ANNEX–E

SOIL AND AGRICULTURE

ANNEX - E

SOIL AND AGRICULTURE

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ANNEX-E SOIL AND AGRICULTURE

E.1 INTRODUCTION

The studies on soil and agriculture were carried out to assess the potential land productivity in the study area and to clarify the present agricultural conditions, as a basis for formulating future agriculture development plan. The data and information on the said subjects were obtained mainly from the following government offices concerned.

1) Bureau of Statistics, Planning and Development Department, Sindh,
2) Federal Bureau of Statistic, Karachi Office,
3) Department of Agriculture, Sindh,
4) Assistant Director Agriculture Office, Karachi,
5) Revenue Department, Sindh,
6) Horticulture Research Institute, Mirpurkhas,
7) Directorate of Agricultural Research Institute, Tandojam, and
8) Assistant Director Livestock, Karachi.

Farmers' interview survey was also carried out for 88 farmers selected at random in the study area so as to get practical information on present agricultural activities, cropping systems and constraints.

E.2 PRESENT CONDITION OF THE STUDY AREA

E.2.1 Administrative Boundary

The study area is located in the east of Karachi city, Karachi East District, Sindh Province. Karachi East District is administratively composed of seven (7) Union Councils and 60 Dehs. Out of them, administrative district of the study area covers four (4) Union Councils and 15 Dehs with an aggregated gross area of about 242.3 km^2. Administrative divisions are illustrated on Fig. E.2-1, and the respective Dehs are as follows:

Union Council		Name of Dehs
Darsano Chano	:	Bail, Kathore, Amilano, Khadeji, Chuhar and Kotero
Kankar	:	Bazar, Darsano Chano, Kharkharo and Malh
Laundhi	:	Kharkhar, Sanhro, Laundhi and Khanto
Thano	:	Thano

Data on present population in the study area is not available, since the population census has not been made since 1981. Assuming the population increases with an annual growth rate of 5.3%, which was recorded during 1971 to 1981 in Karachi East District, the present population in the study area is estimated at 90,300. The results are summarized in Table E.2.1. Population density is 373 persons/km^2. Total household is estimated at 16,200 and average household size is 5.6 persons. The number of farmers in the study area is estimated at about 700 and their average farm size is 8.8 ha.

E.2.2 Climate

The climate in the study area is characterized by the distinct summer and winter seasons. The summer season extends from April to September and the winter season during the remaining of the year. The mean annual rainfall in the project area is about 220 mm, of which some 80% occurs from June to September in the summer season. The amount of rainfall varies much year by year, for example annual rainfall records of recent 10 years show the range from 0 mm to 381 mm. In 1987, in particular, no rainfall was recorded throughout the year. On the other hand, potential evapotranspiration shows around 2,100 mm, which exceeds the amount of average annual rainfall. The annual mean temperature is 26.1°C, ranging from the maximum monthly mean of 31.7°C in June to the minimum of 18.3°C in January. Mean sunshine hour is as short as 4.7 hours/day in June and July, while the other months are rather long ranging from 7.7 to 8.5 hours/day. General climatic characteristics are summarized in Table E.2.2 and illustrated in Fig. E.2-2.

E.2.3 Soils and Land Capability

E.2.3.1 Soils and Landform

The Soil Survey of Pakistan was carried out in the WAPDA study area with a total extent of 29,210 ha which covers the flood plains formed by the Malir river and its surrounding highland. According to the previous study and field surveys, a high coincidence was recognized between distribution patterns of major soils and landforms. The landforms were classified into four (4) units for which seven (7) soil associations were identified in Table E.2.3, and summarized below:

Landform	Geological Era	Soil Association	Extent (ha)
1. Sub-recent flood plain	Quaternary	Mehab	6,460
2. Old piedmont plain less eroded	Late Pleistocene	Iddu, Mauripur and Mindiari	11,560
3. Old dissected piedmont plain	Late Pleistocene	Laundhi and Pipri	8,580
4. Very old dissected gravelly piedmont terrace	Middle Pleistocene	Monze	2,610
Total			29,210

As discussed in ANNEXes-D and G, the potential irrigation area is confined to the area, where the phreatic aquifer exists along a narrow strip of the Malir river. The project area is mainly located on sub-recent flood plains. This unit occurs on narrow river banks formed along the Malir river. Topography is generally level to nearly level. Soils in the project area are classified into Mehab Association which can be characterized by fine silty to sandy textured topsoils with some gravel content underlain by sand at 100 cm or deeper. Soil fertility is rather higher than one of the other landforms. Calcium carbonate ($CaCO_3$) content changes layer to layer. Electrical conductivity (EC) of saturation extract ranges from 0.8 to 8.0 mmho/cm, which are classified into non-saline to strongly saline classes. In cases, soils show non-saline to very slightly saline characteristics in surface soils, while moderately saline in subsoils. Soil pH ranges from 7.9 to 8.4 throughout profiles indicating slightly alkaline. There is no severe alkalinity hazard in the project area except for some crops, e.g. vegetables, with high susceptibility to saline soils.

Old (late Pleistocene) piedmont plains occur in a lower position than the old dissected gravelly piedmont plains, and are seen in the northern and southern part of the study area. This landform has been formed as a result of the deposition of the gravelly materials, brought down by the numerous intermittent streams, the gravelly load being retained in the uplands of the old dissected gravelly piedmont plains. The relief is level to nearly level. The soils are homogenized loams, clay loams and fine sandy loams, and are strongly calcareous. The depth

of homogenization ranges from 10 cm to more than 100 cm. This landform consists of Iddu, Mauripur and Mindiari Associations.

Old (late Pleistocene) dissected piedmont plains are seen higher land of the study area. The surface is level to gently sloping and is well marked by its elevated position and the presence of gullies. The numerous small and big shallow intermittent streams with low gradients have formed very deep gullies. The gravelly load is being retained on the surface. The soils of this plain are massive to very weak coarse subangular blocky, gravelly or very gravelly loam, clay loam or sandy loam. They are strongly calcareous with few to common lime aggregation at lower depth of about 100 cm or below. This landform consists of Laundhi and Pipri Associations.

Very old (middle Pleistocene) dissected gravelly piedmont terraces are the remnants of middle Pleistocene deposits of colluvial debris. This type of landform has emerged as a result of small scale tilting due to folding and faulting of the rock strata. The erosion taken place sub-recently has formed deeply incised "V" shaped gullies filled with colluvial debris. This unit occupies the highest position in the study area, next to the rock lands. Many stones and gravel lie on the surface. The soils of this unit are thin and shallow, very gravelly loam and silt loam. They are strongly calcareous and have many powdery lime in the lower profile. This landform consists of Monze Association.

E.2.3.2 Land Capability

Land capability was assessed for the soils of the WAPDA area in order to classify the suitability of soils for general agricultural purposes including grazing and forestation. Land capability was classified into four (4) as presented in Table E.2.4 and summarized as follows:

Land Capability Class	Area (ha)	(%)
Class I	6,210	21
Class II	9,570	33
Class III	11,190	38
Class IV	2,240	8
Total	29,210	100

Source : Feasibility report, WAPDA in 1979

Class I soils are no or minor limitation for crop production, and have the widest range of agricultural use. These soils are used for variant crop production such as fruit and vegetables with very high yield throughout the year. According to present land use survey, most of these soils are utilized for orchard and upland fields in the Study area.

Class II soils are mostly under rainfed cropping at present. This soils have high potential for irrigation agriculture with minor limitations for crop production throughout the

year or moderate limitations for part of the year or narrow range of suitable crops than the class I soils. Present land use is restricted to torrent water cropping mainly sorghum, maize and millets and with little poor grazing.

Class III and IV soils do not have a potential for agriculture due to various factors. Most of this area is barren with scanty vegetation of shrub and bushes and used only for very poor grazing.

Total arable land in the WAPDA survey area, from the above, is estimated at about 15,800 ha. This area may be large enough for future agriculture development through utilizing groundwater resource, considering the present cultivated area of 2,700 ha as discussed in Section E.2.4. Most of the soils under Mehab Association were classified into Class I. By introducing irrigation and modern crop management techniques, high agricultural productivity can be expected in Class I.

E.2.4 Land Use

The land use survey was carried out in the study area based on the topographic maps with scales of 1/50,000 and 1/16,000 as well as the field investigations. The present land use pattern is closely related to topographic condition, soil condition and availability of irrigation water. The land use is classified into five (5) categories i.e., (a) orchard field, (b) irrigated upland field, (c) rainfed upland field, (d) village and (e) uncultivated land.

The orchard field and irrigated upland field extend over the alluvial plains where the soil condition is good and groundwater can easily be extracted. The rainfed upland fields are scattered in the hilly and sub-hilly lands where groundwater is not available. Villages are also scattered in the alluvial plains adjacent to the irrigated upland field. Uncultivated land consists of roads, rivers, and unutilized land in the hilly and sub-hilly area. Extensive livestock grazing is practised in the hilly area.

The irrigated fields have been developed to possible maximum extent depending on availability of groundwater in the Malir river basin. In resent years, however, irrigated field has decreased due to less available irrigation water. It was ascertained through the field survey that the groundwater table in the study area has been lowered, that many matured mango trees are dying, and that fallow land area has increased. Present land use in the study area is shown in Table E.2.5 and Fig. E.2-3. Total agricultural land fell by about 80% over the period from 1978 to 1987/88, as summarized below:

Land Category	WAPDA Study Area 1978*1		Study Area 1988/89*2	
	(ha)	(%)	(ha)	(%)
Agricultural Land	4,070	13.9	3,220	13.3
- Orchard field (irrigated)	1,380	(4.7)	1,200	(5.0)
- Upland field (irrigated)	2,690	(9.2)	1,540	(6.3)
- Upland field (rain-fed)	(-)		480	(2.0)
Fallow Land	1,590	5.4	2,920	12.1
Non Agricultural Land				
- Villages, hills, rivers and others	23,550	80.7	18,090	74.6
Total	29,210	100	24,230	100

Source: *1; Ref. 01
*2; Estimate based on the data from East Karachi Revenue Office and Bureau of Statistics, Sindh.

E.2.5 Agricultural Production

E.2.5.1 General

The agriculture of the study area is largely concentrated on the production of high value vegetable, fruit and fodder crops, produced under relatively intensive conditions, to supply the Karachi city market. There is little production of staple grain food crops either for subsistence or sale. Traditional livestock production is largely confined to satisfying domestic requirements for milk and poultry products. In recent years a number of small and medium scale intensive poultry units have been established, often by persons from outside the area, to supply the Karachi market. Feed for these units is obtained from Karachi, or elsewhere outside the Study area.

The cropped area has fallen over the last decade so that with only limited improvements in yields overall production in the study area has declined substantially. This is attributable to shortage of water but, also, to other constraints including inadequate supporting services for producers.

Open wells are the only source of water for irrigation in the Study area. There are currently 516 production dug/tube in the study area as described in details in ANNEX-G. The underlying water table has been falling as a result of over-exploitation over the past two decades or more. The resultant shortage of water has led to the fall in cropped area, which is likely to continue to decline unless steps are taken to remedy the situation. Water supply is discussed in detail in ANNEXes-D and G.

E.2.5.2 Cropped Area and Cropping Pattern

The crop year runs from May to end April of the following year with two seasons. The Kharif (summer or monsoon season) runs from May to early September. During this season

which is relatively hot the area receives about 190 mm of rain. During the Rabi (winter season), from September to April, temperatures are relatively cool but there is negligible rainfall. The Kharif is the main crop season when, subject to water availability, the maximum area of irrigable land is cropped. A lesser area is cropped in the winter season.

In the Karachi "green belt", orchard crops are harvested during the summer season; vegetables are grown in both seasons with a preponderance of temperate type vegetables in the cooler winter season. The relatively warm climate of lower Sindh extends the season (at both ends) for a number of crops which affords producers an advantage over those to the north of the country.

The WPADA study estimated the cropped area in 1978, within the Malir basin study area, at some 5,960 ha of which 4,070 ha was in the summer season and 1,880 ha in the winter. Based on an estimated farm area of 5,660 ha in 1978, and allowing for an orchard area of 1,380 ha in both seasons, the cropping intensity was estimated at 1.46. Water constraints prevented the full utilization of the farm area for crops even in the summer season.

The cropped area has fallen over the past decade from 5,960 ha in 1978 to some 3,730 ha in 1987/88. Of the latter total some 3,220 ha was cropped in the summer season and 490 ha in the winter, some 1,200 ha are under permanent orchard fruit crops in both seasons. The crop rotation in 1978 and 1988 included fodder, vegetable, and fruit crops. The cropped area and major crops grown in 1978 and 1988 are shown in the following table and are given in detail in Tables F.7 and F.8. Total cropped area fell by 63% over the period 1978 to 1988, with a fall of 21% in the summer season and 73% in the winter season (when the orchard fruit crop is excluded). Crops grown in the study area are also grown, on a larger scale, elsewhere in Lower Sindh and many are grown in Upper Sindh and other Provinces to the north.

Unit: ha

Crop	WAPDA Study Area 1971/72 - 1975/76*1	JICA Study Area 1987/88 - 1988/89*2
Summer season		
Fodder	590	490
Vegetables	1,920	1,530
Fruit	1,380	1,200
Sub-total	4,070	3,220
Winter season		
Fodder	370	80
Vegetables	1,510	430
Fruit	-	-
Sub-total	1,880	510
Total	5,960	3,730
(cropping intensity)	(1.46)	(1.16)

Source: *1: WAPDA Report (1979)
*2: Estimate based on the data from East Karachi Revenue Office and Bureau of Statistics, Sindh.

The principal features of vegetable production over the decade are, therefore (a) an overall decline in area both absolutely and proportionately with the greatest decline in the Rabi season; (b) an increase in the area under the major crop, tomatoes, and a major increase in its relative importance ; and, probably, (c) the greater relative importance attached to a range of other important crops including in particular, gourds, melons, and cauliflower. Available comparative data for 1978 and 1988 are given in end Table E.2.6 and data for all vegetable and fruit crops for 1988 in Table E.2.7.

Various kinds of vegetables, fruit and fodder crops are planted in the study area. Main crops cultivated in the area are summarized below:

Vegetables :		
Solanaceous	:	Tomato, eggplant and chilli,
Cucurbits	:	Cucumber, bottle gourd, bitter gourd, sponge gourd, melon,
Cole crops	:	Cauliflower, spinach, cabbage,
Root crops	:	Carrot, turnip, radish, beet root
Legumes	:	Peas, mung bean, cluster bean, cowpea, and
Minor vegetables	:	Coriander, Indian squash, lady's finger, mint, fenugreek, dolicus lablab, meha, etc.
Fruit	:	Guava, mango, papaya, custard apple, coconut, chikoo, dates palm, banana, nuts, etc.
Fodder crops	:	Sorghum, maize, millet, lucerne,berseem etc.

The vegetables are cultivated twice a year, the summer and winter seasons, in the study area provided that irrigation water is available. Farmers start cultivation generally in the summer season of June to August when rain moists soils. Since rainfall is not sufficient to grow crops, irrigation utilizing groundwater is a common practice. In the winter season, crops are sown in February and March. Typical cropping calender in the study area at present is summarized as follows:

Crops	Summer Season		Winter Season	
	(Sowing)	(Harvesting)	(Sowing)	(Harvesting)
Fodder Crops :				
Sorghum	July/Aug.	Oct./Nov.	-	-
Maize	June/Aug.	Sep./Nov.	Feb./Mar.	May/June
Lucerne	Sep./Oct.	(all the year round)	-	(all the year round)
Vegetables :				
Tomato	July/Oct.	Oct./Jan	-	-
Eggplant	July/Oct.	Sep./Mar.	Feb./Mar.	Apr./May
Chilli	July/Oct.	Oct./Dec.	Mar./Apr.	May/June
Gourds	July/Oct.	Sep./Dec.	Feb./Mar.	May/June
Cauliflower	June/Oct.	Oct./Feb.	-	-
Spinach	June/Oct.	Aug./Dec.	Feb./Mar.	May/June
Carrot	Aug./Sep.	Nov./Mar.	Feb./Mar.	May/June
Radish	Aug./Sep.	Nov./Feb	Feb./Mar.	May/June
Pea, Beans	Aug./Oct.	Nov./Mar.	Feb./Mar.	May/June
Fruit Crops:		Harvesting Period		
Mango		March to June		
Guava		October to February		
Coconut		February to March		
Chikoo		March to May		
Banana		all year round		

The cropped area and present cropping pattern in the study area is illustrated in Figs. E.2-4 and E.2-5.

E.2.5.3 *Present Farming Practices*

The study area is the most popularized in cultivation of fodder,vegetable, and fruit crops with traditional farming. Cultivation methods like sowing/transplanting time, density, fertilization and irrigation practises are almost uniform all over the irrigated field in the study area.

(1) Seedbed Preparation

Plowing is basic and important work for the cultivation of all crops, which helps in easy planting and sowing with increase aeration, water holding capacity and make soil structure into soft. Land preparation in the study area is done by tractor, ox and manpower. Seed bed preparation is more or less the same for cultivation of fodder and vegetable.

(2) Farm Inputs Application

Almost all the growers applied Farmyard Manure (FYM) at a rate of about 3 tons/ha and Urea only after seeding or planting. In the study area, only a few progressive farmers applied Diammonium Phosphate (DAP) fertilizer at the time of seed bed preparation in addition to FYM. Potassium is never applied even by the progressive farmers. Nitrogen is applied for lucern in a form of urea at a rate of 75 kg/ha after every cutting. In respect of sorghum and maize only one cutting is made. Maize fodder is fertilized after one month of sowing at the rate of 75 kg/ha, whereas in case of sorghum fertilizer is not applied.

