As shown in above table, EIRR of "Alternative 1" is slightly lower than those of "Alternatives 2 and 3" but the Net Present Value, production of paddy and foreign exchange saving in case of "Alternative 1" are expected to be substantially larger than the other two Alternatives. Besides, additional benefits to the Pedro Plain Project would be derived by diverting irrigation water from the irrigation facilities of "Alternative 1". Consequently, it is clear that "Alternative 1" is the most desirable for developed.

4.3 Agricultural Development Plan

4.3.1 Proposed cropping pattern

The proposed development area is divided into two areas, viz., upland comprising mineral soils and marsh areas with peat soils. After implementation of the irrigation and drainage facilities, both areas will be systematically and economically developed for profitable agriculture. The following 2 types of cropping pattern are proposed for the Project in view of the existing cropping practices.

1) Triple cropping on mineral soils

This pattern is proposed for both the Holland area and the Hatfield area, which are composed mostly of mineral soils. In this pattern there would be, double crops of paddy one from April to July and the other from August to November, and legumes from December to February. Since a third crop of rice may be difficult owing to the limitation of irrigation water and growing period, soya bean - which is second in importance to rice in Jamaica - would be introduced as the third crop in the dry season. This pattern which is quite intensive but could be attractive once mechanized. The total area under this cultivation would be about 780 ha (1,950 acre).

2) Double cropping on peat soils

In the case of peat soils, cultivation of upland crops during the dry season should be avoided because tillage and the rapid decomposition of peat when dry would cause subsidence of the field surface and the liberation of toxic organic acids which are harmful to rice. Therefore, double cropping of rice would be practised on peat soil areas namely, Styx River Basin, Frenchman-Holiday Pen, and over both banks of the Broad

River. The spring rice would be grown from the end of March through the end of June and the fall rice from August through mid November. The total area for this pattern would be about 2,300 ha (5,750 acre).

From the viewpoint of photo-synthetic efficiency on yield as well as cold damage on sterility, double crops of paddy are proposed for planting from the end of March through the mid December as shown in Fig. 8. Rice varieties proposed would be both Newbonnet, Lamont and Bond for mineral soils, and both Labelle and Lebonnet for peat soils. For soya beans, Duo-crop-variety is recommended for introduction in the Project. These varieties have been introduced to Jamaica for several years. The following table shows the cropping area under each proposed cropping pattern.

Unit: ha (acre)

Soil type	Name of area	Area	Spring rice	Fall rice	Soya bean
Mineral:	Black River R.B.	560	500	560	560
	Hatfield	220	220	220	220
	Sub-total	780	720	780	780
		(1,950)	(1,800)	(1,950)	(1,950)
Peat:	Styx River Basin	300	300	300	-
	Frenchman-Holiday Pen	400	400	400	
	Broad River R.B.	800	800	800	-
	Broad River L.B.	800	800	800	-
	Sub-total	2,300	2,300	2,300	-
		(5,000)	(5,000)	(5,000)	
	Total	3,080	3,020	3,080	780
		(7,700)	(7,550)	(7,700)	(1,950)

As shown in the above table, the total cultivated area would be 6,880 ha (17,200 acre), therefore, the annual cropping intensity would be 223%. Due to the limited dependable discharge in April (0.24 m^3/sec), the Y.S. River can ensure irrigation water for only 500 ha of spring rice cropping.

4.3.2 Proposed farming practices

Cultural practices for rice and soya beans would be based on methods recommended by MOA or in AGRO 21, and determined according to environmental conditions in the development area after referring to procedures at BRUMDEC and Meylersfield and experimental results in Jamaica and other countries.

The dry seed method would be used for spring rice planting with broadcasting of seeds on mineral soils and drilling on peat soil; wet sowing after puddling/levelling under water would be adopted for fall rice on both mineral and peat soils. Soon after the harvest of fall rice, land preparation for soya beans would require tillage as for spring rice. A moderate soil moisture content is desirable because soya bean seeds require moisture of more than 100% of their dry weight from soil for germination. It is advisable to make ridges and to sow in furrows in order to better withstand drought under the dryland farming condition.

4.3.3 Farm inputs

Fertilizer applications would be determined from experience gained at BURMDEC and Meylersfield and from the nutrient contents of irrigation water and by either mineral or peat soils in the development area, with due consideration to environmental preservation.

Application of chemicals for pest and weed control should be restricted from the view point of environmental pollution and mammalian toxicity. However, there is no prescription at present in Jamaica to regulate the application of agricultural chemicals. Considering the special importance of environmental preservation in this Project area, it is recommended that selection and application of chemicals follow the "Standard Safety Application of Agricultural Chemicals in Japan" which was published in accordance with the Agricultural Chemicals Regulation Law and Food Hygiene Law. Details are given in Table 6 and Annex G.

4.3.4 Anticipated yield and production

With the introduction of improved farming practices as well as proper water management, the crop yield is expected to increase considerably. During the first two years after development, peat soil fields would be in an unstable condition, experiencing differential settlement of field surface and other problems owing mainly to the decomposition of peat. Therefore, even if rice is cultivated under good management, high yields could not be immediately expected. Peat fields will remain somewhat unstable with low yields up to the fourth year, but after that, yields would increase with the stabilization of field conditions and improved cultural conditions suitable to peat soils.

Mineral soil fields would be of unequal soil constitution for the first two years owing to levelling of the field surface at the time of construction, and normal yields could not be expected during the first years. However, by the third years, the soil should have recovered to almost stable conditions and yields would improved steadily through improved cultural conditions, and after that yields would gradually increase up to the seventh year.

Based on the above conditions, and the yields obtained in Meylersfied and BRUMDEC, as well as with the expected effectiveness of water and farm management, the following yields of paddy are anticipated.

Unit: ton/ha (10^3 lb./acre)

Soil Type	Year						
	1st	2nd	3rd	4th	5th	6th	7th
Mineral soil	3.4 (3.0)	3.6 (3.2)	4.2 (3.8)	4.6 (4.1)	5.0 (4.5)	5.3 (4.7)	5.5 (4.9)
Peat soil	2.0 (1.8)	2.2 (2.0)	2.4 (2.1)	2.8 (2.5)	3.6 (3.2)	4.2 (3.8)	4.5 (4.0)

The yield of soya bean is estimated on the basis of actual yields at the research station and on the assumption that suitable new varieties would be chosen for the dry season crop. The anticipated yield is shown below:

Unit: ton/ha (10^3 lb./acre)

Year	1st	2nd	3rd
Yield	1.7 (1.5)	2.2 (2.0)	2.5 (2.2)

The following table shows the anticipated crop production at the full development stage in the Project.

