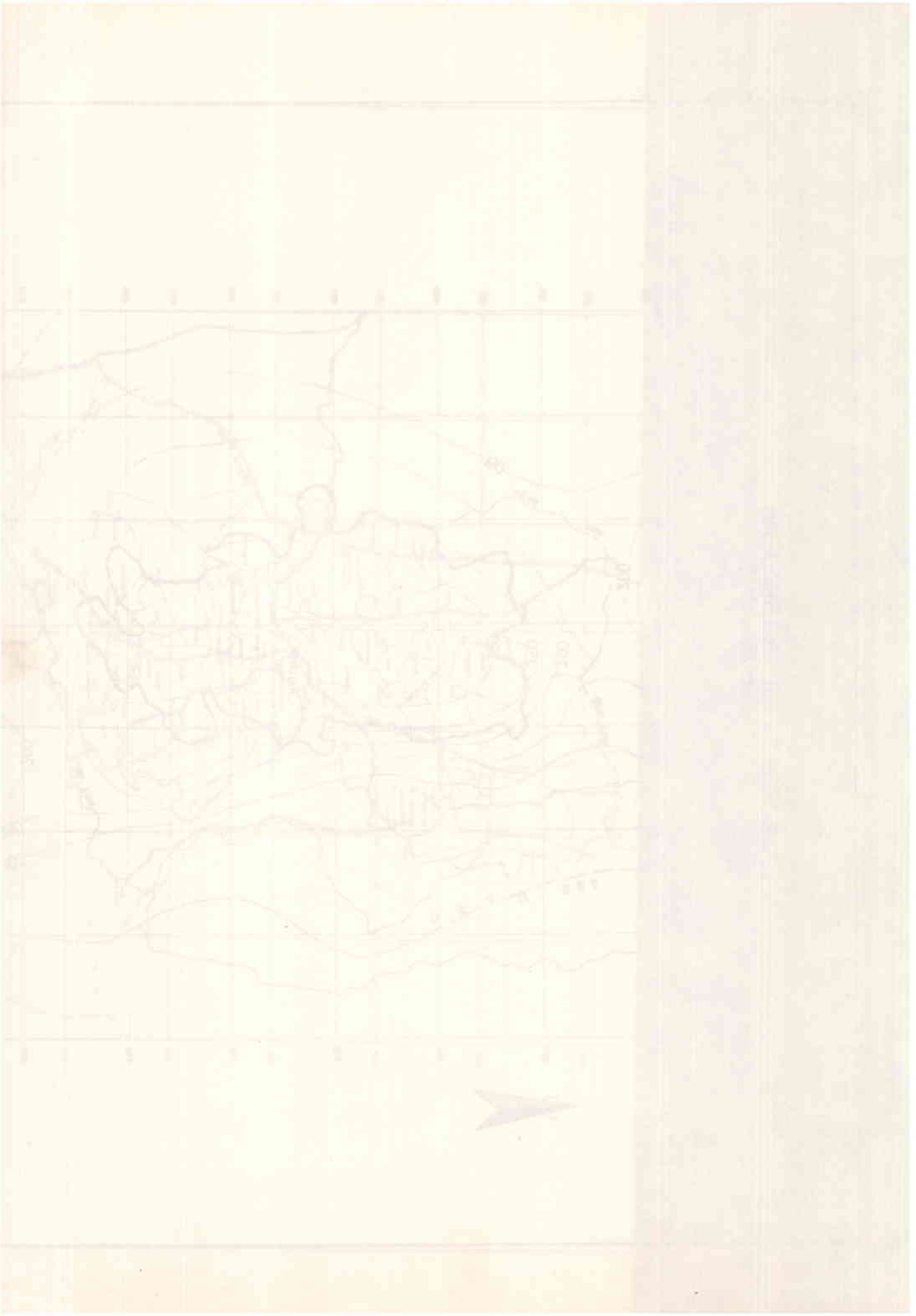
SCALE 1:250,000

REFERENCE

- Towns
- Villages
- Railway & Sta
- Main Roads
- International Bdy
- Governorate Bdy
- District Bdy
- Sub District Bdy
- Nahiya Bdy
- Village Bdy
- Project Bdy
- Rainfall zone

FIG 1/2

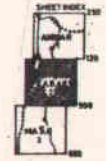
THE HASHEMITE KINGDOM OF JORDAN
THE MINISTRY OF AGRICULTURE
SOIL SURVEY AND LAND CLASSIFICATION PROJECT
DRAUGHTSMAN FADEL AWE[illegible]OUGAHA