Farmers are almost unknown about the varieties of fodder, vegetable and fruit crops. They grow what ever they received the seed. Seed rates are used more or less the same as recommended seed rates by the Agricultural Extension office. Seeds of gourd and bottle gourds are low quantity, while seed of carrot is high quantity.

Vegetables and fruit are infested by some insects and diseases attack. Pest scenting in the proper scale is still unknown to the farmers and have no idea of the significance of this aspect of work. The farmers perform spraying work only one or two times during entire growth period, but sometime spraying is not done against insects attack and also in proper way. Only a few insecticides like BHC powder, Somicidon and Roger are used in the study area, which are obtained from local dealers. These farm inputs are given in Table E.2.8.

(3) Sowing/Planting

Most vegetables are cultivated on flat bed and ridge. Tomato, eggplant, chilli, cauliflower, etc. are grown in transplanting method, while lady's finger, sponge gourd, bottle gourd, spinach, carrot, radish, turnip, peas, etc are sown by direct sowing method. Nursery is usually prepared for transplanting crops. By direct sowing method, the seed is dibbled/broadcasted on the ridges/flat bed. Seeding/planting is done in the following spaces.

Crops	Distance between Row to Row	Distance between Plant to Plant
Transplanting Method		
Tomato	45 - 60 cm	40 - 50 cm
Eggplant	45 - 60 cm	40 - 50 cm
Chilli	45 - 60 cm	40 - 50 cm
Cauliflower	45 - 60 cm	40 - 50 cm
Direct Sowing Method		
Lady's finger	50 - 70 cm	30 - 40 cm
Bitter gourd	120 - 150 cm	40 - 50 cm
Bottle gourd	200 - 250 cm	40 - 50 cm
Sponge gourd	200 - 250 cm	40 - 50 cm
Carrot	50 - 70 cm	Spread over the ridges
Radish	50 - 70 cm	15 - 20 cm
Turnip	50 - 70 cm	15 - 20 cm
Spinach	Broadcast on small flat beds	

In respect of fruit tree, the layout is prepared accordingly. Planting of different fruit are carried out in square method, and spacings are maintained in the following ways:

Fruit Tree		Spacing	Density
Guava	:	about 10 m x 10 m	80 - 100 plant/ha
Mango	:	about 10 m x 10 m	80 - 100 plant/ha
Chikoo	:	about 10 m x 10 m	80 - 100 plant/ha
Coconut:	:	about 7 m x 7 m	150 - 200 plant/ha
Papaya	:	about 3 m x 3 m	1,000 - 1,500 plant/ha

The nursery of the fruit like guava, papaya and custard apple is mostly raised by the farmers in their own fields, and the nursery of chikoo and coconut is also obtained from different Karachi nursery areas. Planting is done in the month of February - March. Guava, chikoo and custard apple give fruit after 3 years of planting. Fruiting of mango and coconut is obtained after 5 years of planting, whereas in respect of papaya fruit is obtained after one year of planting.

(4) Machinery and Labour Requirement

In the study area, only a few farmers have their own tractor, while others hire the tractor. Tractors are mostly attached with cultivator, ridger, furrow maker and disc plow along with local wooden made leveller/clod crasher. Tractor is easily available all the time when it is required. Tractor charges for different operations are higher in opinion of the farmers, and given as below:

Operations	Charge
For plowing	Rs. 70-80/hour
For harrowing	Rs. 60-70/hour
For levelling	Rs. 60-70/hour

Manual labour is easily available and is cheep at the rate of Rs. 50/day as compared to middle and upper Sindh. Manpower is used for final seedbed preparation, sowing/planting, irrigation, insecticide/pesticide application, fertilization, over look (chowkidar), harvesting/ picking, packing/weeding interculture. Manpower is kept for monthly basis as well as on hire basis, but it is observed that farmers mostly carried out their different field operations by hired labours even tenant also. Women and children sometime work for harvesting/picking, weeding, and packing on daily wages at the rate of Rs 15-20 and Rs. 10 for 5 hours respectively. Machinery and labour requirement are given in Table E.2.9.

(5) Water Management

In case of vegetables, the irrigation is given immediately after sowing in dry conditions. First irrigation is given quickly till seed is germinated, while subsequent irrigations are given after every 7 - 15 days intervals depend upon weather conditions. Vegetables are grown sometimes after giving pre-irrigation, and first irrigation is given after 15 - 20 days, and subsequent irrigations are given with intervals of 7 - 15 days. Vegetables are transplanted in standing water, and first irrigation is given quickly till the plant survive, whereas subsequent irrigations are given after every 15 days intervals.

Maize is sown after giving pre-irrigation, and irrigations are given every 20 - 25 days. Sorghum is cultivated mainly in rainfed field in which no artificial irrigation is applied. In case of lucerns, first irrigation is given quickly till seed is germinated, and subsequent irrigations are given after every cuttings.

In respect of newly planted fruit crops, the plants are irrigated quickly, whereas subsequent irrigations are given according to their requirements. Irrigation is given by permanent employed labour or sometimes by daily wages labour.

(6) Weeding/Interculture

The weeding and interculture for vegetables are done by permanent labours as well as by hired labour to be used a Khurpi/Spade. Two to three times weeding is done during entire growth period. No herbicides is used to control weeds. In case of fruit, weeding is done by manpower as well as by tractor plowing. No weeding is done in fodder crops.

(7) Harvesting and Others

All these operations are carried out by manpower. In respect of fruit, it is given on lease at fruiting time for only one year, or some time for 2 - 3 years in that case lessee himself arrange for harvesting, picking/packing/loading/marketing. Fodder is sold to the local traders who themselves arrange all these operations. While in respect of vegetables, farmers themselves arrange all these works. Some farmers take their farm product by trucks or camel carts to the wholesale dealers who sell them to the middle man or big traders.

E.2.5.4 Crop Yields and Production

An estimation of present crop yield and production was made on the major crops based on the data of the Karachi East Revenue office, the Malir Agriculture office and the Bureau of Statistic, Sindh. Aside from data collection, related investigation such as the interview survey to farmers and field extension worker/Agriculture officers were conducted so as to confirm the collected data with more concrete informations.

Primary data on yields for fodder, vegetable and fruit crops in the study area based on actual measurement are not available. Cropped area, production and yield estimations are prepared on an annual basis for Karachi District which includes the study area by the Bureau of Statistic, Planning and Development Department, Sindh. Such estimates are generally made by comparing performances in the present season with those of the past season or previous seasons and at best offer an order of magnitude. It is considered that production conditions in the study area are not dissimilar to those elsewhere in the District.

Most of crop yields in Karachi District averaged over two years 1986/87 - 1987/88 have not reached a sufficient high level of comparable yields for Sindh Province as a whole due to poor soil fertility, shortage of irrigation water, low level of farm inputs and traditional farming practices. In the absence of specific and reliable information for the study area, present unit yields of main crops are estimated based on the Agricultural Statistic Data of Karachi District on two years average (1986/87 - 1987/88), and shown in Table E.2.10. The unit yields of main crops are summarized as below:

Unit: ton/ha

Crops	Sindh Province	Karachi District	Crops	Sindh Province	Karachi District
Vegetables :			Fodder Crops :		
Tomato	5.0	3.3	Sorghum	-	11.5
Eggplant	6.8	4.9	Maize	-	10.6
Chilli	3.5	1.0	Lucerne	-	13.9
Sponge Gourd	6.4	3.1	Fruit :		
Bottle Gourd	5.4	4.7	Mango	7.7	6.1
Cauliflower	5.8	13.3	Guava	6.0	3.8
Spinach	4.2	2.6	Coconut	-	2.7
Carrot	9.9	5.4	Chikoo	-	2.3
Radish	7.8	4.0	Papaya	-	7.3
Peas	4.1	2.6			

Source : Agricultural Statistic of Sindh, 1989

Applying the above averaged yields in Karachi district, production of main crops in the study area for 1988/89 is estimated as shown in Table E.2.11, and summarized below:

Crop	Cropped Area (ha)	Production (ton)	Unit Yield (ton/ha)
1. Fodder	570	6,910	12.1
2. Vegetables	1,940	8,560	4.4
3. Fruit	1,200	5,980	5.0
4. Others	20	50	5.0
5. Total	3,730	21,500	-

E.2.5.5 Livestock

The livestock population of the study area in 1989 is estimated at 4,800 cattle, 15,650 buffalo, 9,490 sheep and goats, and 1,130 other stock (mainly donkeys, mules and horses), and given in Table E.2.12. Livestock are seldom used in crop cultivation, however it is mainly replaced by hired tractors. Animals, mainly donkeys, are used for carting farm inputs and harvested crop within the area. Cattle and buffalo are mainly kept for dairying and this accounts for the rather large proportion of cropped area which is allocated to fodder. Goats are kept for meat and milk.

Most farmers interviewed stated that they maintained one or two cows or buffalo to meet their domestic requirements for milk. With only 700 farmers in the study area it is likely, therefore, that the majority of large stock is kept in dairy units at the edge of the study area in urban zones immediately adjoining Karachi. This milk production does not impact economically upon the majority of farmers or inhabitants of the study area. Similarly several large intensive poultry production units are located in the study area but obtain commercial feed and other inputs from Karachi, and sell their produce into Karachi. They create some employment in the study area, but are mainly owned by Karachi residents.

E.3 AGRICULTURAL DEVELOPMENT PLAN

E.3.1 Agricultural Development Constraints

The Malir area has played an important role to Karachi city for a long time in supplying agricultural products such as vegetable, fruit, fodder crops, etc. and in supplying drinking water. Demand increase of vegetables and fruit started in accordance with rapid population increase of Karachi city. Such magnification of market encouraged the farmers to develop farm land and to exploit the groundwater for achieving higher agricultural products.

In recent years, water table has progressively declined due to overdraft of the groundwater and thereby severe shortage of both the irrigation and drinking water supply has taken place. It is feared presently that further drawdown of water table will result in sea water intrusion into the basin aquifer in the lower parts of the Malir river basin area

Crop production in the study area is reported to have been in decline for about one decade, whilst the population of the area has at least doubled. The major constraints to maintaining or increasing production are well-known to farmers in the area and are readily apparent to visitors. They can be summarized as follows:

a) Overall shortage of water in relation to the area of irrigable land and the farming population; this has resulted in continuing over-pumping and depletion of the aquifer; cropped area, production, crop income and employment have fallen by one half over the decade 1978 -1988.

b) Overall shortage of water is compounded by inefficient use and wastage of available water as a consequence of poor irrigation layouts, excessive distribution losses, poor land levelling, etc and lack of attention to these problems.

c) Competition for available water supplies between well-owners in the absence of any arrangement to share the sustainable water supply on an equitable basis; lack of a farmer/water user organization to provide a forum for discussion and agreement on groundwater extraction.

d) Wide variation in the size of holding, with an average of over 2 holdings per well; many holdings are too small in size to provide a minimum living for a family, which is compounded for 73% of farm operators who are either tenants or owner tenants whose gross income from tenanted land is halved by sharecropping; the potential and incentive for improvement is low for these categories of farmers.

e) Lack of crop packages and inadequate delivery systems including adaptive research, extension, farmer training, input supplies, selling points etc., restricts the feasibility of crop intensification.

f) Poor quality of seed, and short supply of improved varieties of vegetable seed; imported varieties are often not well suited to local conditions.

g) Unreliable electricity supplies for pumping and the application of a high fixed charge which, inter alia, would tend to encourage excessive pumping.

h) Lack of technical knowledge on the part of producers, seed rates, fertilizer rates, insecticide regimes, etc.,

i) High cost of informal credit generally extended by market traders and inability of all, but the largest land owners, to obtain institutional credit; this is attributed to actual procedural difficulties, in particular for tenants.

As a consequence of these constraints the cropped area is decreasing, technical knowledge and input use are low and poorly managed, so that yields are low by the standards of small farmers growing similar crops in other Districts of southern Sindh (Hyderabad, Thatta). The potential for a sustainable potentially high input/high output cropping system is not being exploited.

E.3.2 Basic Concept for Development

The project area enjoys, in many respects, a significant comparative advantage in the production of fruit and vegetables by virtue of its location in southern Sindh very close to the city of Karachi. These advantages include proximity to the country's largest market, low transport costs, the potential to respond to market changes at relatively short notices, an extended crop season, in relation to other supplying regions because of the warmer climate, and access to actual and potential suppliers. In order to exploit these advantages and ensure the future of fruit and vegetable production which is the single largest source of income and employment in the project area, the basic concept for future water resources and agricultural development plan in the Malir area should be formulated as follows:

1) To increase groundwater recharge by construction of dam(s),

2) To expand irrigation area to maximum extent through augmentation of artificial groundwater recharge,

3) To sustain groundwater resource through monitoring and management,

4) To supply vegetables and fruit to the great Karachi market,

5) To increase crop yields through introduction of intensive farming practices,

6) To improve socio-economic situation and to increase in employment opportunities in the area,

7) To maintain a green belt located near the greater Karachi city, and

8) To improve organization to ensure the above strategies.

E.3.3 Agricultural Development Plan

E.3.3.1 General

The objective of the project is to re-charge the phreatic aquifer and maintain a stable supply of water for irrigation, livestock and domestic purposes in the project area. The project would include the design and construction of a dam on the Mol river to store seasonal run-off during the monsoon a proportion of which currently drains to the sea. The stored water would be released so as to increase the re-charge to the aquifer which underlies the area. The operation and maintenance of the dam would be the responsibility of Department of Irrigation and Power, the Government of Sindh, The project would also support the establishment and operation of an adaptive research and demonstration farm which would develop methods designed to lay the basis for the intensification of crop production.

The direct operational benefits of the project are summarized as follows:

a) the continuing decline in the cropped area would be arrested and additional land, under command from existing wells, would be cropped,

b) production of existing crops would be rapidly increased prorate to area by existing farmers with increase of crop yields, and

c) incremental production would find a ready market in Karachi at prices which are profitable to producers.

The project offers substantial other benefits to the population of the area. The population is relatively large and density is relatively high for what is a predominantly rural area. There is considerable infrastructure in the area (roads, power supplies, schools, houses, etc). Without the project, there would be a continuing depletion of water supplies resulting in a reduction in agricultural and related employment.

The direct beneficiaries of the project would be the farm families numbering over 700, in the project area who operate small, medium and larger holdings and several thousand other households who would benefit from a secure long term supply of water for household and other purposes. The project would generate additional income and employment and augment the supply of fruit and vegetables to the nearby Karachi Market. The project area covers some 13,900 ha and its boundary has been determined by reference to the underlying aquifer which is the source of irrigation water. For the purpose of project preparation it is assumed that all are under command from wells supply sources in the project area.

However, in order to maximize long term benefits from the incremental supply of water it will be necessary to:

a) establish a mechanism to control the volume of water withdrawn:, and

b) develop supporting services to assist farmers to increase crop yields from their existing low average levels.

E.3.3.2 Proposed Land Use

The study area covers about 24,200 ha as discussed in Section E.2.4. The project area, to be benefited by the augmentation of groundwater recharge, is delineated based on the results of hydrogeological study which are described in detail in ANNEX-E, referring to the existence of the phriatic aquifer. The phreatic aquifer in the Malir river basin extends over on both sides of the river between the National Highway and the proposed Mol damsite. The present land use in the study area and project area is estimated in Tables E.2.5 and E.3.1, and summarized as below:

Land Category	Study Area		Project Area	
	(ha)	(%)	(ha)	(%)
Agricultural Land	3,220	13.3	2,700	18.7
- Orchard field (irrigated)	1,200	(5.0)	1,180	(8.5)
- Upland field (irrigated)	1,540	(6.3)	1,420	(10.2)
- Upland field (rain-fed)	480	(2.0)	100	(0.7)
Fallow Land	2,920	12.1	2,800	20.1
Non Agricultural Land				
- Villages, hills, rivers and others	18,090	74.6	8,400	61.2
Total	24,230	100	13,900	100

Remarks: The area is estimated based on the land use maps as shown in Fig. E.3-1.

In order to assess possible irrigation area within limited water resources in the basin, alternative case studies on water resources development are carried out and the details are described in ANNEX-D. Depending on the development plans, potential irrigation area varies from 4,000 ha to 4,800 ha, and finally based on the economic comparison of the development plans, possible irrigation area is decided to be 4,350 ha as discussed in ANNEX-H. In addition to the above, projection of drop of groundwater table was made. Based on the water balance study, irrigation area of a long-term average in future will be decreased down to 2,400 ha in future (see ANNEX-G).

The following table shows the present land use, and the future without the project and with the project:

Unit: ha

Description	Present (1989)	Without Project	With Project
1. Agricultural land	5,400	5,400	5,400
2. Upland fields	1,420	1,400	3,350
3. Orchard fields	1,180	1,000	1,000
4. Fallow area	2,800	3,000	1,050
5. Total cultivation area	2,600	2,400	4,350

E.3.3.3 Proposed Cropping Pattern

For formulation of future cropping pattern, the following basic principles for the selection of crops and cropping pattern under the project, are conceived:

a. The crops and cropping pattern create maximum benefits for the farmers as well as the nation as a whole,

b. The crops and cropping pattern make optimum utilization of water to be supplied by the project, and

c. The crops and cropping pattern should be practical and acceptable to the farmers.