Unit: tons (10^6 lb.)

Scheme	Paddy		Soya Bean
	Mineral soil	Peat soil	
Holland	5,830 (12.8)	-	1,400 (3.1)
Black River Left Bank	2,420 (5.3)	6,300 (13.9)	550 (1.2)
Broad River Right Bank	-	7,200 (15.8)	-
Broad River Left Bank	-	7,200 (15.8)	-
Total	8,250 (18.1)	20,700 (45.5)	1,950 (4.3)

4.3.5 Labor force and farm mechanization

Land preparation and harvesting of rice and soya beans, which require considerable manpower in manual operation would be mechanized, while sowing, weeding and fertilizing etc., would be done manually. Manual works would be done by family labor force (an average of 3 persons per family).

Small type tractors of the 30 HP class with adequate implements are proposed for land preparation, because the bearing capacity of paddy soil will be so low in wet fields, especially on peat soils, that larger tractors with larger attachments would not be able to operate with normal efficiency. As to harvesting, a small type of conventional combine to rice specification is recommended because of its better trafficability on such weak ground, durability and wider adaptability for crop conditions than head-feeding type combine. Table 10 shows the required numbers of farm machinery in the Project. The duration of mechanized operation would be extended as much as possible within the range of a growing season, so that the required number of machines could be minimised. The required numbers of machines per sub-area would be determined for each cropping pattern taking into consideration the number of workable days and hours.

A mechanical service station would be located in each sub-area. Each station would contract out the mechanized operations in the field for settled farmers and rent out small equipments for self-operation in the field. Each station would also have a workshop for maintenance and repair of farm machinery and other facilities, management staff and facilities including a stock of necessary tools, spare parts and materials.

4.3.6 Marketing and price prospects

1) Marketing prospects

In order to estimate the marketable surplus of products after implementation of the Project, the following demand and supply balance study was made for the full development stage (details are given in Annex F):

Unit: ton (10^6 lb.)

Item	Paddy
1. Total production	28,950 (63.7)
2. Seeds and waste requirement	2,895 (6.4)
3. Conversion to rice (0.6 of paddy)	15,633 (34.4)
4. Consumption in the Project area (8,880 persons)	266 (0.6)
5. Marketable surplus	15,367 (33.8)

From the above study, the expected marketable surplus of products would be about 15,400 tons (34 million lb.) of milled rice (25,660 tons of dried paddy). In addition, a marketable surplus of about 1,950 tons (4.3 million lb.) of soya beans will be expected, from which edible oil would be produced.

2) Price prospects

In assessing the prospective prices of farm inputs and production cost, a shadow exchange rate (SER) was studied to assess the economic viability of the proposed agricutural development realistically. Based on the average external trade value of the last 5 years in Jamaica, SER was estimated at 1.02. Thus, if the current exchange rate of US$1.00 equals to J$4.00 (as of 1984) in terms of the financial price factor, then US$1.00 equals to J$4.1 in terms of the economic price factor when converted.

The conversion between international market prices and farm gate prices was made by reference to "The Price Prospects for Major Primary Commodities" prepared by IBRD, December 1983. The economic farm gate prices of products were estimated to be J$1,500/ton for paddy, J$2,400/ton for soya bean and J$70/ton for sugar cane (see Table 12).

The financial prices of farm products and inputs at farm gate prices were estimated from available data on present farm gate prices. For the financial evaluation, farm gate prices of paddy at J$1,100/ton and soya bean at J$1,300/ton in 1984 were used (see Table 12).

4.3.7 Crop production cost and value

1) Crop production cost

The present agricultural condition would not be changed significantly unless a new irrigation and drainage project is

implemented. For the estimation of production costs in the without Project condition, therefore, only unit prices of production expenses were forecast by using the economic farm gate prices of farm inputs, without changing the unit requirement for farm inputs and labour.

After implementation of the Project, the economic crop production cost of a small farm and the mother farm would increase by about J$7,330 and J$7,640 per ha on mineral soil and J$4,030 and J$4,210 per hectare on peat soil (see Table 13). This anticipated increase is primarily attributable to the increase of expenses for fertilizer, agro-chemicals, farm machinery and labour costs, etc.

2) Crop production value

The annual net crop production values without the Project are estimated to be about J$304,000 in which J$273,000 of sugar cane is included, on the basis of the forecast economic farm gate prices as shown in Table 14.

After implementation of the Project, the annual net crop production value of a small farm will amount to J$15,350 per ha on mineral soil and J$9,660 per ha on peat soil at the full development stage. While the annual net crop production value per ha of the mother farm will amount to J$15,040 on mineral soil and J$9,480 on peat soil (see Table 13). The total annual net production values with the Project is estimated at about J$33.7 million at full development stage (see Table 14).

4.3.8 Farm economy

1) Selection of Farm size

The farm size of a settler was planned tentatively based on the following conditions:

i) The net annual reserve of a settler should be equal to or greater than that of the government policy of (J$10,000 to 12,000),

ii) The net annual reserve of a settler on mineral soil and peat soil should be similar, and

iii) The labour force for manual work should to be covered by family labor, consequently 6 ha was the maximum to be considered.

The farm size for a settler was estimated to be 3 ha on mineral soil and 5 ha on peat soil respectively.

2) Estimation of Farm Budget

The settler will reach the maximum net annual reserve 7 years after settlement both on mineral and peat soils due to increase in productivity. After 7 years, the net reserve of settlers on mineral soil (3 ha) will be J$21,310 and on peat soil (5 ha) J$25,390 per annum (see Table 16). However, the net annual reserve of a settler stands at a very low level in the initial stage especially on peat soil as shown in Table F-42 in Annex F. Hence it is considered that some financial arrangement such as a government subsidy will be necessary for the execution of his annual farm production plan during the initial stage of settlement. The increased net reserve would offer incentives to the farmers for further development, and the substantial payment capacity would enable them to pay some charge for irrigation water.