MAP SHOWING WATER WAYS IN KARAK, TAFILA, SHAUBAK DISTRICTS

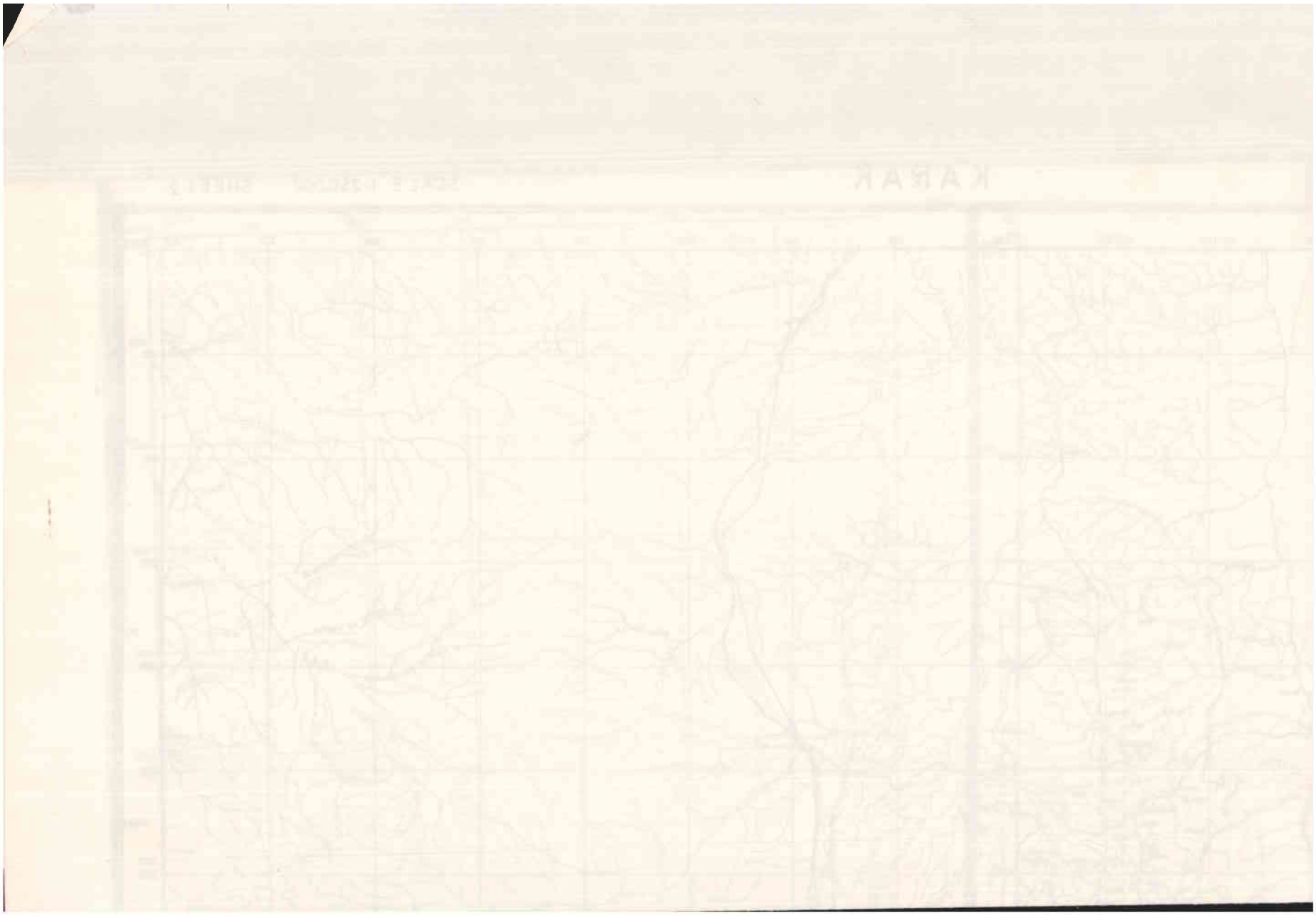
MAP LEGEND

WATER WAYS
RAILWAY
MAIN ROAD
HIGH WAY
QA (MUDFLAT)
TOWN, VILLAGE
INTERNATIONAL BOUNDARY :



THE HASHEMITE KINGDOM OF THE JORDAN
THE MINISTRY OF AGRICULTURE
SOIL SURVEY AND LAND CLASSIFICATION PROJECT
DRAFTSMAN : NAIM EL-DUGHEILI

1:250,000



AREAS WITH POTENTIAL FOR AGRICULTURAL DEVELOPMENT IN KARAK DISTRICT
BETWEEN W. MUJIB AND W. HASSA