(1) Selection of Crops

In due consideration of the basic principles described above, fodder,vegetable and fruit crops are selected in making a proposed cropping pattern as the major crops. Vegetables and fruit are the most profitable crops under present economic situations, among other crops including fodder and cereal crops. According to the field survey in the project area, various kind of crops were widely grown, and the farmers have long experience in fodder, vegetable and fruit crops cultivation and are likely to master the irrigated farming practices and to realize the maximum irrigation benefits under the project.

For the introduction of new crops in the proposed cropping pattern, the readily available data do not permit a reasonable level of accuracy in projecting profitability of the very wide range of crops grown in the project area. It is assumed that the present proportions of each kind of vegetables and fruit crops will remain broadly.

(2) Proposed Cropping Pattern

The climate in the project area, generally characterized by the summer and winter seasons having warm and relatively dry as well as sufficient sunshine hours, is very favorable for cultivation of fodder, vegetable and fruit crops throughout the year. No significant variation of yields for major crops is observed in the year-round cultivation

which is now being practiced by the farmers in the project area. Most of farm operations such as land preparation and sowing/planting will be started to fit the rainfall from June to September in the summer season, and February and March in the winter season. For vegetable cultivation, the crop rotation will be introduced to minimize crop damage of disease and nematode by continuous cropping.

In due consideration of above and the present cropping pattern, the proposed cropping calender for each crop is fixed as shown below:

Crops	Summer Season		Winter Season	
	(Sowing)	(Harvesting)	(Sowing)	(Harvesting)
Fodder Crops:				
Maize, others	June/Aug.	Sep./Nov.	Feb./Mar.	May/June
Lucerne	- perennial cropping -			
Vegetables:				
Tomato/ eggplant	July/Sep.	Oct./Jan		
Chilli			Jan./Apr.	Apr./Aug.
Sponge/ bottle gourd			Jan./Apr.	Apr./Aug.
Cauliflower/ spinach	July/Sep.	Oct./ Jan.		
Carrot/ radish	Aug./Oct.	Nov./Jan.		
Peas, others	Aug./Oct.	Nov./Jan.	Jan./Apr.	Apr./July
Fruit:	- perennial cropping -			

The proposed cropped area for each crop is estimated based on following conditions:

a. Production of fodder crop will be planted basically to meet home-consumption of livestock and to contribute to the farm economy with some marketable surplus. Cropped area in the summer season will be kept at present level.

b. Production of vegetables will be planned to meet the demand of Karachi market which will increase substantially due to growing population and urban development. Cropped area in the both seasons will increase in the maximum depending on water availability, and

c. Orchard fields will be kept at the present level except mango fields, because mango trees are so old and mango fields have decreased as rapidly for the last one decade.

The proposed cropping pattern is determined in consideration of profitability, peak water requirement, labour requirement, etc. referring to the cropping pattern in 1977 and proposal by WAPDA, and the present cropping pattern (1988/89) as discussed in Sub-Section E.2.5.2 (see Fig. E.2-4). The cropping patterns with- and without-project condition are formulated as shown in Figs. E.3-2 and E.3-3, and their cropped areas are also presented in Tables E.3.2, E.3.3 and E.3.4. The summary is presented in the following table:

Unit: ha

Crops	WAPDA Study*		JICA Study	
	Area in 1977	Proposed Project	Without Project	With Project
Summer season				
Fodder	590	700	150	150
Vegetables	2,100	2,280	1,250	3,200
Fruit	1,380	1,380	1,000	1,000
Sub-total	4,070	4,360	2,400	4,350
Winter season				
Fodder	370	450	40	50
Vegetables	1,520	1,740	290	2,100
Sub-total	1,890	2,190	330	2,150
Total	5,960	6,550	2,730	6,500
(cropping intensity)	(1.46)	(1.50)	(1.14)	(1.50)

Source: Ref. 01

In order to introduce the proposed cropping pattern into the project area successfully, it is vital to provide strong agricultural supporting services including training of both the agricultural officers for extension works and farmers.

E.3.3.4 Proposed Farming Practices

The project area is the most popularized in cultivation of fodder, vegetable and fruit crops with traditional farming under irrigation condition. The low production of these crops in the project area is mainly due to the lack of farming technique and knowledge about cultivation, soil management, crop protection, improved seeds for suitable high yielding/disease resistant strains and shortage of water.

It become essential to propose and design new farming practices such as sowing/planting, farm inputs, high yielding varieties and their crop protection measures under the project.

(1) Seedbed Preparation

Immediately after harvesting previous crops, the land should be plowed with a turning plow. Farmyard Manure (FYM) should be spread evenly at least one month before the planting operations.

Seven to ten days before planting, the field should be pre-irrigated, and be re-plowed lengthwise and then crosswise followed by planking. Three to five plowings and 2 - 3 plankings are essential for fine seed bed which is extremely critical to successful cultivation of vegetable/ fruit. For cultivation of fodder only two plowings followed by

planking are sufficient. It is also recommended to provide deep plowing with chisel plow/gobal plow after every 2 or 3 years, to bring lower soils upward and upper soils downward and finally to prepare fine seed bed with fertile surface.

(2) Farm inputs Application

Introduction of improved seeds is an important role in increasing crop yield. Not only variety but also quality of the seeds influence crop yields. Improved high yielding varieties are recommend as shown below:

Name of Crop	Varieties
Tomato	T-10, SR-II, Pome
Eggplant	Round Black, Black Beauty
Chilli	Cluster, Longi, Ghotki
Cauliflower	Mirpurkhas Moti, Cheen-ka-Moti
Radish	MPS Selection, Japani
Turnip	Red Purple white, Desi
Peas	Blue Bantam, Early Dwarf, Kelves
Maize	Akbar Neelam
Mango	Sindhri Langra Collector

Source : Horticulture Research Institute, Mirpurkhas

Nitrogenous, phosphorous and potassium have often been found to be deficient in the soils and consequently have to be supplied to the plant in a form of fertilizers. Fertilizers are classified organic and inorganic. Organic fertilizer is Farmyard Manure (FYM) and inorganic fertilizers are Nitrogen, Phosphorous and Potassium. Nitrogen gives dark green color to the plant, promotes rapid plant growth enhance quality of leaf and increases yields. Phosphorous stimulates early root formation, hastens maturity and stimulates flowering and aids seed formation. Potassium increases vigor and disease resistance of plants, improve quality of fruit and flowers, organic manures occupy a key position in the successful cultivation of all crops. Maintain organic matter/fertility of the soil is to be applied not only FYM, but also rotation cropping with legume crops.

Fertilizer application for root vegetables by broadcasting after plowing is recommended for farming practices. Fertilizers for fruit vegetable and leaf vegetable are applied between plant rows by mixing with compost to prevent running off (loss) of elements. Proposed amounts of seed, fertilizer and agro-chemicals are given in Tables E.3.5 and E.3.6.

(3) Sowing and Planting

There are two seedling techniques for the proposed farming. One is to prepare seedlings in a nursery bed, and thereafter, to transplant the seedlings in a main field. This practices will be applied for cultivation of fruit and some kinds of vegetables. The other farming technique is direct sowing in the main field. This technique will be applied to fodder crops and some kinds of vegetables.

In case of vegetable cultivation, kinder seedlings are to be grown first in small beds with shade roofing, and then, transplanted in a nursery bed with suitable space. Seedlings will be transplanted in main fields with the recommended space about 30 days after sowing. In direct sowing method, thinning and control of seedlings will be required after establishing the seedlings.

(4) Water Management

Due to shortage of water, crops are not irrigated properly. Farmers are mostly habitual to give more water unnecessary. In order to irrigate more field under limited available water, the farmers should adopt water management practices, i.e. when, how much and how to apply. For that purposes, training programme should be organized at farmer's level to cope them with better water management practices.

There are two methods of irrigation i.e., (a) furrow method, and (b) basin method. Transplanted vegetables would be irrigated by furrow irrigation method, while others may be irrigated by basin irrigation method. Fodder crops are irrigated by basin method. The fruit plants are irrigated by furrow irrigation method and/or drip method in future.

The first irrigation for vegetable and fruit crops should be given quickly with a little quantity till the seed is germinated and plants survive. While subsequent irrigations should be given according to their requirements. The first irrigation for lucern should be given quickly till seed is germinated, whereas subsequent irrigation may be applied according to the requirement.

(5) Plant Protection and Weeding

As for plant protection, intensive application of insecticides and fungicides is required for control and protection of the crops from the damage caused by insects, pests and diseases. At present, damage of crops caused by insects and diseases is not serious. Although the plant protection is not widely practiced yet, most of farmers are using local crop varieties which have a tolerance to diseases. However, when the high yielding varieties of crops are introduced, it will be necessary properly to apply agro-chemicals.

For application of agro-chemicals to fields, a knapsack type sprayer is planned to be used which will be easily managed by the farmers. Selection of the applicable agro-chemicals is made with reference to the presently marketed chemicals in the project area. Suitable dosage and type of agro-chemicals is estimated as shown in Table E.3.7.

Weed control is one of the essential practices in the proposed crop production programme. At present many herbicides have been developed for weeding purposes, and their efficiency is highly accepted particularly for saving labour. However, these agro-chemicals are harmful not only for human beings, but also to livestock production and the natural environment. The proposed practice for weeding will be, therefore, performed by the manual with the traditional instruments.

(6) Harvesting

Manual harvesting is planned, in consideration of the large capacity of labour force in and around the Malir area, and labour requirements are estimated in Table E.3.8.

E.3.3.5 Anticipated Crop Yield and Crop Production

In the without project condition, the future anticipated unit yields of crops are set as the same levels of the present unit yields which are estimated on the two years average of 1986/87 and 1987/88 in Karachi District. It is considered that the present constraints in shortage of water, traditional farming practices and poor agricultural supporting services remains unchanged.

After completion of the project, it is expected that the unit yields of crops would stabilize and increase on account of increasing of irrigation water by well and introduction of improved farming practices. However, a little data are available on the crop yields under full irrigated condition and proper fertilization in and around the project area. There are three data on unit yields for vegetables; (a) the crop guide prepared by the Government of Sindh's Agricultural Extension Department, (b) the experimental results of the Horticulture Research Institute (HRI), Mirpurkhas and (c) the agricultural statistic data of Hyderabad District. The crop guide sets out a range of recommended practices for the most important vegetables grown in the project area and gives a range of unit yields to be obtained. Crop yields in Hyderabad District show data in advanced crop cultivation area under full irrigation system in Sindh Province. These unit yields for selected crops are summarized as follows:

Unit: ton/ha

Crops	Crop Guide*1	HRI*2	Hyderabad*3
Tomato	5 - 10	23.2	6.0
Eggplant	5 - 10	19.1	7.8
Chilli	5 - 10	7.2	2.3
Sponge Gourd	10 - 15	22.2	9.8
Bottle Gourd	8 - 15	11.9	5.9
Cauliflower	13 - 18	23.1	9.7
Spinach	10 - 13	-	4.9
Carrot	10 - 13	14.2	10.1
Radish	18 - 20	16.8	11.0
Turnip	13 - 20	12.2	13.8
Peas	8 - 10	6.2	3.9

Sources: *1 Agricultural Extension Department, Sindh
*2 Horticulture Research Institute, Mirpurkhas
*3 Bureau of Statistics, Planning and Development, Sindh

The anticipated unit yields with project condition are estimated with reference to the above unit yield of crops and present crop yields of Hyderabad district in 1986/87 and 1987/88. The unit yields of cauliflower, coconut and papaya have already attained desirable level, so that the anticipated unit yields of these crops are set at slightly high level by proper water management and proposed farming practices. The target yields of other crops are projected at the nearly same level of present averaged crop yields in Hyderabad District. The anticipated unit yields under the future without and with project conditions are estimated in Tables E.3.9 and E.3.10, and summarized below:

Unit: ton/ha

Crops		Present	Without Project	With Project
Fodder:	Lucerne	13.9	13.9	26.0
	Maize	10.6	10.6	18.0
Vegetables:	Tomato	3.3	3.3	7.0
	Eggplant	4.9	4.9	9.0
	Chilli	1.0	1.0	2.5
	Sponge Gourd	3.1	3.1	11.0
	Bottle Gourd	4.7	4.7	8.0
	Cauliflower	13.3	13.3	16.0
	Spinach	2.6	2.6	6.0
	Carrot	5.4	5.4	11.0
	Radish	4.0	4.0	13.0
	Turnip	6.6	6.6	15.0
	Pea, Beans	2.6	2.6	5.0
Fruit:	Mango	6.1	6.1	9.0
	Guava	3.8	3.8	7.0
	Chikoo	2.3	2.3	3.0
	Coconut	2.7	2.7	4.0
	Papaya	7.3	7.3	8.5

In order to achieve the anticipated unit yields in the future under the with project condition, it is necessary that the farmers should be informed and trained on the improved farming practices supported by the agricultural extension service. The unit yields will increase gradually from the present level, and reach the target yields around the 5th year after completion of the project.

Based on the proposed cropping pattern, the cropped area, crop yields and total crop production under both "with project" and "without project" conditions are estimated in Tables E.3.11 and E.3.12, and summarized as follows:

Item	Without Project	With Project	Increment
1. Cultivation Area (ha)			
- Fodder crops	190	200	10
- Vegetables	1,540	5,300	3,760
- Fruit	1,000	1,000	-
Annual cropped area	2,730	6,500	3,770
2. Averaged Crop Yield (tons/ha)			
Fodder crops	12.3	22.0	9.7
Vegetables	4.5	8.8	4.3
Fruit	4.8	7.3	2.5
3. Production (tons)			
Fodder crops	2,340	4,400	2,056
Vegetables	6,960	46,646	39,690
Fruit	4,760	7,256	2,498
Total production	14,060	58,302	44,244

The annual fodder,vegetable and fruit production at full development stage would amount to 58,302 tons. The expected annual increment of fodder, vegetable and fruit production would be about 44,244 tons as shown in Table E.3.13.

E.4 RECOMMENDATIONS

E.4.1 General

In order to assure the successful implementation of the project, the following institutional development are recommended:

1. Legal regulation on further groundwater development,
2. Self-management on groundwater use by beneficiaries, and
3. Establishment of a demonstration farm for improved farming practice.

Agriculture support services including supply of seeds, supply of farm input, agricultural credit, research and extension, etc. should be strengthened.

E.4.2 Legal Regulation on Further Groundwater Development

In order to sustain steady groundwater supply, excessive exploitation of groundwater must be avoided. Until the safety amount of exploitable groundwater is determined, further groundwater development should be regulated. Such regulation will be effected legally.

E.4.3 Self-management on Groundwater Use by Beneficiaries

In order to maintain a proper groundwater level, pumping of groundwater must be controlled and regulated. For this, it is recommended that a water extraction management system be established.

Although water extraction management should ultimately be made by beneficiary farmers themselves, they seems not capable of doing such self-management at present. The farmers should firstly be trained to be aware of the groundwater volume to be extracted. This training should be made by an engineer in the Irrigation and Power Department, through some influential people like chairman of Union Council and/or chief of Deh.

As described in the ANNEX-H, a water management section will be established for the project in the Malir Project Office under the Irrigation and Power Department. This section will be responsible for groundwater extraction management, so as to ensure the sustainable development and proper utilization of groundwater. The functions of the water management section are to monitor the groundwater table and pumping record in the project area periodically and to establish a guideline on the water extraction capacity in each well.

This section will be established prior to the commencement of the dam construction. The series of monitoring works should be done with beneficiary farmers through the supervision of Chairmen and/or Chiefs of Union Council and/or Deh under the strong initiative by the Department of Irrigation and Power, so that the farmers could understood the importance

of monitoring works. In this period, the following should be made by the Department of Irrigation and Power:

1) Determination of the groundwater volume to be able to be extracted, and
2) Determination of the groundwater extraction plan.

The monitoring works should gradually be transferred from the Malir Project Office under the Department of Irrigation and Power to the farmers. The farmers should be organized by Deh or Union Council under the supervision of the Department of Irrigation and Power, to succeed monitoring works and maintain groundwater at a proper level. This organization may be called Groundwater Users Association. The Groundwater Users Association will prepare the articles under the guidance of the groundwater management section of the Malir Project Office. The articles will include the following:

1) Name, address and purpose of the association
2) Membership
3) Rights and duties of members
4) Termination and suspension of membership
5) Membership fees and dues
6) Membership meeting
7) Board of director and committee
8) Officer of the association
9) Education and training committee
10) Finance and development committee
11) Monitoring committee
12) Dissolution and liquidation
13) Other rules and regulations
14) Miscellaneous provisions
15) Amendments

After the completion of the dam, groundwater extraction plan will be revised according to the increase of groundwater recharge under the guidance of the Department of Irrigation and Power. The Groundwater Users Association will finally be responsible for all groundwater management works.

E.4.4 Establishment of Pilot Demonstration Farm for Improved Farming Practice

Fruit and vegetable crop yields achieved by producers in the project area are significantly lower than those generally achieved in Sindh and much below national averages. This may be due to the lack of irrigation water, the lack of knowledge on proper farming practice as well as low level of farm input.

The restoration of a reliable and properly managed supply of water under the proposed project would create the conditions for the development of more intensive fruit and vegetable production system in the project area. With the provision of on-farm investment and the strengthening of supplying services it should be possible for the producers to achieve yield levels similar to those now being obtained in Hyderabad District.

Further expansion of cultivated area would also be expected provided water-saving irrigation technology such as sprinkler and/or trickle (or drip) irrigation method is introduced.