4.3.9 Land settlement

The immediate target of the Project would be to develop 3,080 ha (7,700 acres) and a tentative allocation of this land was made as follows:

Mother Farm	800 ha (2,000 acres)
Pilot Scheme	70 ha (170 acres)
Small Farmers	2,210 ha (5,530 acres)
Total	3,080 ha (7,700 acres)

If the size of average farm units on mineral and peat soils are to be 3 ha and 5 ha respectively, then the number of settlers in the entire area will be 518 in total. The following table shows the number of farms for which settlers would be recruited and trained:

- Holland	117
- Black River Left Bank	169
- Broad River Right Bank	116
- Broad River Left Bank	116
Total	518

The recruitment and training of settlers would be the responsibility of the Farm Liaison Committee of the Holding Company. However, the settlers would become the responsibility of the Farm Development Company. The Farm Development Company through its Farm Manager would have an important part in the training and selection process being a member of the Farm Liaison Committee and consequently, would be in support of those selected. The proposed organisation of the Project is described in Section 4.6.

Recruits who have successfully pursued the training course would be settled on lands closest to their homes. For others not from the immediate area, provision for accommodation will need to be considered. After settlement, the Farm Development Company will accept responsibility for extension services, farm supplies, credit and marketing. The Holding Company will supply irrigation and drainage facilities and prepare contracts that will stipulate the lease conditions of land. The detailed functions of the Companies are presented in Section 4.6.

4.4 Irrigation and Drainage Plan

4.4.1 Irrigation water requirement

Measurement of evapotranspiration and percolation rates in paddy fields were made during a crop season from late July to mid October 1984. Although the results obtained are reasonably close to the amounts estimated from climatic data, the observed period is too short to be used for predicting irrigation water requirements. The evapotranspiration of crops were therefore estimated from climatic data. Since flood irrigation is proposed for paddy cultivation, percolation rates have to be taken into account. The percolation rates on mineral soils and peat soils were estimated to be 1.0 mm/day and 5.0 mm/day respectively. Consequently the summation of evapotranspiration and percolation gives the water requirement of paddy. For soya beans, for which furrow irrigation is proposed, the percolation rate was not taken into account.

Effective rainfall is the product of rainfall efficiency and probable minimum monthly rainfall in a 5 year return period. The rainfall efficiency was estimated by the daily water/moisture balance method using daily rainfall records at several rainfall stations. As a result, the rainfall efficiency varies from 70% to 90% of actual rainfall

for rice and 65% to 70% for soya beans. The balance of the water requirement and effective rainfall indicates the irrigation water requirement. The irrigation period was taken to be about 80 days for rice on mineral soil, 90 days on peat soil and 80 days for soya bean. Pre-irrigations have to be done prior to land preparation and sowing. The calculation was made on a monthly basis and is summarized for one crop season as shown below:

Unit: mm

Soil/Crop	Evapotranspiration	Percolation	Effective rainfall	Balance	Pre-irrigation	Net irrigation requirement
Mineral soil						
Spring rice	502(621)	81	222(248)	361	120	481
Fall rice	402(481)	81	282(296)	201	120	321
Soya bean	255(305)	-	37(44)	218	30	248
Peat soil						
Spring rice	496(613)	450	239(285)	707	90	797
Fall rice	402(481)	450	320(345)	532	90	622

(Figures in parentheses are the total amount for the growing period. Effective rainfall at the Holland rainfall station was adopted in the above example.)

The overall irrigation efficiency (Ei) was estimated as a product of application efficiency (Ea), operation efficiency (Eo) and conveyance efficiency (Ec).

Unit: %

	Ea	Eo	Ec	Ei	
Flooding irrigation	100	80	85	68	Say 70
Furrow irrigation	70	80	85	48	Say 50

Taking into account the above overall irrigation efficiency, the gross irrigation requirement and monthly peak diversion requirement were estimated as shown below:

	Gross irrigation requirement (mm)			Monthly peak diversion requirement(lit./sec/ha)
	Spring rice	Fall rice	Soya bean	
Mineral soil	687	459	496	0.96
Peat soil	1,139	889	-	1.45

Consequently, the peak diversion requirement for the Holland area was estimated at 0.45 m^3/sec, by which 560 ha would be irrigated, and that for the other areas, which would be pumped up from the Black River, was estimated to be 3.42 m^3/sec as shown in the following table:

	Unit: m^3/sec
Y.S. System; Holland	0.45
Lacovia pump up system;	3.42
Hatfield	0.20
Styx River	0.44
Frenchman-Holiday Pen	0.48
Broad River Right Bank	1.15
Broad River Left Bank	1.15

4.4.2 Drainage water requirement

1) Water to be drained at flood time

Drainage is essential for the Project particularly in the marsh land. The runoff from the drainage basin was estimated by the unit hydrograph method. A probable maximum 3-days continuous rainfall with a 10-year return period was adopted as the design rainfall in the estimation. The peak runoff obtained by unit hydrograph in each drainage basin were estimated as follows (see Annex H):

Area	Drainage area(ha)	Design rainfall(mm)	Peak runoff (m^3/sec)
Holland	990	228	25.0
Black River Left Bank	1,680	256	51.5
Broad River Right Bank	1,180	256	36.4
Broad River Left Bank	1,080	199	23.0

The above peak runoffs include the base flow, which comprises other components such as percolation losses from the paddy field, loss of irrigation water and groundwater inflow from the hinterland of the Project area, as shown below:

Area	Base flow (m^3/sec)
Holland	0.35
Black River Left Bank	0.94
Broad River Right Bank	0.87
Broad River Left Bank	0.86

In general, rice plants can be submerged without undue damage for a period of less than 3 or 4 days. In this case, the top of plants must be exposed to at least 15 cm above the water surface. Taking this condition into consideration, the allowable inundation water depth and time was taken as 30 cm and 48 hours. In order to estimate the actual inundation depth and time on the paddy fields, a water balance calculation was made between runoff due to design rainfall and discharge to be drained by pumps. As a result, the design discharge and peak discharge was determined in each area as shown below:

Unit: m^3/sec

Area	Discharge	
	Design	Peak
Holland	4.5	5.2
Black River Lefk Bank	7.5	8.7
Broad River Right Bank	6.0	6.7
Broad River Left Bank	4.5	5.0

2) Water to be drained in an ordinary period

The elevation of the paddy fields to be developed is lower than the water surface in the rivers into which water will be discharged, hence excess water will ordinarily have to be drained by pumps. The amount of excess water is taken as the surplus between the summation of annual rainfall, irrigation losses, groundwater inflow, and evapotranspiration. The amount of excess water was estimated as shown below:

	Drainage area (ha)	Annual amount ($10^3 m^3$)	Drainage requirement (m^3/sec)
Holland	990	8,800	0.28
Black River Left Bank	1,680	22,600	0.73
Broad River Right Bank	1,180	13,000	0.42
Broad River Left Bank	1,080	12,000	0.38

4.4.3 Irrigation system

1) Y.S. intake system (Holland area)

A new intake structure will be constructed and about 1.5 km of the main canal will be rehabilitated to divert the diversion requirement of 0.45 m^3/sec. After crossing the Bamboo Avenue, the main canal will branch off to twelve secondary and sub-secondary canals, 11.1 km in total (see PLATE 5). From the viewpoint of irrigation efficiency and minimizing operation and maintenance costs as well as protection against weeds, the main, secondary and sub-secondary canals will be lined with concrete. This system will covers a net area of 560 ha. At various intervals along the secondary canals, tertiary turnouts will be provided to convey water to the tertiary canals. As a result of economic comparison, soil cement in which cement and sand are mixed was selected for lining tertiary canal. Side spillways will be provided at a few places to prevent overtopping and damage to the embankments due to mismanagement.

2) Lacovia pump up system

This system covers a net area of about 2,520 ha that includes the Black River left bank, and the Broad River right and left banks. A pump station with a 3.42 m^3/sec discharge capacity will be constructed on the left bank of the Black River at about 1.6 km downstream from the Lacovia old bridge. A further 1.7 m^3/sec is allowed for the Pedro Plain Irrigation Project.

An inclined mixed flow pump was selected by economic comparison as it offers construction costs will be less than for a vertical mixed flow pump. Four sets of 700 mm diameter pump will be installed, while 2 additional sets would be necessary for water supply to the Pedro Plain as mentioned in Section 4.5. Since the pumps will be operated almost throughout the year, electric motor drive will be more economical than a diesel engine drive. The pump station will be located near Lacovia village, where electrification will be economical. From the stilling basin to be constructed at the delivery point of the pump station, two main canals will bifurcate, one to both the Black River left bank and the Broad River right bank areas and the other to the Broad River left bank area (see PLATEs 6 and 7). The former (Slipe Main Canal) commands about 1,520 ha and the latter (Mountainside Main Canal) 1,000 ha respectively.

The 5.2 km Slipe Main Canal will have 1.98 m^3/sec of design discharge capacity at its head and 0.63 m^3/sec at its tail. The 8.8 km Mountainside Main Canal will have 1.44 m^3/sec capacity at its head and 0.59 m^3/sec at its tail (see Vol. III Drawings).

The secondary canal will feed a secondary field unit by drawing its water from the main canal through its turnout. Eleven secondary canals totalling 15.4 km will branch off from Slipe Main Canal and three canals of 5.1 km in all will branch off from Mountainside Main Canal. The main and secondary canals will be of trapezoidal shape and lined with concrete. On one side of the canal a gravel paved farm road will be constructed for maintenance and water management and for access to the tertiary field units for tillage and harvesting operations. Tertiary canals lined with soil cement will branch off from secondary canals to divert irrigation water to the farm land.

4.4.4 Drainage system

1) Drainage canals

Farm drain will be provided at intervals of 50 m (see Annex H). After several years, the open ditches will be replaced by pipe drains for more effective operation of farm mechanization. The total length of farm drains was estimated to be about 650 km.

From the farm drains, drainage water will be collected by the lateral drain, which is a trapezoidal open ditch. The main drainage canal will lead the drainage water collected from the lateral drains to the drainage pump station. The total length of the main and lateral drainage canals is listed below.

Unit: km

	Holland	Black R. L/B	Broad R. R/B	Broad R. L/B	Total
Main	8.9	17.1	7.0	8.2	41.2
Lateral	28.0	46.0	40.0	40.0	154.0

2) Drainage pump station

Four drainage pump stations are proposed to be established, in the areas as described below. In the Holland area the existing pump station will be reconstructed. In the Black River left area, a new pump station

is proposed at Cataboo upland at the western end of the area, in the Broad River right bank area at the site of Salt Spring bridge, in the Broad River left bank area near Salt Spring bridge. The locations of the proposed pump stations are shown in PLATEs 5, 6 and 7.

As the drainage water requirement at flood time is larger than that in ordinary times, the required number of pumps would be between 3 and 5 sets to save operation costs. Generally a pump of more than 1,000 mm in diameter necessitates more complicated maintenance work than that of small pumps. Taking the above conditions into consideration, the required numbers and diameter of the pumps are determined as shown below:

Pump station	Diameter (mm)	Number	Total discharge(m^3/sec)
Holland	800	3	4.5
Black River Left	800	5	7.5
Broad River Right	800	4	6.0
Broad River Left	800	3	4.5

Inclined axial flow pumps are proposed from economic comparison as they offers more economical cost than vertical axial flow pumps. Diesel engined power units are proposed since operational hours at maximum capacity would be short and construction cost economical.

4.4.5 Polder dike

The agricultural development area will be protected by artificial dikes from floods of the Black River and the Broad River. The flood dikes along both banks of the Black River are designed to pass 200 m^3/sec (Sub-section 3.3.3) of flood between 2 m high embankments spaced 150 m apart. Fill materials for embankments will be borrowed from the excavated spoil of the drainage system. In some cases, additional embankment materials will be employed from the outside of the proposed dikes. A 8 m wide service track for inspection as well as traffic purposes will be provided on the embankment. The existing dike along the right side will be raised up to 2.0 m height (see Vol. III Drawings). The total length of the Black River dikes will be 10.2 km of which left dike will be 8.3 km.

A dike to be called as the Holland East dike will be newly constructed along the main drain located at eastern part of the Holland area. The length of the dike is to be 2.9 km. Another dike is proposed along the left bank of the Y.S. River. The average height and length is 1.0 m and 1.6 km respectively.

No specific high flood in the Broad River is expected, because most of flood water in the development area will be drained by the pumps in the lower reach of the River after the dikes have been constructed, limiting the catchment basin to a negligible area. Furthermore, the dike will be constructed about 700 m apart in due consideration of the impact of the Project on the Broad River ecosystem. Consequently, only a 0.8 m height of dike with a 6 m service track width is to be provided. The length of the dike of the right side and left side are 5.7 km and 5.7 km respectively. The layout of polder dikes are shown in PLATEs 5, 6 and 7.

4.4.6 On-farm development

The land reclamation plan on marsh land was carefully made based on the physical characteristics of the peat soil as well as the trafficability of farm machinery after the construction of fields. A typical field plot was determined to be 50 m by 100 m, and rectangular in shape, which will be enlarged to 100 m by 200 m after the field has adequately subsided. Farm ditches lined with soil cement will be spaced at 200 m intervals. The standard length of a farm ditch will be about 1,000 m. Division boxes will be provided on a farm ditch at about 200 m intervals. The division box will be made of precast concrete.