In order to demonstrate improved farming practice with high level of input and to introduce new irrigation technology, the establishment of a demonstration farm is proposed. The farm shall be located in the Project area to attain the said purposes. The farm will have two sections: (1) production section and (2) irrigation section.

(1) Production Section

The function of the production section may be a part of the Horticulture Research Institute located in Mirpurkas. Improved farming practice to be established in the Horticulture Research Institute will be tried and shown to the farmers within the project area. The new farming practice may be modified by further experiment so that more adaptable farming practice could be introduced in the project area.

To disseminate the new farming technology, manual on the farming practice in which variety, quantity of seeds, recommendable dosage and timing of application of fertilizer, pesticide, etc. are included, will be prepared. The farm will be open to the public. After realizing the effectiveness of the new farming practice, farmers will be encourage to adopt the new farming technology. This section should have close relation with extension workers.

(2) Irrigation Section

New water-saving irrigation technology such as sprinkler and/or drip irrigation method may be introduced by the progressive farmers in the future to expand irrigation area. Since such technology is still new to Pakistan, it is necessary to make some experiment on the said irrigation methods. The experiment will be made in the pilot demonstration farm by irrigation engineer who belongs to the Irrigation and Power Department in association with the production section described in the preceding paragraph.

Conceptual proposed organization is illustrated on Fig. E.4.1.

E.4.5 Strengthening Other Agriculture Support Services

With the introduction of improved farming practice, the dosage of farm input such as seeds, fertilizer, agro-chemicals, machinery, etc. will be considerably increased. Although

such farm inputs will easily be available since the project area is located adjacent to Karachi, private sector will be encouraged to deal with those commodities in the project area.

Agricultural credit will also be increased by Agricultural Development Bank of Pakistan through the introduction of supervised credit system. Production credit for seed, fertilizer, agro-chemical, etc. should be increased to help small farmers to avail of those inputs.

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TABLES

Table E.2.1 DEMOGRAPHIC CONDITION OF THE STUDY AREA

Name of Deh and Union Concil	Total Area (Km2)	Total Population	Population Density (persons/Km2)	No of Household	Household Size	No of Farmers
DARSANO CAHANNO						
1) Bail	9.7 *	136	14	32	4.2	5
2) Kathore	24.6 *	2,706	110	576	4.7	63
3) Amilano	11.5	1,248	109	290	4.3	25
4) Khadeji	4.5 *	54	12	12	4.6	2
5) Chuhar	29.8	4,735	159	877	5.4	25
6) Kotero	25.7	3,753	146	682	5.5	27
Sub-total	105.8	12,632	119	2,469	5.1	147
KANKAR						
1) Bazar	22.0	2,722	124	534	5.1	51
2) Darsano Channo	24.4	8,186	335	1,462	5.6	89
3) Kharkharo	32.1	4,853	151	851	5.7	55
4) Malh	15.9	24,394	1,534	4,435	5.5	124
Sub-total	94.4	40,155	425	7,282	5.5	319
LANDHI						
1) Kharkhar	9.9	3,493	353	647	5.4	34
2) Sanhro	10.1	5,666	561	944	6.0	74
3) Landhi	10.2	11,439	1,121	1,875	6.1	44
4) Khanto	5.3 *	5,602	1,057	949	5.9	26
Sub-total	35.5	26,200	738	4,416	5.9	178
THANO						
1) Thano	6.6	11,391	1,726	2,109	5.4	54
Sub-total	6.6	11,391	1,726	2,109	5.4	54
Total	242.3	90,378	373	16,277	5.6	698

Source : 1981 Census Report, Karachi Division, May 1984
Population Census Organization Statistics Division, Government of Pakistan

Remarks : Number of household are estimated based on household size for each Deh in 1981 Census.
(*) ; The area is estimated in the Study area only.

Table E.2.2 GENERAL FEATURE OF THE CLIMATIC CONDITION IN THE STUDY AREA

Year / Month	Annual / Monthly Rainfall (mm)	Monthly Average Temperature Mean (°C)	Max. (°C)	Min. (°C)	Mean Relative Humidity (%)	Mean Sunshine Houres (hrs/day)	Monthly Mean Wind Velocity (m/sec.)
1979	381.0	26.2	31.8	20.6	65.9	8.3	5.1
1980	193.8	26.3	31.6	21.1	66.8	8.5	5.4
1981	185.6	26.3	31.9	20.2	65.3	8.3	5.2
1982	161.2	26.2	31.9	20.6	65.0	7.8	5.2
1983	282.1	25.9	31.6	20.2	66.3	7.9	4.9
1984	270.0	25.6	31.6	19.6	67.3	7.9	4.5
1985	154.6	25.5	32.1	20.1	67.7	8.0	5.2
1986	91.6	25.8	31.8	19.8	63.0	7.7	-
1987	0.0	26.4	32.6	20.4	61.6	7.9	-
1988	160.0	27.1	32.7	21.4	62.5	-	4.5
Average (1979 -1988)							
January	0.6	18.3	26.1	10.0	51.1	8.8	3.0
February	15.0	20.2	27.9	12.4	55.0	8.7	3.6
March	9.6	24.6	31.4	17.5	62.1	8.6	4.9
April	9.0	28.6	34.6	22.4	66.2	9.4	6.2
May	0.0	30.8	35.4	26.1	71.2	9.6	8.4
June	6.4	31.7	35.5	28.2	73.7	8.6	8.8
July	34.2	30.3	33.2	27.6	76.3	4.7	9.3
August	99.0	29.0	31.7	26.2	79.0	4.8	8.9
September	5.5	29.3	33.0	25.5	73.7	7.0	7.1
October	2.8	27.3	34.9	21.3	64.3	9.0	4.0
November	0.7	24.0	32.1	15.9	56.1	8.9	2.7
December	7.8	19.6	27.7	11.5	53.2	8.6	2.7
Total / Average	189.0	26.1	32.0	20.4	65.2	8.0	5.8

Source : Pakistan Meteological Department
Karachi Airport Station

Table E.2.3 SOIL ASSOCIATIONS IN THE STUDY AREA

Landform	Sr. No.	Soil Association	Composition (Soil Series)		Area (ha)	Percentage
Sub-recent River Plains	1)	Mehrab	Mehrab Malir Mehrab	70% 25% 5%	6,590	22.6%
Old (Late Pleistocene) Piedmont Plains	2)	Iddu	Iddu Gadap Phalwara	60% 20% 20%	1,860	6.4%
	3)	Mauripur	Mauripur Mindiari	90% 10%	620	2.1%
	4)	Mindiari	Mindiari Iddu	90% 10%	10,190	34.9%
Old (Late Pleistocene) Dissected Piedmont Plains	5)	Landhi	Landhi Pipri	80% 20%	3,110	10.6%
	6)	Pipri	Pipri Landri Phalwan	50% 20% 30%	4,600	15.7%
Very Old (Middle Plestocene) Dissected Gravelly Piedmont Terraces	7)	Monze	Monze Channel bed Rockland	90% 5% 5%	2,240	7.7%
				Total	29,210	100%

Sources : Feasibility Report, WAPDA in 1982
Reconnaissance Soil Survey in The Soil Survey of Pakistan

Table E.2.4 LAND CAPABILITY CLASSFICATION IN THE STUDY AREA

Land Capability Class	Land Capability Sub-class	Land Capability Association	Unit of Association	Area (ha)	Percentage
I	ir I, irIIs, and irIIIs	Good with some very good irrigated land	Mehrab	6,210	21.3%
II	dIVs and dIVc	Very good irrigable land	Mauripur Mindiari	9,570	32.8%
III	VIIs	Land with very poor grazing potential	Landi, pipri, Iddu and Mauripur, Mindiari	11,190	38.3%
IV	VIIIs, VIIIc, and VIIIw	Agriculturally unproductive land	Monze	2,240	7.7%
			Total	29,210	100%

Sources : Feasibility Report, WAPDA in 1982
Reconnaissance Soil Survey in The Soil Survey of Pakistan

Table E.2.5 PRESENT LAND USE IN THE STUDY AREA

Unit : ha

Name of Deh / Union Concil		Total Area	Agricultural Land					Non-Agricultural Land
			Irrigated Field		Rainfed	Fallow		
			Orchard	Upland	Upland	Area	Total	
DARSANO CAHANNO								
1) Bail	*	970	5	5	5	5	20	950
2) Kathore	*	2,460	170	220	55	410	855	1,605
3) Amilano		1,150	60	65	10	135	270	880
4) Khadeji	*	450	0	5	0	10	15	435
5) Chuhar		2,980	30	70	120	115	335	2,645
6) Kotero		2,570	35	45	85	75	240	2,330
Sub-total		10,580	300	410	275	750	1,735	8,845
KANKAR								
1) Bazar		2,200	200	200	35	415	850	1,350
2) Darsano Channo		2,440	70	255	80	345	750	1,690
3) Kharkharo		3,210	85	100	75	135	395	2,815
4) Malh		1,590	220	105	0	330	655	935
Sub-total		9,440	575	660	190	1,225	2,650	6,790
LANDHI								
1) Kharkhar		990	50	115	15	200	380	610
2) Sanhro		1,010	50	160	0	275	485	525
3) Landhi		1,020	115	100	0	240	455	565
4) Khanto	*	530	25	30	0	65	120	410
Sub-total		3,550	240	405	15	780	1,440	2,110
THANO								
1) Thano		660	85	65	0	165	315	345
Sub-total		660	85	65	0	165	315	345
Total		24,230	1,200	1,540	480	2,920	6,140	18,090
Percentage			(5.0%)	(6.4%)	(2.0%)	(12.1%)	25.3%	74.7%

Remarks : *); The area is estimated in the Study area only.
Sources : Topographic maps 1/50,000 (1974) and 1/16,000
Malir Agricultural office

Table E.2.6 CROPPED AREA AND CROPPING INTENSITY 1978 AND 1988

Unit: ha

Crops	1978 (1) Summer	Winter	Total	1988 (2) Summer	Winter	Total
A. Fodder Crops						
Sorghum				210		210
Lucerne				150		150
Maize, others				130	80	210
All Fodder	590 *	370 *	960	490	80	570
	(15%)	(20%)	(16%)	(15%)	(16%)	(15%)
B. Vegetables						
Tomato	370		370	480		480
Eggplant	330		330	110	50	160
Chilli	280		280	10	40	50
Sponge Gourd	320		320	130	70	200
Bottle Gourd				100	50	150
Bitter Gourd				30	5	35
Cucumber				20		20
Melon				40		40
Cauliflower				120		120
Spinach		280	280	60	60	120
Carrot *		480 *	480	100	50	150
Radish *				60	45	105
Turnip *				50	15	65
Peas				100	5	105
Potato		120	120			
Others	620	460	1,080	110	35	145
All Vegetables	1,920	1,340	3,260	1,520	425	1,945
	(47%)	(71%)	(55%)	(47%)	(83%)	(52%)
C. Fruits						
Guava				280		280
Mango				570		570
Chikoo				80		80
Coconut				90		90
Papaya				50		50
Dates Palm				40		40
Others				90		90
All Fruits	1,380 *		1,380	1,200		1,200
	(34%)		(23%)	(37%)		(32%)
D. Other Crops						
Miscellaneous	180 *	180 *	360	10	5	15
	(4%)	(9%)	(6%)	(1%)	(1%)	(1%)
Total	4,070	1,890	5,960	3,220	510	3,730
Command Area :		5,660 ha			6,140 ha	
Cropping Intensity :		1.46			1.16	

Remarks : (1) WAPDA study, 1979
(2) 2 years average, 1987/88 - 1988/89
Command area include fallow field becouse of water constraint.
(*) ; Data are not available for each crops.

Table E.2.7 PRESENT CROPPED AREA AND CROPPING INTENSITY IN THE STUDY AREA

Crops	Cropped Area				Annual Cropped Area	
	Summer Season		Winter Season		Area	Percentage
A. Fodder Crops						
Sorghum	210	6.5%			210	6.5%
Lucerne	150	4.7%			150	4.7%
Maize, others	130	4.0%	80	2.5%	210	6.5%
Sub-total	490	15.2%	80	2.5%	570	17.7%
B. Vegetables						
Solanaceous						
Tomato	480	14.9%			480	14.9%
Eggplant	110	3.4%	50	1.6%	160	5.0%
Chilli	10	0.3%	40	1.2%	50	1.6%
Cucurbits						
Sponge Gourd	130	4.0%	70	2.2%	200	6.2%
Bottle Gourd	100	3.1%	50	1.6%	150	4.7%
Bitter Gourd	30	0.9%	5	0.2%	35	1.1%
Cucumber	20	0.6%			20	0.6%
Water Melon	30	0.9%			30	0.9%
Musk Melon	10	0.3%			10	0.3%
Cole Crops, Green, Herbs						
Cauliflower	120	3.7%			120	3.7%
Spinach	60	1.9%	60	1.9%	120	2.0%
Root Crops						
Carrot	100	3.1%	50	1.6%	150	4.7%
Radish	60	1.9%	45	1.4%	105	3.3%
Turnip	50	1.6%	15	0.5%	65	2.0%
Legunes, others						
Peas	100	3.1%	5	0.2%	105	3.3%
Mung Bean	15	0.5%	5	0.2%	20	0.6%
Cluster Bean	10	0.3%			10	0.3%
Others	85	2.6%	30	0.9%	115	3.6%
Sub-total	1,520	47.2%	425	13.2%	1,945	60.4%
C. Fruits						
Guava	280	8.7%			280	8.7%
Mango	570	17.7%			570	17.7%
Chikoo	80	2.5%			80	2.5%
Coconut	90	2.8%			90	2.8%
Papaya	50	1.6%			50	1.6%
Dates Palm	40	1.2%			40	1.2%
Custard Apple	10	0.3%			10	0.3%
Banana	10	0.3%			10	0.3%
Others	70	2.2%			70	2.2%
Sub-total	1,200	37.3%			1,200	37.3%
D. Other Crops						
Sesamum Seed	5	0.2%			5	0.2%
Rose Flower	5	0.2%			5	0.2%
Others			5	0.2%	5	0.2%
Sub-total	10	0.3%	5	0.2%	15	0.5%
Total	3,220 ha	100.0%	510 ha	15.8%	3,730 ha	115.8%
Cropping Intensity (3,220 ha)	Fodder : 0.18,	Vegetable : 0.61,	Fruit : 0.37		Total : 1.16	

Source : East Karachi Revenue Office, Malir
Remark : Cropping area is estimated on 2 years average (1987/88, 1988/89).

Table E.2.8 PRESENT AMOUNT OF FARM INPUTS PER HA IN THE STUDY AREA

Crops	Seeds	Fertilizers			Agro-chemicals	
		Urea	DAP	FYM	Insecticide	Fungicide
	(Kg)	(Kg)	(Kg)	(Ton)	(lit, Kg)	(lit, Kg)
A. Fodder Crops						
Sorghum	50.0	75	None	None	None	None
Lucerne	25.0	75	None	3.0	None	None
Maize	80.0	75	None	None	None	None
B. Vegetables						
Tomato	1.5	75	125	5.0	1.0	None
Eggplant	1.5	75	None	7.5	1.0	None
Chilli	2.5	75	None	5.0	None	None
Lady's Finger	20.0	75	None	5.0	None	None
Sponge Gourd	5.0	75	75	3.0	1.0	None
Bottle Gourd	7.0	75	75	2.0	1.0	None
Cauliflower	1.5	125	125	7.5	2.0	None
Spinach	12.5	75	None	3.0	1.0	None
Carrot	4.5	75	None	3.0	0.5	None
Radish	7.5	75	None	3.0	0.5	None
Turnip	2.5	75	None	3.0	0.5	None
Peas	30.0	None	None	5.0	None	None
C. Fruits	(seedling)					
Guava	85	125	None	6.0	3.0	None
Mango	85	250	None	6.0	3.0	None
Chikoo	85	125	None	5.0	None	None
Coconut	170	125	None	4.0	None	None
Papaya	1,100	75	None	5.0	1.0	None

Remarks : Farm inputs are estimates based on field survey and information supplied by the Agriculture officers/ Field assistants in the study area.
Amount of fertilizer for fruit crops is estimated at fruiting stage.
DAP ; Diammonium, FYM ; Farmyard Manual

Table E.2.9 PRESENT MACHINERY AND LABOUR REQUIREMENT PER HA

Crops	Machinery Requirement			Labour Requirement		
	Plowing	Levelling	Total	Land Prep.	Sowing/Planting	Fertilizer
	(hour)	(hour)	(hour)	(man-day)	(man-day)	(man-day)
A. Fodder Crops						
Sorghum	4.0	2.5	6.5		2.5	1.0
Lucern	4.0	2.5	6.5	2.5	2.5	1.0
Maize	4.0	2.0	6.0		2.5	1.0
B. Vegetables						
Tomato	5.0	5.0	10.0	13.5	10.0	2.0
Eggplant	5.0	5.0	10.0	15.5	10.0	3.5
Chilli	4.0	2.0	6.0	15.5	10.0	2.5
Lady's Finger	4.0	2.0	6.0	10.0	5.0	2.5
Sponge Gourd	4.0	2.0	6.0	10.0	2.5	2.0
Bottle Gourd	4.0	4.0	8.0	10.0	2.5	3.5
Cauliflower	5.0	2.0	7.0	15.5	10.0	3.5
Spinach	4.0	2.0	6.0	4.0	2.0	3.0
Carrot	5.0	5.0	10.0	15.0	5.0	2.5
Radish	5.0	5.0	10.0	15.0	5.0	2.5
Turnip	5.0	5.0	10.0	15.0	5.0	3.5
Peas	5.0	5.0	10.0	10.0	3.0	2.0
C. Fruits						
Guava	5.0	4.0	9.0	(30.0) *	(10.0) *	5.0
Mango	5.0	4.0	9.0	(30.0) *	(10.0) *	6.0
Chikoo	5.0	4.0	9.0	(30.0) *	(10.0) *	5.0
Coconut	5.0	4.0	9.0	(50.0) *	(10.0) *	4.0
Papaya, others	5.0	2.5	7.5	12.0	10.0	3.5

Crops	Labour Requirement					
	Insecticide	Weeding	Watering	Harvesting	Packing	Total
	(man-day)	(man-day)	(man-day)	(man-day)	(man-day)	(man-day)
A. Fodder Crops						
Sorghum				10.0	4.0	17.5
Lucerne			5.0	15.0	5.0	31.0
Maize			2.5	10.0	4.0	20.0
B. Vegetables						
Tomato	1.5	15.0	5.0	15.0	10.0	72.0
Eggplant	1.5	15.0	5.0	15.0	10.0	75.5
Chilli		10.0	5.0	20.0	5.0	68.0
Lady's Finger		10.0	5.0	20.0	5.0	57.5
Sponge Gourd	2.0	5.0	5.0	10.0	5.0	41.5
Bottle Gourd	2.0	5.0	5.0	10.0	5.0	43.0
Cauliflower	2.0	15.0	5.0	8.0	5.0	64.0
Spinach	1.5	7.5	5.0	8.0	4.0	35.0
Carrot	1.5	10.0	5.0	15.0	10.0	64.0
Radish	1.5	10.0	5.0	15.0	10.0	64.0
Turnip	1.5	10.0	5.0	15.0	10.0	65.0
Peas		10.0	5.0	20.0	10.0	60.0
C. Fruits						
Guava	3.0	6.0	10.0	20.0	5.0	89.0
Mango	3.0	6.0	10.0	10.0	5.0	80.0
Chikoo		6.0	10.0	10.0	4.0	75.0
Coconut		6.0	10.0	10.0	4.0	94.0
Papaya	1.5	10.0	10.0	10.0	5.0	62.0

Remarks : (*) ; Labour requirement is only first year.
Machimery and labour requirement are estimated based on field survey and information supplied by the Agricultural officers/ Field assistance.