4.4.7 Road system

A road system is contemplated within the development area so as to connect the farm land to the main traffic road, the processing facilities and the proposed machinery centers. The proposed widths of roads are 8 m for the main, 7 m for secondary and 6 m for tertiary farm roads. A farm road is proposed along one side of the main and secondary irrigation canals. Gravel metalled roads are the proposed until embankment of materials have settled. The total length of the proposed roads is approximately 300 km.

4.5 Proposed Works

A general layout of proposed irrigation and drainage facilities is shown in the PLATEs 5 to 7. The principal features of the proposed facilities are summarized as follows:

PRINCIPAL FEATURES OF HOLLAND SYSTEM

1.	Source of Irrigation Water	:	Y. S. river
2.	Gross Irrigable Area	:	680 ha
3.	Net Irrigable Area	:	560 ha
4.	Y.S Intake Weir		
	4.1 Design discharge of intake	:	0.45 m^3/s
	4.2 Intake weir	:	Fixed type concrete weir B = 14.0 m, H = 2.6 m
	4.3 Gate	:	Submerged orifice gate 0.5 m x 0.7 m
5.	Irrigation Facility		
	5.1 Main canal		
	(1) Canal type	:	Trapezoidal concrete lined canal
	(2) Design discharge	:	0.45 - 0.31 m^3/s
	(3) Canal length	:	3.2 km
	5.2 Secondary & Sub-secondary Canal		
	(1) Canal type	:	Trapezoidal concrete lined canal
	(2) Design discharge	:	0.18 - 0.02 m^3/s
	(3) Canal length	:	11.1 km
6.	Holland Drainage Pump Station		
	6.1 Type of pump	:	Inclined axial flow driven by diesel engine
	6.2 Diameter	:	800 mm
	6.3 Design discharge per one unit	:	90 m^3/min
	6.4 Capacity of power unit	:	125 HP
	6.5 Number of pump sets	:	3 sets
7.	Main Drainage Canal		
	7.1 Canal type	:	Trapezoidal earth canal
	7.2 Design discharge	:	2.68 - 0.93 m^3/s
	7.3 Canal length	:	8.9 km
8.	Roads		
	8.1 Length of main road	:	9.0 km
	8.2 Length of secondary road	:	19.4 km
	8.3 Length of farm road	:	34.0 km
9.	On-farm Development	:	560 ha
10.	Dike		
	10.1 Length of Black river right dike	:	1.9 km
	10.2 Length of Holland east dike	:	2.9 km
	10.3 Length of Holland west dike	:	2.4 km
	10.4 Length of Black River short cut	:	0.5 km
11.	Y.S. River Bank (Improvement)	:	1.6 km

PRINCIPAL FEATURES OF LACOVIA PUMP UP SYSTEM

(Figures in the parentheses in case of water supply to Pedro Plain)

1.	Source of Irrigation Water	:	Black river
2.	Lacovia Pump Station		
	2.1 Type of pump	:	Inclined mixed flow driven by electric motor
	2.2 Diameter	:	700 mm
	2.3 Peak discharge per one unit	:	68 m^3/min (61 m^3/min)
	2.4 Capacity of power unit	:	120 kW (110 kW)
	2.5 Number	:	4 nos. (6 nos.)
3.	Irrigation Facility		
	3.1 Slipe Main Canal		
	(1) Canal type	:	Trapezoidal concrete lined canal
	(2) Design discharge	:	1.98-0.63 m^3/s (2.55-1.20 m^3/s)
	(3) Canal length	:	5.2 km
	3.2 Mountainside Main Canal		
	(1) Canal type	:	Trapezoidal concrete lined canal
	(2) Design Discharge	:	1.44-0.59 m^3/s (2.57-0.59 m^3/s)
	(3) Canal length	:	8.8 km
4	Roads		
	4.1 Length of main road	:	25.5 km
	4.2 Length of secondary road	:	26.2 km
	4.3 Length of farm road	:	64.0 km

(Black River Left Bank Area)

5.	Gross Irrigable Area	:	1,200 ha
6.	Net Irrigable Area	:	920 ha
7.	Secondary Canal		
	7.1 Canal type	:	Trapezoidal concrete lined canal
	7.2 Design discharge	:	0.57-0.03 m^3/s
	7.3 Canal length	:	12.3 km
8.	Black River Left Pump Station		
	8.1 Type of pump	:	Inclined axial flow driven by diesel engine
	8.2 Diameter	:	800 mm
	8.3 Pump capacity	:	90 m^3/min
	8.4 Capacity of power unit	:	110 HP
	8.5 Number of pump sets	:	5 sets
9.	Main Drainage Canal		
	9.1 Canal type	:	Trapezoidal earth canal
	9.2 Design discharge	:	8.70-0.62 m^3/s
	9.3 Canal length	:	17.1 km
10.	Length of Secondary Farm Road	:	27.3 km
11.	On-farm Development	:	920 ha
12.	Length of Black River Left Dike	:	8.3 km

(Broad River Right Bank Area)

5.	Gross Irrigable Area	:	1,000 ha
6.	Net Irrigable Area	:	800 ha
7.	Secondary Canal		
	7.1 Canal type	:	Trapezoidal concrete lined canal
	7.2 Design discharge	:	0.41-0.16 m^3/s (0.98-0.16 m^3/s)
	7.3 Canal length	:	3.1 km (5.5 km)
8.	Broad River Right Pump Station		
	8.1 Type of pump	:	Inclined axial flow driven by diesel engine
	8.2 Diameter	:	800 mm
	8.3 Design discharge per one unit	:	90 m^3/min
	8.4 Capacity of power unit	:	105 HP
	8.5 Number of pump sets	:	4 sets
9.	Main Drainage Canal		
	9.1 Canal type	:	Trapezoidal earth canal
	9.2 Design discharge	:	6.70-0.88 m^3/s
	9.3 Canal length	:	7.0 km
10.	Length of Secondary Farm Road	:	17.5 km (18.9 km)
11.	On-farm Development	:	800 ha
12.	Length of Broad River Right Dike	:	5.7 km
13.	Santa Cruz (North) Catch Drain	:	4.0 km

(Broad River Left Bank Area)