Table E.2.10 PRESENT UNIT YIELDS OF MAJOR CROPS IN KARACHI DISTRICT

Crops	Cropped Area 1986/87 (ha)	Cropped Area 1987/88 (ha)	Total Production 1986/87 (tons)	Total Production 1987/88 (tons)	Unit Yield 1986/87 (t /ha)	Unit Yield 1987/88 (t /ha)	Average (tons/ha)
A. Fodder Crops							
Sorghum	293	291	3,382	3,359	11.5	11.5	11.5
Maize	189	182	2,004	1,932	10.6	10.6	10.6
Lucerne	513	595	7,130	8,285	13.9	13.9	13.9
B. Vegetables							
Solanaceous							
Tomato	1,463	1,465	4,864	4,932	3.3	3.4	3.3
Eggplant	137	138	725	636	5.3	4.6	4.9
Chilli	158	158	153	158	1.0	1.0	1.0
Lady's Finger	172	172	396	397	2.3	2.3	2.3
Cucurbits							
Bottle Gourd	132	129	612	602	4.6	4.7	4.7
Bitter Gourd	132	138	543	545	4.1	3.9	4.0
Sponge Gourd	129	129	400	400	3.1	3.1	3.1
Cucumber	32	32	62	63	1.9	2.0	2.0
Melon	12	13	35	37	2.9	2.8	2.9
Cole Crop, Green, Herbs							
Cauliflower	156	160	2,090	2,126	13.4	13.3	13.3
Spinach	215	214	555	564	2.6	2.6	2.6
Root Crops							
Carrot	235	223	1,210	1,265	5.1	5.7	5.4
Radish	194	195	761	783	3.9	4.0	4.0
Turnip	10	10	65	66	6.5	6.6	6.6
Beet Root	11	8	54	38	4.9	4.8	4.8
Legunes, Others							
Mung Bearn	209	128	92	38	0.4	0.3	0.4
Peas	109	109	282	287	2.6	2.6	2.6
C. Fruits							
Guava	59	20	150	152	2.5	7.6	3.8
Mango	202	202	1,232	1,227	6.1	6.1	6.1
Chikoo	101	101	230	230	2.3	2.3	2.3
Coconut	95	95	247	260	2.6	2.7	2.7
Papaya	329	320	2,420	2,329	7.4	7.3	7.3
Dates Palm	99	99	272	274	2.7	2.8	2.8
Banana	51	51	420	420	8.2	8.2	8.2

Source : Agricultural Statistics of Sindh, 1989
Bureau of Statistics, Planning and Development Depertment,
Government of Sindh

Table E.2.11 PRESENT CROP PRODUCTION IN THE STUDY AREA

Crops	Summer Season			Winter Season			Annual Production
	Area (ha)	Unit Yield (t/ha)	Production (tons)	Area (ha)	Unit Yield (t/ha)	Production (tons)	(tons)
A. Fodder Crops							
Sorghum	210	11.5	2,415				2,415
Lucerne	150	13.9	2,085				2,085
Maze	50	10.6	530	50	10.6	530	1,060
Others	80	12.3	981	30	12.3	369	1,350
All Fodder	490	(12.3)	6,011	80	(11.2)	899	6,910
B. Vegetables							
Solanaceous							
Tomato	480	3.3	1,584				1,584
Eggplant	110	4.9	539	50	4.9	245	784
Chilli	10	1.0	10	40	1.0	40	50
Cucurbits							
Sponge Gourd	130	3.1	403	70	3.1	217	620
Bottle Gourd	100	4.7	470	50	4.7	235	705
Bitter Gourd	30	4.0	120	5	4.0	20	140
Cucumber	20	2.0	40				40
Water Melon	30	3.0	90				90
Musk Melon	10	2.9	29				29
Cole Crops, Green, Herbs							
Cauliflower	120	13.3	1,596				1,596
Spinach	60	2.6	156	60	2.6	156	312
Root Crops							
Carrot	100	5.4	540	50	5.4	270	810
Radish	60	4.0	240	45	4.0	180	420
Turnip	50	6.6	330	15	6.6	99	429
Legunes, others							
Peas	100	2.6	260	5	2.6	13	273
Others	110	4.5	521	30	4.5	155	676
All Vegetables	1,520	(4.6)	6,928	420	(3.9)	1,630	8,558
C. Fruits							
Guava	280	3.8	1,064				1,064
Mango	570	6.1	3,477				3,477
Chikoo	80	2.3	184				184
Coconut Palm	90	2.7	243				243
Papaya	50	7.3	365				365
Dates Palm	40	2.8	112				112
Custard Apple	10	3.0	30				30
Banana	10	8.2	82				82
Others	70	4.9	424				424
All Fruit	1,200	(5.0)	5,981				5,981
D. Other Crops							
Sesamum Seed	5						
Rose Flower	5						
Others				10			
All Others	10	2.5	25	10	2.5	25	50
Total	3,220		18,945	510		2,554	21,499

Sources : East Karachi Revenue Office, Malir
Agricultural Statistics of Sindh, 1989

Remarks : Annual crop production in the study area is estimated on 2 years average, 1987/88 and 1988/89.

Table E.2.12 PRESENT POPULATION OF LIVESTOCK IN AND AROUND THE STUDY AREA (1989)

Name of U/C and Deh	Cattle	Buffalow	Sheep/Goat	Others*
DARSANO CAHANNO				
1) Bail	560	1,460	1,626	15
2) Kathore	536	4,313	2,530	195
3) Amilano	150	565	697	30
4) Khadeji	595	787	235	45
5) Chuhar	340	980	280	87
6) Kotero	290	885	375	85
Sub-total	2,471	8,990	5,743	457
KANKAR				
1) Bazar	537	980	375	45
2) Darsano Chano	985	1,293	1,045	502
3) Khar Kharo	310	435	510	20
4) Malh	215	857	343	35
Sub-total	2,047	3,565	2,273	602
LANDHI				
1) Kharkhar	14	4	48	3
2) Sanhro	20	3	63	12
3) Landhi	20	124	39	9
4) Khanto	219	2,940	801	32
Sub-total	273	3,071	951	56
THANO				
1) Thano	10	24	520	12
Total	4,801	15,650	9,487	1,127

Source : Assistant Director Animal Husbandry, Karachi
Remarks : (*) ; donkeys, mules and horses

Table E.3.1 PRESENT LAND USE IN THE PROJECT AREA

Unit : ha

Name of Deh / Union Concil		Total Area	Agricultural Land					Non-Agricultural Land
			Irrigated Field		Rainfed	Fallow		
			Orchard	Upland	Upland	Area	Total	
DARSANO CAHANNO								
1) Bail	*	120	5	5	0	0	10	110
2) Kathore	*	1,200	170	165	15	410	760	440
3) Amilano		1,150	60	65	10	135	270	880
4) Khadeji	*	220	0	5	0	5	10	210
5) Chuhar	*	650	20	20	20	55	115	535
6) Kotero	*	330	30	45	5	75	155	175
Sub-total		3,670	285	305	50	680	1,320	2,350
KANKAR								
1) Bazar		2,200	200	200	35	415	850	1,350
2) Darsano Channo	*	1,480	70	255	0	295	620	860
3) Kharkharo	*	1,170	80	85	0	135	300	870
4) Malh		1,590	220	105	0	330	655	935
Sub-total		6,440	570	645	35	1,175	2,425	4,015
LANDHI								
1) Kharkhar		990	50	115	15	200	380	610
2) Sanhro		1,010	50	160	0	275	485	525
3) Landhi	*	880	115	100	0	240	455	425
4) Khanto	*	250	25	30	0	65	120	130
Sub-total		3,130	240	405	15	780	1,440	1,690
THANO								
1) Thano		660	85	65	0	165	315	345
Sub-total		660	85	65	0	165	315	345
Total		13,900	1,180	1,420	100	2,800	5,500	8,400
Percentage			(8.5%)	(10.2%)	(0.7%)	(20.1%)	39.6%	60.4%

Remarks : (*) ; The area is estimated in the Project area only.
Sources : Topographic maps 1/50,000 (1974) and 1/16,000
Malir Agricultural office

Table E.3.2 CROPPED AREA AND CROPPING INTENSITY UNDER WITHOUT PROJECT CONDITION

- Present Condition, 1989 -

Crops	Cropped Area				Annual Cropped Area	
	Summer Season		Winter Season		Area	Percentage
	(ha)	(%)	(ha)	(%)	(ha)	(%)
A. Fodder Crops						
Lucerne	110	4.2			110	4.2
Maize, others	60	2.3	50	1.9	110	4.2
All Fodder	170	6.5	50	1.9	220	8.5
B. Vegetables						
Tomato	400	15.4			400	15.4
Eggplant	90	3.5	50	1.9	140	5.4
Chilli	10	0.4	10	0.4	20	0.8
Sponge Gourd	110	4.2	50	1.9	160	6.2
Bottle Gourd	80	3.1	40	1.5	120	4.6
Cauliflower	100	3.8			100	3.8
Spinach	50	1.9	60	2.3	110	4.2
Carrot	80	3.1	40	1.5	120	4.6
Radish	50	1.9	20	0.8	70	2.7
Turnip	40	1.5	10	0.4	50	1.9
Peas	80	3.1			80	3.1
Others	160	6.2	30	1.2	190	7.3
All Vegetables	1,250	48.1	310	11.9	1,560	60.0
C. Fruits						
Guava	280	10.8			280	10.8
Mango	570	21.9			570	21.9
Chikoo	80	3.1			80	3.1
Coconut	90	3.5			90	3.5
Papaya	50	1.9			50	1.9
Others	110	4.2			110	4.2
All Fruit	1,180	45.4			1,180	45.4
Total	2,600 ha	100	360 ha	13.8	2,960 ha	113.8
Cropping Intensity (2,400 ha)	Fodder : 0.08	Vegetables : 0.60	Fruit : 0.46		Total : 1.14	

- Without Project Condition, 1995 -

Crops	Cropped Area				Annual Cropped Area	
	Summer Season		Winter Season		Area	Percentage
	(ha)	(%)	(ha)	(%)	(ha)	(%)
A. Fodder Crops						
Lucerne	100	4.2			100	4.2
Maize, others	50	2.1	40	1.7	90	3.8
All Fodder	150	6.3	40	1.7	190	7.9
B. Vegetables						
Tomato	400	16.7			400	16.7
Eggplant	90	3.8	50	2.1	140	5.8
Chilli	10	0.4	10	0.4	20	0.8
Sponge Gourd	110	4.6	50	2.1	160	6.7
Bottle Gourd	80	3.3	40	1.7	120	5.0
Cauliflower	100	4.2			100	4.2
Spinach	50	2.1	60	2.5	110	4.6
Carrot	80	3.3	40	1.7	120	5.0
Radish	50	2.1	20	0.8	70	2.9
Turnip	40	1.7	10	0.4	50	2.1
Peas	80	3.3			80	3.3
Others	160	6.7	10	0.4	170	7.1
All Vegetables	1,250	52.1	290	12.1	1,540	64.2
C. Fruits						
Guava	280	11.7			280	11.7
Mango	390	16.3			390	16.3
Chikoo	80	3.3			80	3.3
Coconut	90	3.8			90	3.8
Papaya	50	2.1			50	2.1
Others	110	4.6			110	4.6
All Fruit	1,000	41.7			1,000	41.7
Total	2,400 ha	100	330 ha	13.8	2,730 ha	113.8
Cropping Intensity (2,400 ha)	Fodder : 0.08	Vegetables : 0.64	Fruit : 0.42		Total : 1.14	

Table E.3.3 CROPPED AREA AND CROPPING INTENSITY UNDER WITH PROJECT

Crops	Cropped Area				Annual Cropped Area	
	Summer Season		Winter Season		Area	Percentage
	(ha)	(%)	(ha)	(%)	(ha)	(%)
A. Fodder Crops						
Lucerne	100	2.3			100	2.3
Maize, others	50	1.1	50	1.1	100	2.3
All Fodder	150	3.4	50	1.1	200	4.6
B. Vegetables						
Solanaceous						
Tomato	1,000	23.0			1,000	23.0
Eggplant	500	11.5			500	11.5
Chilli			350	8.0	350	8.0
Cucurbits						
Sponge Gourd			1,000	23.0	1,000	23.0
Bottle Gourd			400	9.2	400	9.2
Cole Crops, Green, Herbs						
Cauliflower	300	6.9			300	6.9
Spinach	300	6.9			300	6.9
Root Crops						
Carrot	200	4.6			200	4.6
Radish	150	3.4			150	3.4
Turnip	150	3.4			150	3.4
Legunes, others						
Peas	200	4.6			200	4.6
Others	400	9.2	350	8.0	750	17.2
All Vegetables	3,200	73.6	2,100	48.3	5,300	121.8
C. Fruits						
Guava	280	6.4			280	6.4
Mango	390	9.0			390	9.0
Chikoo	80	1.8			80	1.8
Coconut	90	2.1			90	2.1
Papaya	50	1.1			50	1.1
Others	110	2.5			110	2.5
All Fruit	1,000	23.0			1,000	23.0
Total	4,350 ha	100	2,150 ha	49.4	6,500 ha	149.4
Cropping Intensity (4,350 ha)	Fodder : 0.05		Vegetables : 1.21	Fruit : 0.23	Total : 1.49	

Table E.3.4 INCREMENTAL CROPPED AREA

Unit : ha

Crops	With Project			Without Project			Increment		
	Summer	Winter	Total	Summer	Winter	Total	Summer	Winter	Total
A. Fodder Crops									
Lucerne	100		100	100		100			
Maize, others	50	50	100	50	40	90		10	10
All Fodder	150	50	200	150	40	190		10	10
B. Vegetables									
Solanaceous									
Tomato	1,000		1,000	400		400	600		600
Eggplant	500		500	90	50	140	410	-50	360
Chilli		350	350	10	10	20	-10	340	330
Cucurbits									
Sponge Gourd		1,000	1,000	110	50	160	-110	950	840
Bottle Gourd		400	400	80	40	120	-80	360	280
Cole Crops, Green, Herbs									
Cauliflower	300		300	100		100	200		200
Spinach	300		300	50	60	110	250	-60	190
Root Crops									
Carrot	200		200	80	40	120	120	-40	80
Radish	150		150	50	20	70	100	-20	80
Turnip	150		150	40	10	50	110	-10	100
Legunes, others									
Peas	200		200	80		80	120		120
Others	400	350	750	160	10	170	240	340	580
All Vegetables	3,200	2,100	5,300	1,250	290	1,540	1,950	1,810	3,760
C. Fruits									
Guava	280		280	280		280			
Mango	390		390	390		390			
Chikoo	80		80	80		80			
Coconut	90		90	90		90			
Papaya	50		50	50		50			
Others	110		110	110		110			
All Fruit	1,000		1,000	1,000		1,000			
Total	4,350	2,150	6,500	2,400	330	2,730	1,950	1,820	3,770

Remarks : see Table E.3.2 and E.3.3

Table E.3.5 PROPOSED AMOUNT OF FARM INPUTS PER HA

Crops	Seeds	Fertilizers			Agro-chemicals	
		Urea	DAP	FYM	Insecticides	Fungicides
	(kg)	(kg)	(kg)	(ton)	(lit)	(lit)
A. Fodder Crops						
Lucerne	25.0	125	None	5.0	1.0	Non
Maize	80.0	125	None	5.0	Non	Non
B. Vegetables						
Tomato	1.5	125	125	10.0	2.0	1.0
Eggplant	1.5	125	125	15.0	2.0	1.0
Chilli	2.5	75	125	10.0	2.0	1.0
Sponge Gourd	5.0	125	125	5.0	2.0	Non
Bottle Gourd	7.0	125	125	5.0	2.0	Non
Cauliflower	1.5	150	125	15.0	2.0	1.0
Spinach	12.5	125	125	10.0	1.0	Non
Carrot	4.5	125	125	15.0	2.0	1.0
Radhish	7.5	125	125	10.0	2.0	1.0
Turnip	2.5	125	125	10.0	2.0	1.0
Peas	30.0	75	125	5.0	1.0	Non
C. Fruits	(seedling)					
Guava	85	250	None	10.0	2.0	2.0
Mango	85	250	None	10.0	3.0	2.0
Chikoo	85	250	None	10.0	2.0	1.0
Coconut	170	250	None	10.0	Non	Non
Papaya	1,100	125	None	10.0	2.0	1.0

Remarks : Farm inputs are estimates based on information supplied by the Horticulture Research Institute, Mirpurkhas
DAP ; Diammonium Phosphate, FYM ; Farmyard Manual

Table E.3.6 PROPOSED PLANT PROTECTION PRACTICES

Crops	Insects / Deseases	Insecticides /Fungicides	
		Chemical Name	Trade Name/ Formulation
Solanceous			
Tomato	- Whiteflies, jassids, thrips, fruit borers	- Dimethoate	Roger 40 EC, Perfecthion 40 EC Roxion 40 EC, Cygon 40 EC
	leaf-eating beetles	- Malathion	Fyfanon 57 EC, Emmatos 57 EC
	- Virus, diseases	- Dithiocarbamats	Dithane M-45
Eggplant	- Fruit borer, stem borer bud worm, aphids	- Dimethoate	Roger 40 EC, Perfecthion 40 EC Roxion 40 EC, Cygon 40 EC
	mites, caterpillers	- Malathion	Fyfanon 57 EC, Emmatos 57 EC
	- Virus, diseases	- Dithiocarbamats	Dithane M-45
Chilli	- Jassids, aphids	- Dimethoate	Roger 40 EC, Perfecthion 40 EC
	mites , borers	- Malathion	Fyfanon 57 EC, Emmatos 57 EC
	- Virus, diseases	- Dithiocarbamats	Dithane M-45
Cucurbits			
Sponge Gourd	- Red pumpkin beetles,	- Malathion	Fyfanon 57 EC, Emmatos 57 EC
Bottle Gourd	melon fruit flies, mites	- Quinalphos	Ekhalux 25 EC
	pumpkin caterpiler, bugs		
Cole Crop, Green, Herps			
Cauliflower	- Aphids, jassids, bugs	- Malathion	Fyfanon 57 EC, Emmatos 57 EC
	leaf cutter, cabbage borer,	- Quinalphos	Ekhalux 25 EC
	cabbage butterfly	- Fenitrothion	Sumithion 50 EC
	- Virus, diseases	- Dithiocarbamats	Dithane M-45
Spinach	- Leaf cutter, Blue beetles	- Malathion	Fyfanon 57 EC, Emmatos 57 EC
	aphids, jassids	- Fenitrothion	Sumithion 50 EC
Root Crops			
Carrot	- Leaf cutter, aphids, bugs	- Malathion	Fyfanon 57 EC, Emmatos 57 EC
Radish	jassids, flea beetles,	- Fenitrothion	Sumithion 50 EC
Turnip	cabbage butterfly, mites		
	- Virus, diseases	- Dithiocarbamats	Dithane M-45
Legunes			
Peas	- Aphids, jassids, thrips	- Malathion	Fyfanon 57 EC, Emmatos 57 EC
	white flies, pod borer,	- Fenitrothion	Sumithion 50 EC
	powdery mildew		
Fruit			
Mango	- Mango hopper,	- Dimethoate	Roger 40 EC, Perfecthion 40 EC
Guava	fruit flies, mango scales		Roxion 40 EC, Cygon 40 EC
Chikoo	mealy bugs, thrips,	- Fenitrothion	Sumithion 50 EC
Papaya	shoot borer	- Malathion	Fyfanon 57 EC, Emmatos 57 EC

Remarks : Agro-chemicals are estimates based on recommendation by the Horticulture Research Institute, Mirpurkhas and Directorate of Agricultural Research Institute, Tandojam.
High toxicity chemicals such as Methyl Parathion, Endosulfan, Tamaron, DDT and BHC are not recommend due to human beings and nutural emviroment.

Table E.3.7 PROPOSED CROPPING CALENDER AND FARMING PRACTICES

Crops	Sowing	Trans-planting	Harvesting (days)*	Distance between row to row (cm)	Distance between plant to plant (cm)	Seedbed
A. Fodder Crops						
Lucerne	Oct.- Nov.	-	30 - 40	Broadcasting		Flat bed
Maize	Throughout a year		65 - 75	Broadcasting		Flat bed
B. Vegetables						
Tomato	Jul. - Sep.	Aug.- Oct.	50 - 70	90 - 120	45 - 60	Ridge
Eggplant	Jul.- Sep.	Aug.- Oct.	50 - 70	90 - 120	45 - 60	Ridge
Chilli	Jan. - Apr.	Feb. - May	60 - 70	90 - 120	30 - 45	Ridge
Sponge Gourd	Jan. - Apr.	-	60 - 70	240	45 - 60	Risen bed
Bottle Gourd	Jan. - Apr.	-	60 - 70	240	45 - 60	Risen bed
Cauliflower	Jul. - Sep.	Aug.- Oct.	60 - 70	45 - 60	30 - 45	Ridge
Spinach	Jul. - Sep.	-	45 - 60	Broadcasting		Flat bed
Carrot	Aug. - Sep.	-	60 - 90	60 - 75	10 - 15	Flat bed
Radish	Aug. - Sep.	-	60 - 90	60 - 75	15 - 30	Flat bed
Turnip	Aug. - Sep.	-	60 - 70	60 - 75	15 - 30	Flat bed
Peas	Aug. - Sep.	-	50 - 70	60 - 75	15 - 30	Flat bed
C. Fruits						
Mango	Feb. - Mar.	Feb. - Mar.	after 5 years Feb.- May	10.5 m	10.5 m	
Guava	Jun. - Oct.	Jun. - Oct.	after 3 years Nov. - Feb.	10.5 m	10.5 m	
Chikoo	Oct.- Dec.	Oct. - Dec.	after 3 years Feb.- May	10.5 m	10.5 m	
Coconut	Jul. - Oct.	Jul. - Oct.	after 5 years Feb.- May	7.5 m	7.5 m	
Papaya	Jun.- Aug.	Jun.- Aug.	after 1 year Feb.- May	3.0 m	3.0 m	

Remarks : (days)* = after sowing / transplanting
Sources : Horticulture Research Institute, Mirpurkhas
Directorate of Agricultural Research Institute, Tandojam

Table E.3.8 PROPOSED MACHINERY AND LABOUR REQUIREMENT PER HA

Crops	Machinery Requirement			Labour Requirement		
	Plowing	Levelling	Total	Land Prep.	Sowing/Planting	Fertilizer
	(hour)	(hour)	(hour)	(man-day)	(man-day)	(man-day)
A. Fodder Crops						
Lucern	4.0	2.5	6.5	2.5	2.5	5.0
Maize	4.0	2.0	6.0	2.5	2.5	3.0
B. Vegetables						
Tomato	5.0	5.0	10.0	15.5	10.0	5.0
Eggplant	5.0	5.0	10.0	15.5	10.0	7.0
Chilli	5.0	5.0	10.0	15.5	10.0	5.0
Sponge Gourd	4.0	4.0	8.0	10.0	2.5	5.0
Bottle Gourd	4.0	4.0	8.0	10.0	2.5	5.0
Cauliflower	5.0	2.0	7.0	15.5	10.0	7.0
Spinach	4.0	2.0	6.0	5.0	2.0	5.0
Carrot	5.0	5.0	10.0	15.0	5.0	5.0
Radish	5.0	5.0	10.0	15.0	5.0	5.0
Turnip	5.0	5.0	10.0	15.0	5.0	5.0
Peas	5.0	5.0	10.0	10.0	3.0	5.0
C. Fruits						
Guava	5.0	4.0	9.0	(30.0) *	(10.0) *	10.0
Mango	5.0	4.0	9.0	(30.0) *	(10.0) *	10.0
Chikoo	5.0	4.0	9.0	(30.0) *	(10.0) *	10.0
Coconut	5.0	4.0	9.0	(50.0) *	(10.0) *	10.0
Papaya	5.0	2.5	7.5	12.0	10.0	5.0

Crops	Labour Requirement					
	Spraying	Weeding	Watering	Harvesting	Packing	Total
	(man-day)	(man-day)	(man-day)	(man-day)	(man-day)	(man-day)
A. Fodder Crops						
Lucerne	2.0	3.0	5.0	25.0	10.0	55.0
Maize		3.0	2.5	12.5	5.0	31.0
B. Vegetables						
Tomato	6.0	15.0	5.0	20.0	15.0	91.5
Eggplant	6.0	15.0	5.0	20.0	15.0	93.5
Chilli	6.0	10.0	5.0	25.0	10.0	86.5
Sponge Gourd	4.0	5.0	5.0	15.0	7.5	54.0
Bottle Gourd	4.0	5.0	5.0	15.0	7.5	54.0
Cauliflower	6.0	15.0	5.0	15.0	10.0	83.5
Spinach	2.0	10.0	5.0	12.5	7.5	49.0
Carrot	6.0	10.0	5.0	20.0	15.0	81.0
Radish	6.0	10.0	5.0	20.0	15.0	81.0
Turnip	6.0	10.0	5.0	20.0	15.0	81.0
Peas	2.0	10.0	5.0	25.0	15.0	75.0
C. Fruits						
Guava	4.0	6.0	10.0	25.0	10.0	105.0
Mango	5.0	6.0	10.0	15.0	10.0	96.0
Chikoo	3.0	6.0	10.0	10.0	5.0	84.0
Coconut		6.0	10.0	15.0	5.0	106.0
Papaya	6.0	10.0	10.0	15.0	7.5	75.5

Remarks : (*) ; Labour requirement is only first year.
Machimery and labour requirement are estimated based on field survey and information supplied by the Agricultural officers/ Field assistance.

Table E.3.9 RESULTS OF VARIETIES TRIAL FOR MAJOR VEGETABLES AT THE VEGETABLE RESEARCH STATION, MIRPURKHAS

Crops	Name of Variety	Growing Period (days)		Unit Yield (t/ha)	Average (t/ha)
Tomato	T-10	54.7	*	26.2	
	SR-II	60.5	*	23.6	
	Roma	69	*	19.7	23.2
Eggplant	Black Beuty	90.0	*	20.6	
	Black King	90.0	*	15.2	
	Purple Round	87.0	*	21.6	19.1
Chilli	Longi	68.6	*	9.1	
	Ghotki	69.5	*	7.1	
	Bengali	81.0	*	6.5	
	Talkari	92.5	*	5.9	7.2
Lady's Finger	Green Pusa	47.2	*	11.8	
	Mirpurkhas-1	46.9	*	10.9	
	Mirpurkhas-2	54.8	*	8.8	10.5
Bottle Gourd	White	-		27.8	
	Local	49.0	*	23.3	
	Locki	55.0	*	15.6	22.2
Bitter Gourd	Nusarpari	57.1	*	15.7	
	Ghotki	47.0	*	11.0	
	Lucknow	62.6	*	9.1	11.9
Cauliflower	Cheen-ka-Moti	97.1	*	23.1	23.1
Carrot	Desi	95.2		14.2	14.2
Radish	Japani	75.0		16.8	16.8
Turnip	Japani	57.5		14.2	
	Purple Top	69.6		10.5	
	Local	60.2		11.8	12.2
Peas	Early Dwarf	65.8		8.0	
	Kelves	88.2		5.8	
	Newzeeland	90.5		4.9	6.2

Remarks : (*) ; Growth period after transplanting
Source : Annual Report, 1985 - 1989
The Horticulture Research Institute, Mirpurkhas

Table E.3.10 POTENTIAL AND ANTICIPATED CROP YIELD

Crops	Potential Yield			Anticipated Yield		
	Crop Guide (1)	HRI (2) Mirpurkas	Hyderabad District (3)	Present	Without Project	With Project
	(t/ha)	(t/ha)	(t/ha)	(t/ha)	(t/ha)	(t/ha)
A. Fodder Crops						
Lucerne	20 - 30	-	25.4	13.9	13.9	26.0
Maize	18 - 23	-	16.4	10.6	10.6	18.0
B. Vegetables						
Solanaceous						
Tomato	5 - 10	23.2	6.0	3.3	3.3	7.0
Eggplant	5 - 10	19.1	7.8	4.9	4.9	9.0
Chilli	5 - 10	7.2	2.3	1.0	1.0	2.5
Cucurbits						
Sponge Gourd	10 - 15	-	9.8	3.1	3.1	11.0
Bottle Gourd	8 - 15	22.2	5.9	4.7	4.7	8.0
Cole Crops, Green, Herbs						
Cauliflower	13 - 18	23.1	9.7	13.3	13.3	16.0
Spinach	10 - 13	-	4.9	2.6	2.6	6.0
Root Crops						
Carrot	10 - 13	14.2	10.1	5.4	5.4	11.0
Radish	18 - 20	16.8	11.0	4.0	4.0	13.0
Turnip	13 - 20	12.2	13.8	6.6	6.6	15.0
Legunes, others						
Peas	8 - 10	6.2	3.9	2.6	2.6	5.0
C. Fruits						
Guava	-	-	6.3	3.8	3.8	7.0
Mango	-	-	8.5	6.1	6.1	9.0
Chikoo	-	-	2.7	2.3	2.3	3.0
Coconut	-	-	-	2.7	2.7	4.0
Papaya	-	-	6.9	7.3	7.3	8.5

Sources : 1) Crop Guide ; Agricultural Extension Depertment, Government of Sindh
2) HRI ; Vegetable Reseach Station, Horticulture Research Institute, Mirpurkhas
3) Hyderabad District , 1987/88 ; Bureau of Statistics, Planning and Development Department, Government of Sindh

Table E.3.11 CROP PRODUCTION UNDER WITHOUT PROJECT

Crops	Summer Season			Winter Season			Annual
	Cropped Area (ha)	Unit Yield (t/ha)	Production (tons)	Cropped Area (ha)	Unit Yield (t/ha)	Production (tons)	Production (tons)
A. Fodder Crops							
Lucerne	100	13.9	1,390				1,390
Maize, others	50	10.6	530	40	10.6	424	954
All Fodder	150	(12.8) *	1,920	40	(10.6) *	424	2,344
B. Vegetables							
Solanaceous							
Tomato	400	3.3	1,320				1,320
Eggplant	90	4.9	441	50	4.9	245	686
Chilli	10	1.0	10	10	1.0	10	20
Sub-total	500	(3.5) *	1,771	60	(4.3) *	255	2,026
Cucurbits							
Sponge Gourd	110	3.1	341	50	3.1	155	496
Bottle Gourd	80	4.7	376	40	4.7	188	564
Sub-total	190	(3.8) *	717	90	(3.8) *	343	1,060
Cole Crops, Green, Herbs							
Cauliflower	100	13.3	1,330				1,330
Spinach	50	2.6	130	60	2.6	156	286
Sub-total	150	(9.7) *	1,460	60	(2.6) *	156	1,616
Root Crops							
Carrot	80	5.4	432	40	5.4	216	648
Radish	50	4.0	200	20	4.0	80	280
Turnip	40	6.6	264	10	6.6	66	330
Sub-total	170	(5.3) *	896	70	(5.2) *	362	1,258
Legunes, others							
Peas	80	2.6	208				208
Others	160	4.6	742	10	4.6	46	788
All Vegetables	1,250	(4.6) *	5,794	290	(4.0) *	1,162	6,956
C. Fruits							
Guava	280	3.8	1,064				1,064
Mango	390	6.1	2,379				2,379
Chikoo	80	2.3	184				184
Coconut	90	2.7	243				243
Papaya	50	7.3	365				365
Others	110	4.8	523				523
All Fruit	1,000	(4.8) *	4,758				4,758
Total	2,400		12,472	330		1,586	14,058

Remarks : (*) ; Weighted average = Annual production ÷ Annual cropped area
All fodder ; 2,344 tons ÷ 190 ha = 12.3 t/ha
All vegetables ; 6,956 tons ÷ 1,540 ha = 4.5 t/ha
All fruit ; 4,758 tons ÷ 1,000 ha = 4.8 t/ha