5.	Gross Irrigable Area	:	1,000 ha
6.	Net Irrigable Area	:	800 ha
7.	Secondary Canal		
	7.1 Canal type	:	Trapezoidal concrete lined canal
	7.2 Design discharge	:	0.32 - 0.15 m^3/s
	7.3 Canal length	:	5.1 km (6.6 km)
8.	Broad River Left Pump Station		
	8.1 Type of pump	:	Inclined axial flow driven by diesel engine
	8.2 Diameter	:	800 mm
	8.3 Design discharge per one unit	:	90 m^3/min
	8.4 Capacity of power unit	:	100 HP
	8.5 Number of pump sets	:	3 sets
9.	Main Drainage Canal		
	9.1 Canal type	:	Trapezoidal earth canal
	9.2 Design discharge	:	5.00-0.49 m^3/s
	9.3 Canal length	:	8.2 km
10.	Length of Secondary Farm Road	:	19.2 km (20.7 km)
11.	On-farm Development	:	800 ha
12.	Length of Broad River Left Dike	:	5.7 km
13.	Santa Cruz & Arlington Catch Drain	:	13.0 km

4.6 Project Organization and Management

4.6.1 Factors influencing the proposed management structures

In planning the management and settlement structure, the Government has contributed the accumulated experiences of a series of such programmes and, more recently, the experience of AGRO 21 in divesting the Meylersfield Rice Project as well as other joint venture projects developed by the Jamaica National Investment Bank (formerly Jamaica National Investment Co. and a government organization), and by the private sector like Jamaica Agri Products Ltd., among others.

Certain policies of the Government have evolved from this experience. They have also helped the Government to adopt new concepts in agricultural development. Some of the concepts and policies are cited below:

i) the private sector should be the engine of growth;

ii) all development programmes should be viable, export oriented or designed towards foreign exchange saving;

iii) each farmer, before settlement, should be recruited, trained and selected;

iv) the recruitment process should include selection by an accepted set of criteria, and should be done by an committee appointed for the purpose;

v) lands allocated to settlers should have the potential of producing a net income of J$10,000 to 12,000/unit/annum;

vi) such projects should be structured around a central unit which will provide all the support services - farm inputs, land preparation and reaping services, credit support, water management, all these in a system of supervised credit, extension and marketing. This will be the role of the mother farm;

vii) administration and support services already in the government sector should be utilized, where possible.

4.6.2 Organization structure

The organizational structure of the Project will be divided into three components as follows (see Fig. 9):

i) the Holding Company,
ii) the Farm Development Company, and
iii) the Farmers' Association.

1) The Holding Company

The Holding Company would be responsible for the construction of civil engineering works, development of the pilot farm, land lease and management as well as recruitment, training, selection and settlement of farmers. These functions are essentially those of the government and it is proposed that they be accommodated in a Holding Company of the Government. This company will require a Board of Directors appointed by the government. Its membership should not exceed 7 and should include:

- the Permanent Secretary, MOA or his nominee
- the Commissioner of Lands
- a respresentative from the Ministry of Finance
- a representative from the Jamaica National Investment Bank
- a representative from the National Water Commission, and
- two other nominees.

The Holding Company would be organized into two departments, Technical and Administration Department.

2) The Farm Development Company

The Farm Development Company would represent the private sector either on its own or in joint venture with the Government, being responsible for developing the mother farm, managing the milling and marketing functions of the Project and providing certain prescribed services as part of a contract to the satellite farmers who would have been trained and settled by the Holding Company. Such functions would be carried out through the Farm Development Company which would lease the land and either lease or purchase the other facilities from the Holding Company. The Farm Development Company would be organized into 4 departments, Commercial, Operation and Maintenance, Farm Supplies and

Mother Farm. Should the private sector/joint venture attempts not materialize then the functions of the Farm Development Company, perhaps with slight modification, would be taken over by the Government.

3) The Farmers' Association

The Farmers' Association would represent the farmers on the proposed 5 farm development areas for their mutual benefit as shown in Fig. 9. The Association would organize regular meetings for farmers to discuss management, would provide a cooperative negotiating body with the Farm Development Company, and would promote agricultural extension and credit, etc. As there are 5 branches of the Jamaica Agricultural Society (JAS) in and around the Project area at present it is possible that the farmers may organize themselves through JAS.

4.6.3 Coordination and liaison

Though the Holding Company and the Farm Development Company are separate entities there must be wide areas of collaboration between them for mutual benefit. For example, the Managing Director of the Holding Company should be a member of the Development Company, and the Farm Manager should be represented on the sub-committee responsible for selection, training and settlement of the farmers. In this way, matters of common interest can be discussed like irrigation and drainage, and selection and settlement of farmers among others.

4.7 Implementation Schedule

4.7.1 Basic considerations

The implementation schedule for the Project was worked out on the following basis:

(1) The construction schedule is drawn up in such a way as to make capital investment productive as soon as possible.

(2) On-farm development and the civil works are integrated in one working schedule particularly in the peat area.

(3) Since swamp land is mostly composed of peat with a very low bearing capacity, an amphibious type of equipment is used for land reclamation as well as for canal excavation and embankment construction.

(4) Before commencement of the actual construction works, about 12 months of detailed design, preparation of tender documents, tender calling and tender award are needed.

(5) A consultant will be engaged by the Project Office to prepare the detailed design, tender documents, supervision of construction works, assistance and guidance in operation and maintenance of project facilities, and farm guidance to the Holding Company, the Farm Development Company and farmers.

(6) Although the Government owns most of the Project area, some areas may belong to private persons. Compensation for land acquisition and right of way will have to be made by the Government prior to the commencement of the works.

(7) Prior to commencement of construction works of Broad river right and left bank areas, hydrogeological investigations will be carried out for about 1 year and a half to evaluate post project groundwater flow regime as well as change of groundwater quality. (See ANNEX C Table C-8)

4.7.2 Work quantities and construction materials

The quantities of works and main construction materials needed for the Y.S. and Lacovia Systems are shown below:

1) Work Quantities

	Unit	Y.S	Lacovia	Total
Excavation	$10^3 m^3$	295	1,378	1,673
Earth embankment	$10^3 m^3$	286	1,446	1,732
Concrete for structures	$10^3 m^3$	2.2	6.5	8.7
Concrete for canal linings	$10^3 m^3$	4.6	13.5	18.1
Soil cement	$10^3 m^3$	3.0	17.0	20.0
Land levelling	$10^3 m^3$	134	351	485

2) Construction Materials

	Unit	Y.S	Lacovia	Total
Cement	10^3ton	2.1	7.4	9.5
Reinforcing bars	ton	110	330	440
Gravel for concrete	10^3m^3	6.7	20.3	27.0
Sand for concrete	10^3m^3	6.8	29.2	36.0
Gravel for roads	10^3m^3	87	178	265
Timber	10^3m^3	0.1	0.3	0.4
Fuel	kl	330	1,490	1,820
Gates (steel)	ton	3	16	19

4.7.3 Construction time schedule

The time required for construction works of the Project would be about 5 years including mobilization, construction of office and quarters, and operation and adjustment of the irrigation and drainage system. A tentative implementation schedule is shown in Fig. 10. Construction on the marsh land will be commenced from the polder dikes, main and secondary drainage canals and the drainage pump stations. As soon as polder dikes and pump stations are completed, drainage pumps will be operated to drain the area inside the dikes. Construction of the polder dikes and drainage pump stations in the Holland and Black River Left Bank areas will be started in the second year, and in the fourth year construction will start in the Broad River Right and Left areas.