Table E.3.12 CROP PRODUCTION UNDER WITH PROJECT

Crops	Summer Season Cropped Area (ha)	Unit Yield (t/ha)	Production (tons)	Winter Season Cropped Area (ha)	Unit Yield (t/ha)	Production (tons)	Annual Production (tons)
A. Fodder Crops							
Lucerne	100	26.0	2,600				2,600
Maize, others	50	18.0	900	50	18.0	900	1,800
All Fodder	150	(23.3) *	3,500	50	(18.0) *	900	4,400
B. Vegetables							
Solanaceous							
Tomato	1,000	7.0	7,000				7,000
Eggplant	500	9.0	4,500				4,500
Chilli				350	2.5	875	875
Sub-total	1,500	(7.7) *	11,500	350	(2.5) *	875	12,375
Cucurbits							
Sponge Gourd				1,000	11.0	11,000	11,000
Bottle Gourd				400	8.0	3,200	3,200
Sub-total				1,400	(10.1) *	14,200	14,200
Cole Crops, Green, Herbs							
Cauliflower	300	16.0	4,800				4,800
Spinach	300	6.0	1,800				1,800
Sub-total	600	(11.0) *	6,600				6,600
Root Crops							
Carrot	200	11.0	2,200				2,200
Radish	150	13.0	1,950				1,950
Turnip	150	15.0	2,250				2,250
Sub-total	500	(12.8) *	6,400				6,400
Legunes, others							
Peas	200	5.0	1,000				1,000
Others	400	8.1	3,238	350	8.1	2,833	6,071
All Vegetables	3,200	(9.0) *	28,738	2,100	(8.5) *	17,908	46,646
C. Fruits							
Guava	280	7.0	1,960				1,960
Mango	390	9.0	3,510				3,510
Chikoo	80	3.0	240				240
Coconut	90	4.0	360				360
Papaya	50	8.5	425				425
Others	110	7.3	803				803
All Fruit	1,000	(7.3) *	7,298				7,298
Total	4,350		39,536	2,150		18,808	58,344

Remarks : (*) ; Weighted average = Annual production ÷ Annual cropped area
All fodder ; 4,400 tons ÷ 200 ha = 22.0 t/ha
All vegetables ; 46,646 tons ÷ 5,300 ha = 8.8 t/ha
All fruit ; 7,298 tons ÷ 1,000 ha = 7.3 t/ha

Table E.3.13 INCREMENTAL CROP PRODUCTION WITHOUT AND WITH PROJECT

Crops	Without Project			With Project			Incremental Production
	Cropped Area (ha)	Unit Yield (t/ha)	Production (tons)	Cropped Area (ha)	Unit Yield (t/ha)	Production (tons)	(tons)
A. Fodder Crops							
Lucerne	100	13.9	1,390	100	26.0	2,600	1,210
Maize, others	90	10.6	954	100	18.0	1,800	846
All Fodder	190	(12.3) *	2,344	200	(22.0) *	4,400	2,056
B. Vegetables							
Tomato	400	3.3	1,320	1,000	7.0	7,000	5,680
Eggplant	140	4.9	686	500	9.0	4,500	3,814
Chilli	20	1.0	20	350	2.5	875	855
Sponge Gourd	160	3.1	496	1,000	11.0	11,000	10,504
Bottle Gourd	120	4.7	564	400	8.0	3,200	2,636
Cauliflower	100	13.3	1,330	300	16.0	4,800	3,470
Spinach	110	2.6	286	300	6.0	1,800	1,514
Carrot	120	5.4	648	200	11.0	2,200	1,552
Radish	70	4.0	280	150	13.0	1,950	1,670
Turnip	50	6.6	330	150	15.0	2,250	1,920
Peas	80	2.6	208	200	5.0	1,000	792
Others	170	4.5	788	750	8.1	6,071	5,283
All Vegetables	1,540	(4.5) *	6,956	5,300	(8.8) *	46,646	39,690
C. Fruits							
Guava	280	3.8	1,064	280	7.0	1,960	896
Mango	390	6.1	2,379	390	9.0	3,510	1,131
Chikoo	80	2.3	184	80	3.0	240	56
Coconut	90	2.7	243	90	4.0	360	117
Papaya	50	7.3	365	50	8.5	425	60
Others	110	4.8	523	110	6.9	761	238
All Fruit	1,000	(4.8) *	4,758	1,000	(7.3) *	7,256	2,498
Total	2,730		14,058	6,500		58,302	44,244

Remarks : (*) ; weighted average, see Table E.3.11 and E.3.12

FIGURES

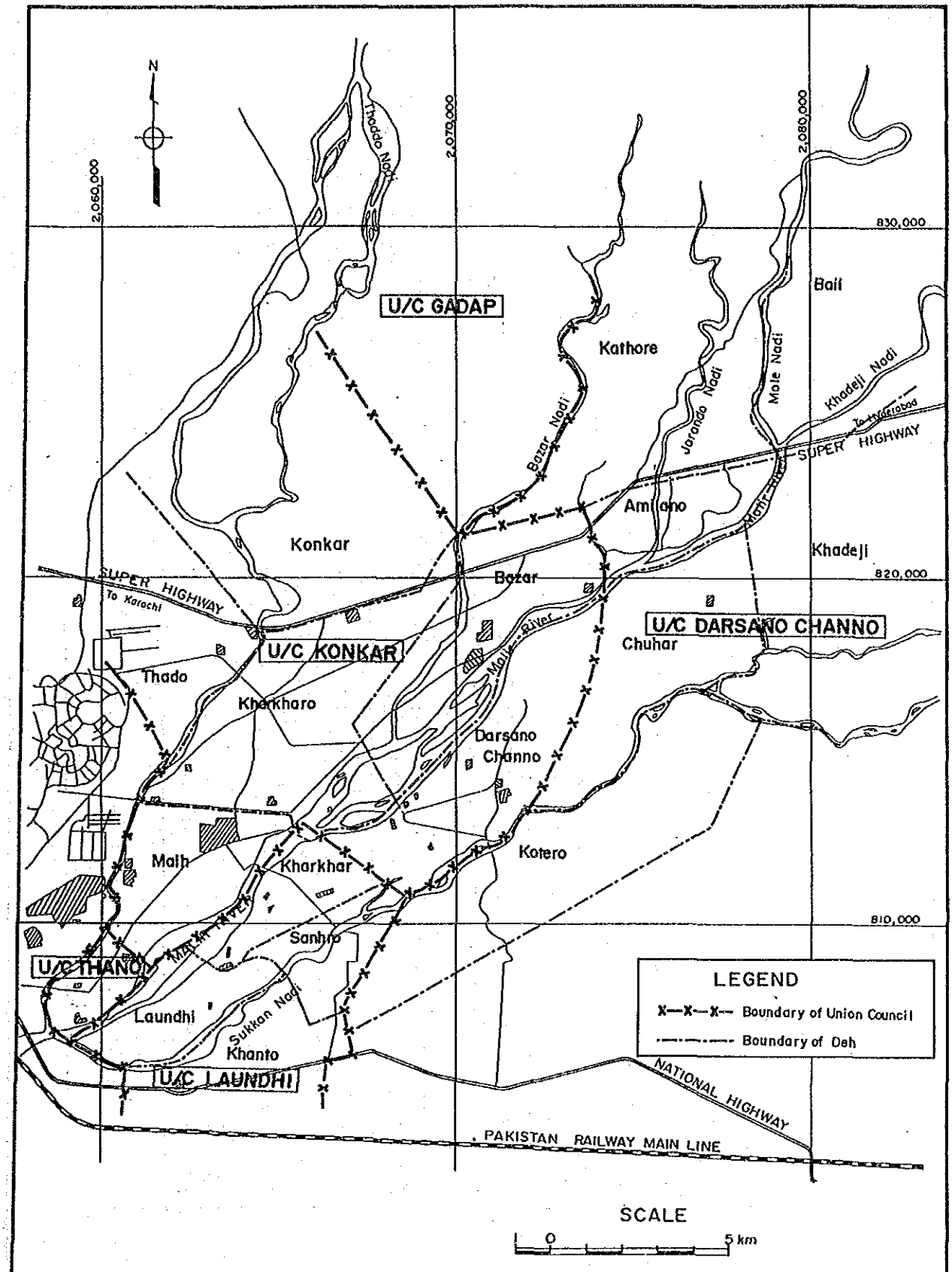

Fig. E.2-1 Administrative Divisions

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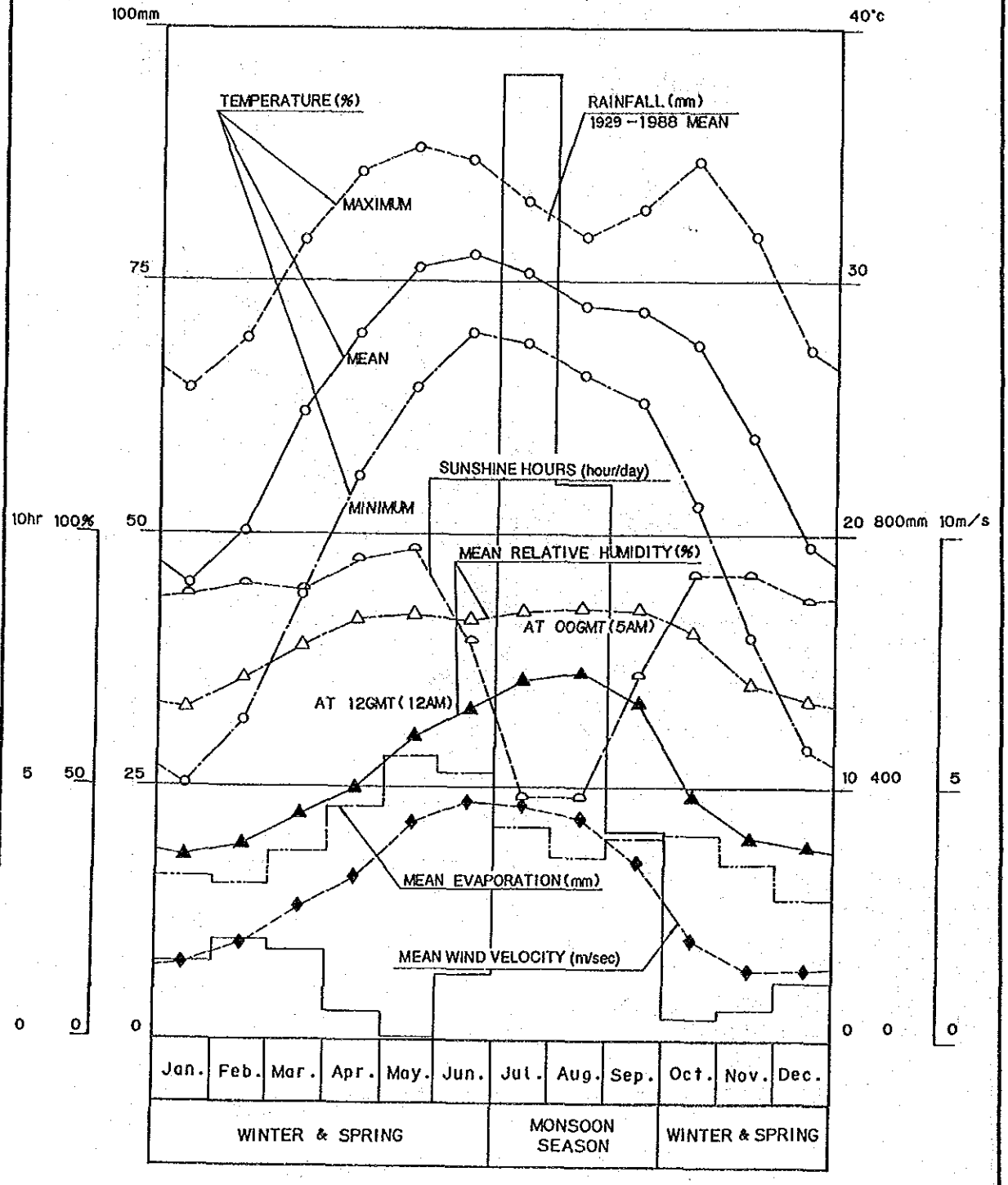

Fig. E.2-2 Monthly Meteorological Characteristics

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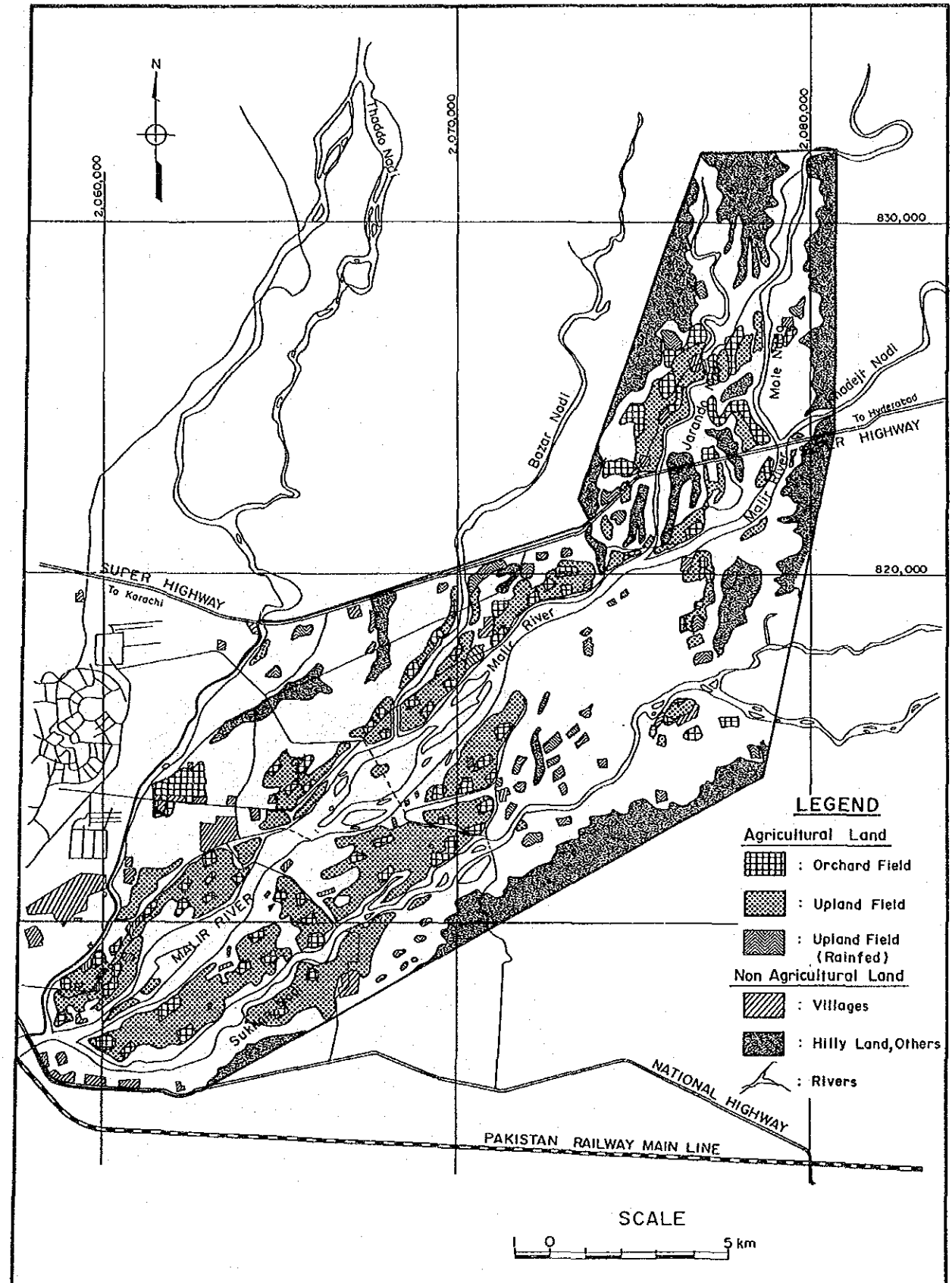

Fig. E.2-3 Present Land Use Map

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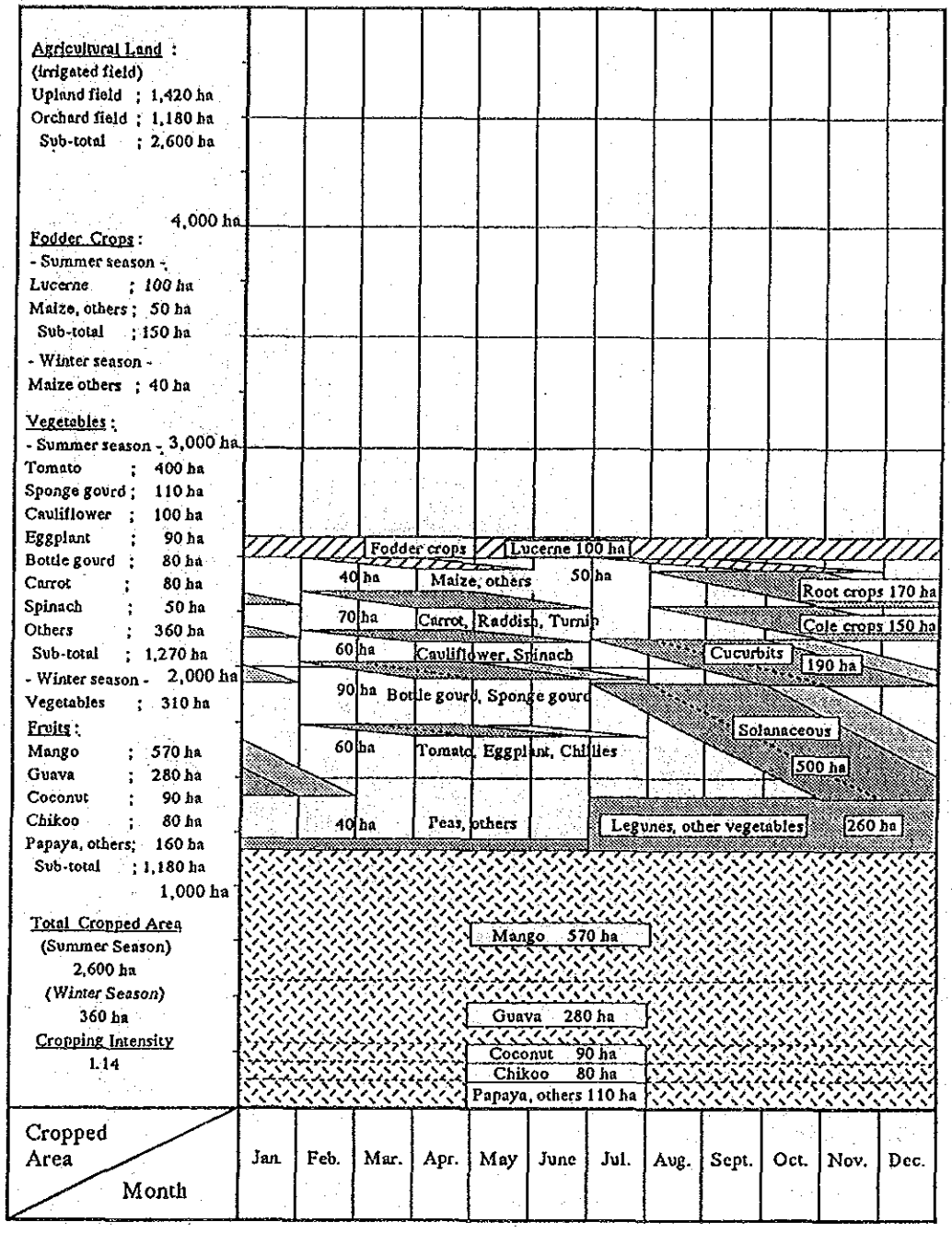