Construction of new Y.S. Intake Weir and its irrigation system will be one of the first activities to be carried out in order to supply irrigation water in time for the first fall season rice crop in the third year. On-farm development in the Holland area will also be started from the upper reaches of the system early in the third year and be completed in that year. Construction of the Lacovia pump station and its irrigation system would be commenced from the third year. In order to start the on-farm work in the Black River Left Bank area in the early third year, the early construction of drainage canals and temporary operation of drainage pumps would be necessary. The on-farm works would be completed in the middle of the fourth year. The on-farm work in the Broad River Right and Left areas would be commenced from the fourth year and completed in the sixth year.

Housing facilities, workshop, guest house and other permanent facilities will be required at an early stage to facilitate activities for project construction supervision and management.

The construction equipment needed for Project implementation was estimated from the work quantities, construction time schedule, construction method and site specific conditions as shown below:

Equipment	Specifications		Number of Equipment
Amphibious clamshells	0.4 m^3	125 HP	7
Super swamp dozers	12 ton	93 HP	5
Swamp type backhoes	0.4 m^3	92 HP	10
Swamp type bulldozers	13 ton	112 HP	10
Backhoes	0.7 m^3	130 HP	2
Backhoes	0.4 m^3	85 HP	3
Tractor shovels (wheel)	1.0 m^3	75 HP	3
Dump trucks	8 ton	242 HP	15
Bulldozers (with Ripper)	21 ton	211 HP	4
Motor graders	2.5 m	76 HP	4
Rubber-tire rollers	10 ton	89 HP	4
Concrete mixers	0.2 m^3	7 HP	5
Aggregate plant	165 ton/day		1
Truck cranes	15 ton		2
Cargo trucks with crane	3 ton		4
Fuel tankers	6 kiloliter		3
Water tankers	6 m^3		2
Batcher plant	20 m^3/hr		1
Agitator trucks	1.5 m^3		7
Water pumps	8"		5

4.8 Cost Estimate

4.8.1 Basic conditions

The construction cost was estimated on the following basis:

i) The exchange rate used in the estimate was

US$1.0 = J$4.0 = ¥240.0

ii) All construction works will be carried out on an international contract basis using contractors' own machinery.

iii) The unit rates for civil work items were estimated using prices prevailing in Jamaica as of August 1984.

iv) Taxes on construction materials, machinery and equipment to be imported, if needed, were not included in the construction cost estimate.

v) The associated costs to be financed by the Government or other enterprise such as the cost of social infrastructures were not included in the construction cost.

vi) The construction cost was divided into foreign and local currency portions. The foreign currency portion was estimated from CIF prices at Kingston. The allocation of local and foreign currency portions was defined as follows:

Local currency portion	Foreign currency portion
- Labour force,	- Depreciation cost of construction equipment,
- Sand, gravel and rock,	- Reinforcing bars and gates,
- Cement,	- Structural steel and pumps,
- Wooden materials,	- PVC pipes and steel pipes,
- Inland transportation costs,	- Fuel and lubrication oil,
- Administration expenses,	- Contractor's general expenses and profit,
- Land acquisition cost, and	- Expenses and fees of engineering and farm guidance services by foreign consultants, and
- Expense and fees of local consultants.	- Procurement costs of farm machinery and O & M equipment.

vii) Physical contingencies relating to the construction quantities of 10% of the direct construction cost were included.

viii) Price contingencies were assumed to be 5% per annum for the foreign currency portion and 10% per annum for the local currency portion.

4.8.2 Capital cost

1) Construction costs

The total construction cost of the Project for a net development area of 3,080 ha (7,700 acres) was estimated to be US$43.4 million (J$174 million equivalent) including price contingencies for 6 years. This cost would comprise US$26.2 million (J$105 million equivalent) of foreign currency and US$17.2 million (J$69 million equivalent) of local currency as summarized in Table 8. The annual disbursement schedule was tentatively worked out based on the construction time schedule and shown in Table 9. The break down of costs are shown in Annex N.

In case of providing additional canal capacity to cover the supply of irrigation water required for the Pedro Plain Project, about US$1.3 million (J$5.2 million equivalent) would be required in addition.

2) Farm machinery costs

The initial investment for the Project operation comprises the procurement cost of farm machinery and cost of related facilities and workshop. The total costs required for the farm machinery and workshop were estimated to be US$7.9 million (J$32 million equivalent) which consists of US$7.5 million (J$30 million equivalent) in foreign currency component and US$0.4 million (J$2 million equivalent) in local currency component. Detailed costs of these are given in Annex G.

3) Protection of the ecology and environment

In view of the particular importance of the effects on habitat in the Lower Morass, adequate protection and management of the ecology and environment both during the construction period and after its implementation are needed, for which about US$0.2 million of cost is estimated. Details are given in Annexes G, L and N.

4.8.3 Annual operation and maintenance costs

Annual operation and maintenance costs include the salaries of the Project administrative and water control staffs, materials and labour costs for repair, maintenance of project facilities, costs for operation,

repair and maintenance of O & M equipment, and running costs of project facilities. The annual operation and maintenance costs at the full development stage of the Project were estimated to be US$1.1 million (J$4.4 million equivalent). The details of these costs are described in Annex N.

4.8.4 Replacement costs

Some of the facilities, especially mechanical and electrical facilities will have a shorter useful life than civil works and will have to be periodically replaced. The replacement costs and useful lives of these facilities are listed in Annex N.

5. OTHER NECESSARY INFRASTRUCTURES

5.1 Rice Processing Facilities

The expected total production of the Project of approximately 28,950 tons of paddy will justify the operation of a rice mill as part of the Project. To save transportation costs and to improve processing efficiency, drying and storage equipment will be supplied at each of the five sections, with the mill concentrated at one site.