Fig. E.2-4 Cropping Pattern and Cropping Intensity (Present Condition in the Project Area)

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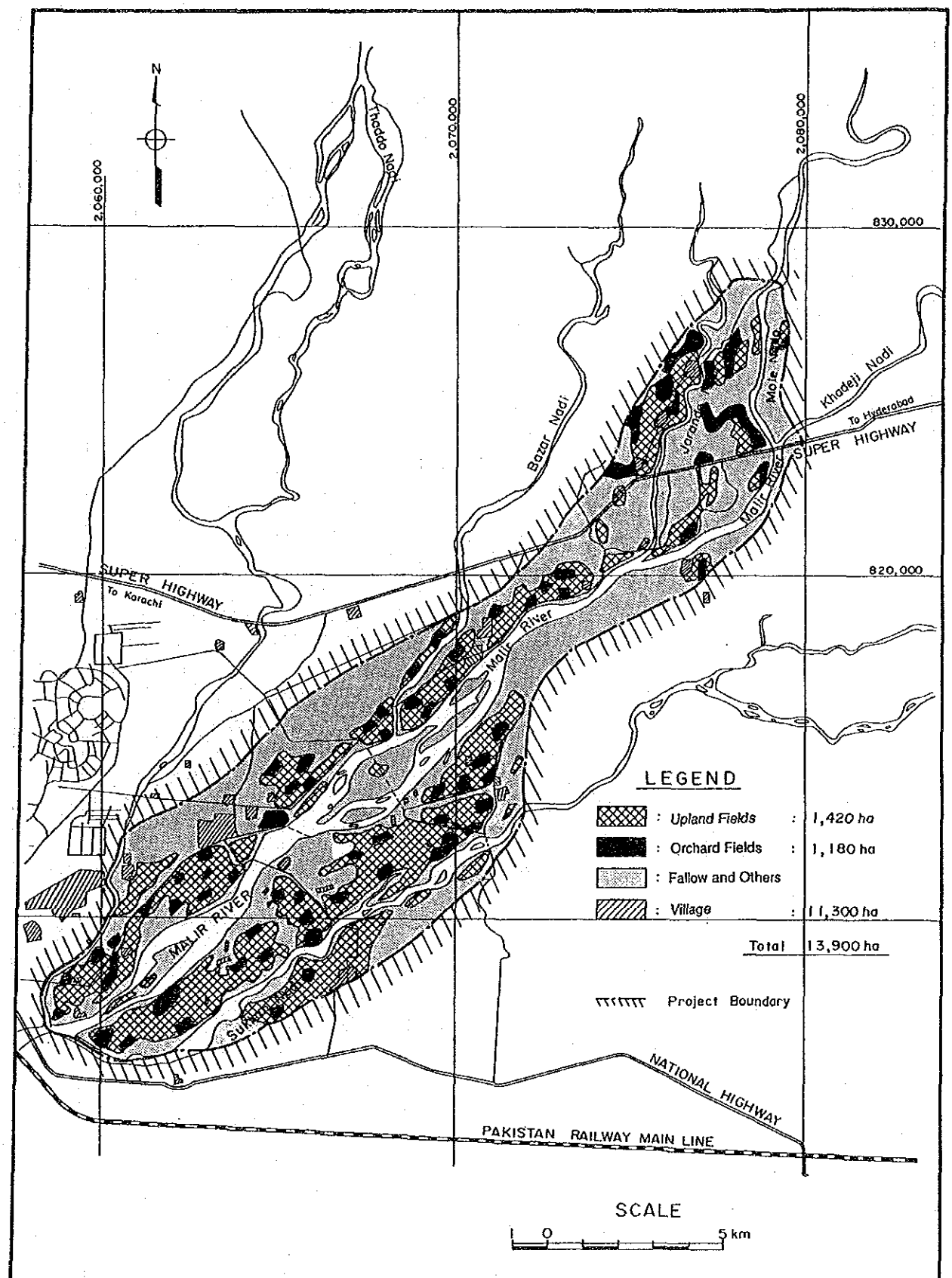

Fig. E.3-1 Project Boundary

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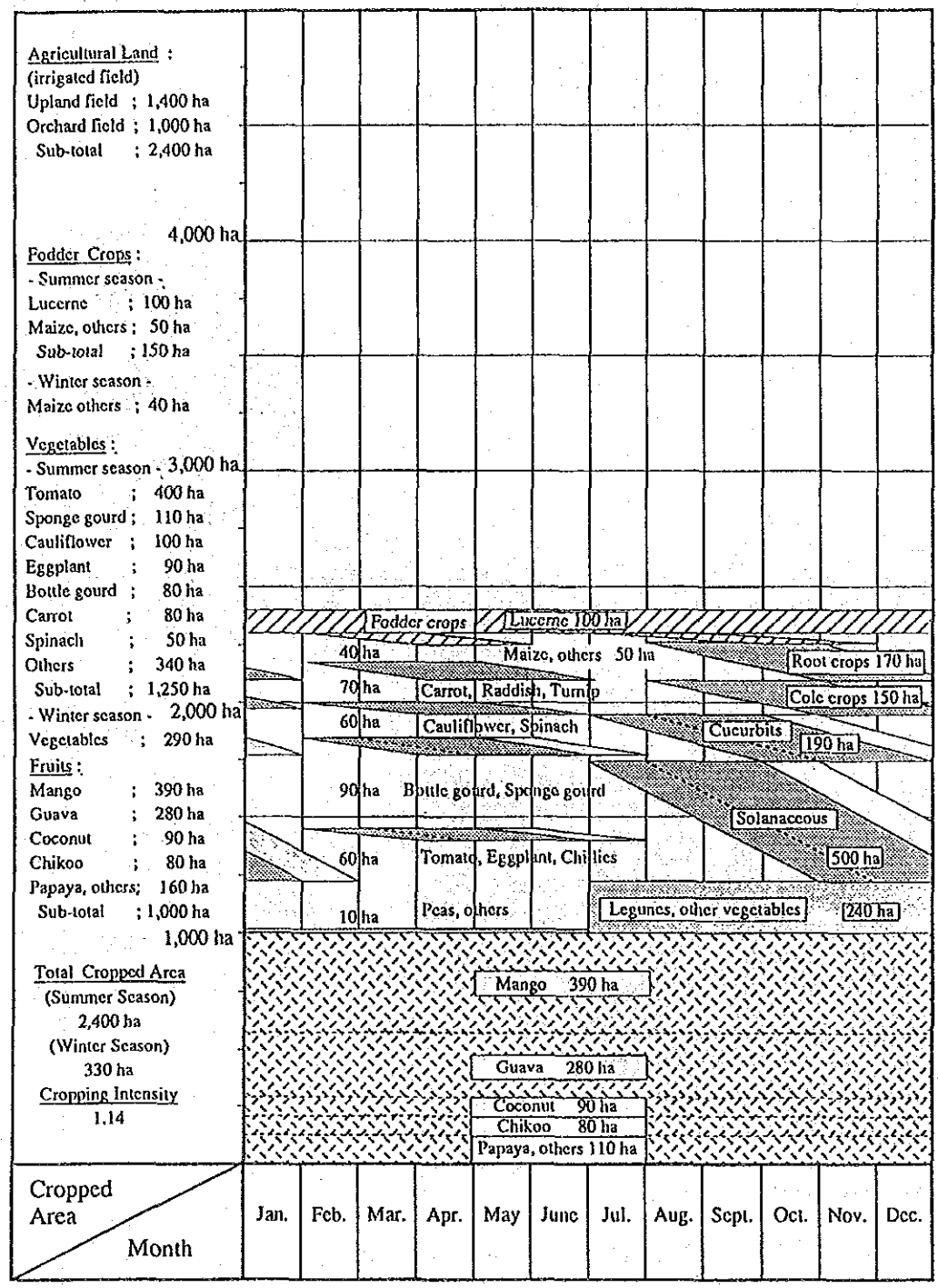

Fig. E.3-2 Cropping Patten and Cropping Intensity (Without Project)

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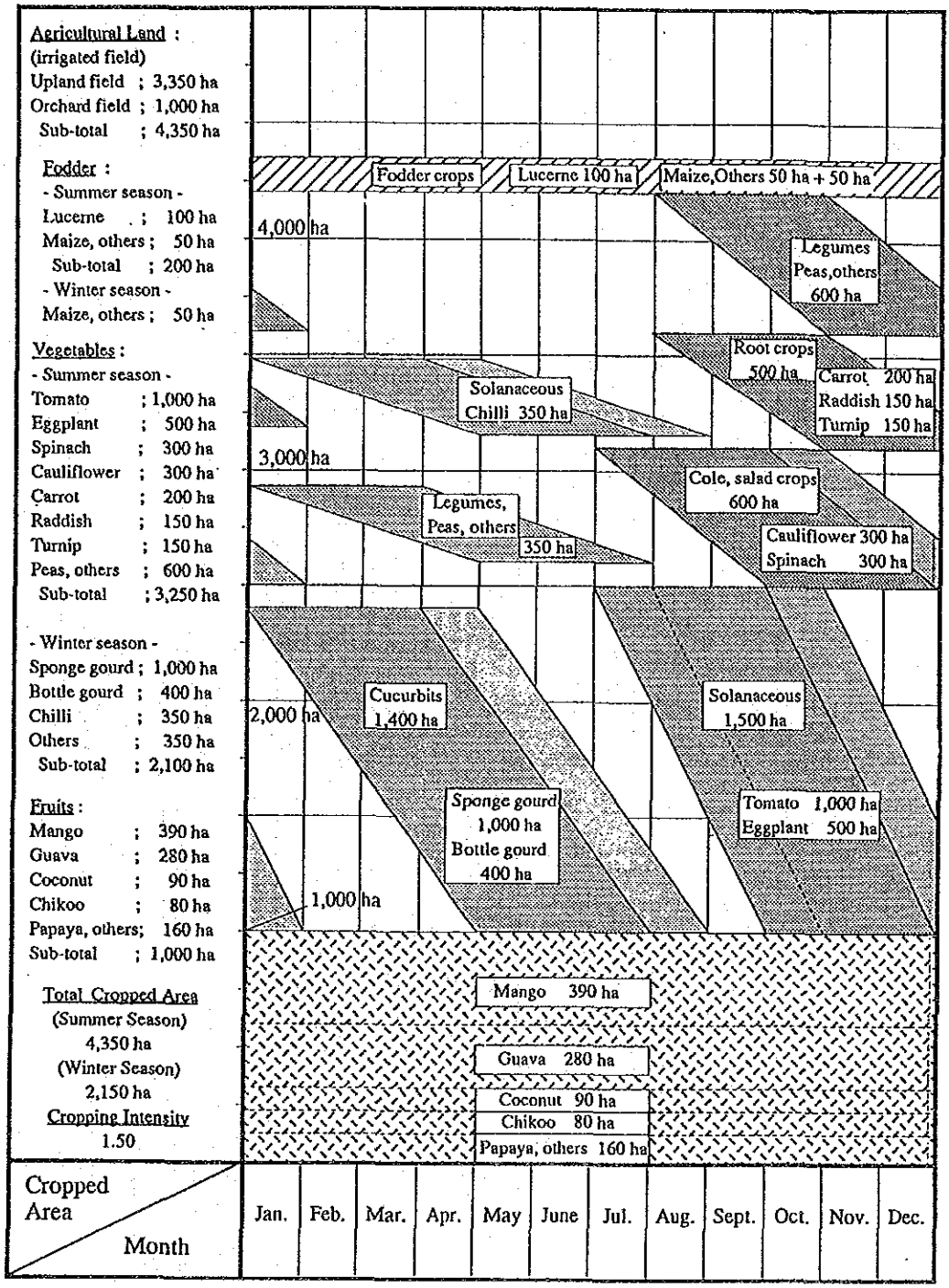

Fig. E.3-3 Proposed Cropping Pattern and Cropping Intensity (With Project)

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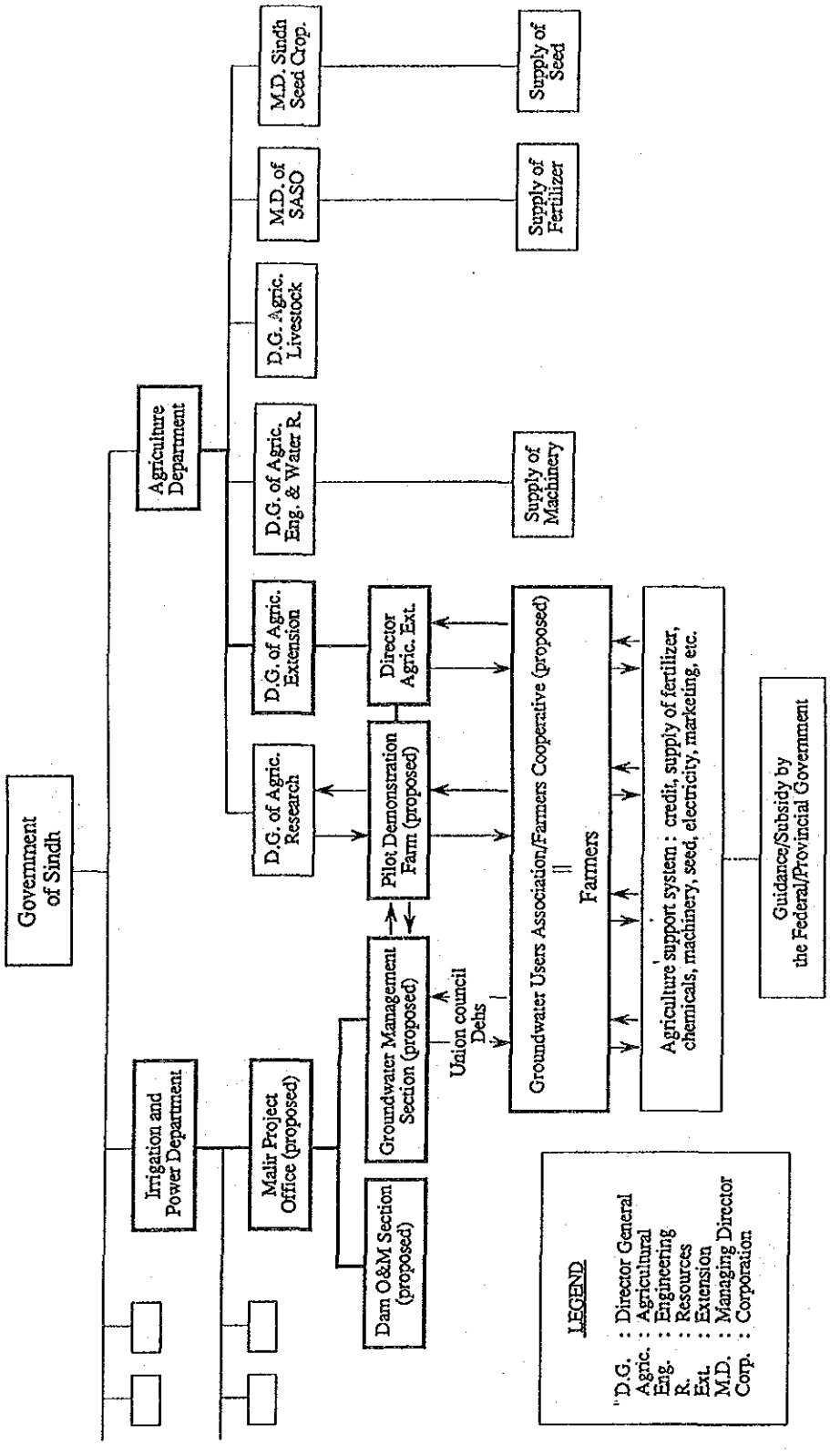

Fig. E.4-1 Organization during O&M Stage

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