The success of the milling process is directly related to the quality of the paddy grown. Several qualities of rice with different prices are available on the local market, based mainly on the percentage of broken grains contained in the rice. The proposed mill will produce a relatively high quality rice but mainly for the local market.

The high number of sunshine hours and relatively high relative humidity of the air prevailing throughout the reaping period in the Project area will make drying facilities essential. After the paddy is dried at drying facilities at each section, it may be kept in storage until the central mill can receive it. After milling the rice will be transported to market directly by truck. The capacity of the proposed facilities is shown in Table 11. The operation conditions and capacity of the mill may be summarized as follows:

- Operating days: 150 days in one crop season
- Operating hours per day: 16 hours (8 hours x 2 shifts)
- Moisture content of milled rice: 12% or below
- Finished rice density: 0.8 tons/m^3
- Daily processing capacity: 96 tons (6 ton/hour)

Rice bran is a valuable product for its nutritional qualities (bran contains 15 - 20% of fat, rough starch, protein and Vitamins A and D). But the high fat content means that the quality of the bran deteriorates rapidly. Bran should not be stored for longer than 2 to 3 days. The fat in the bran can be extracted as rice oil and the residue used as cattle and fish feed. So, a detailed study is recommended to determine whether a feed mill on the Project would be profitable.

Costs of facilities required for rice processing consisting of drying, storage and milling components are estimated to be US$11.7 million (J$47 million equivalent). The total cost for rice processing

facilities consists of US$10.8 million (J$43 million equivalent) in foreign currency and US$0.9 million (J$4 million equivalent) in local currency component.

5.2 Social Infrastructures

Agricultural development necessitates other kinds of developments that will support, complement and stimulate its progress. Well planned agricultural production requires adequate communication and transportation systems that will facilitate easy access to information, agro-inputs and market outlets; it requires a reasonably healthy population with a reasonably sufficient provision of water, electricity and housing; it requires the support of and stimulation of adequate educational and training facilities for children, as well as adults (particularly the farmers themselves and participants in specialized additional programmes). The social/ psychological value of such developments must never be under-estimated. It is only when the farmers, their families and the community of which they are a part, experience a sense of security, achievement and social well-being that they can be truly motivated.

The table below provides an estimate total cost of desirable improvement the social infrastructure of the Project area.

Item	Quantity	Cost	
		J$10^3	(US$10^3)
1. Housing			
- Upgrade	195	2,925	(731)
- New housing	260	11,765	(2,942)
2. Schools			
- Upgrade and expand	2	1,275	(319)
- Upgrade	9	917	(229)
3. Health Care (New)			
- Health centre	1	272	(68)
4. Roads (upgrade)			
- Salt spring to Lacovia via Slipe	13 km	2,925	(731)
- Frenchman to Slipe	2 km	450	(113)
5. Water Supply			
- Pipe line	3.7 km	2,006	(502)
- Pump	1	80	(20)
6. Community Centre	1	25	(6)
Total		22,640	(5,611)

6. INLAND FISHERY DEVELOPMENT PLAN

6.1 Impacts of the Project on Inland Fisheries

The Project covers the eastern part of the Lower Morass and is likely to have little serious impact on inland fisheries from the decrease of swamps, because the distribution of shrimp is concentrated in the western part of the Lower Morass. However to protect the canoe base in Frenchman and the fishing ground in the Broad River, the following precautions need to be taken in implementing the Project:

1) A channel must be retained from the Frenchman canoe base to the Black River, or a new canoe base must be established in the Black River.
2) A sufficient distance (about 700 m) must be kept between the dikes on either side of the Broad River.

The construction phase is expected to cause a temporary increase in suspended solids, turbidity, colour and petroleum pollution. However, these impacts are not considered to be serious. The Project will result in (1) an increase in outflow during the rainy season, (2) a decrease in flow in the dry season, and (3) an intrusion of saltwater. The impact due to the first change (1) in the river regime will be beneficial to fishery resources. The impacts resulting from the other two changes (2) and (3) though adverse are not considered to be critical to inland fisheries.

The inflow of fertilizers into the river and swamp will cause eutrophic conditions, which will be favorable to fishery resources, provided it is not excessive. In the Project area, applied chemicals such as herbicides and pesticides will be of classes A and B which should not be harmful to fisheries resources under appropriate management (see Table 6). Therefore, it is concluded that there should be no serious impact from agricultural chemicals used in the Project on the fisheries resources.

6.2 Impacts of Peat Mining Project on Inland Fisheries

The most critical impact of the Peat Mining Project will be the decrease in area of the shallow swamp. Because shrimps are thickly distributed in the Peat Mining Project area, the implementation of the

Peat Mining Project would annihilate the shrimp industry in the Lower Morass through adverse change in the water conditions.

6.3 Land use of Post Peat Mining Lakes for Aquaculture

Post peat mining lakes if dug up to 9 m in depth would result in little shallow water area being left and stratified condition with freshwater on top and salt water below. The water of lakes would be characterized by poor dissolved oxygen. Under these conditions, there will be little possibility of establishing shrimp/fish farming by means of pond culture. Cage and raft cultures might possibly be introduced in these lakes, but these cultures are considered to be relatively inefficient at present.

6.4 Prospective Plan of Fisheries Development in the Lower Morass

6.4.1 National development policy of fish culture

Jamaica has put a great emphasis on the development of aquaculture, especially freshwater shrimp/fish culture and oyster culture to help in meeting its protein needs as well as for foreign exchange saving. The inland Fishery Unit (IFU) under the Ministry of Agriculture (MOA) prepared a Five Year Aquaculture Development Plan for the years 1984-1988 in which the total production of inland fish is projected to increase from 0.5 million lbs in 1983 to 6.1 million lbs in 1988, including a rise in the yield of shrimp culture from 0.3 million lbs to 1.0 million lbs per annum. The main objectives of the plan are to:

- increase food production,
- increase the income of farmers and rural/coastal dwellers,
- create employment, especially in rural and coastal areas,
- improve nutrition in rural areas,
- bring marginal (unproductive) sugar cane land into productive aquaculture,
- increase skills and introduction of appropriate technology,
- develop a self-sustaining local industry, utilize agro/marine skills and locally available waste materials for recycling, and
- assist the Government of Jamaica in alleviating its foreign exchange problems through import substitution.

6.4.2 Marketability of shrimp

The worldwide marketability of shrimps as well as prawns seems to be favorable. Europe's supply of freshwater prawns is only one-fifth of the demand and is seen as an important prespective market for Jamaican suppliers, as this market is closed to U.S. producers. The U.S. market for shrimp, 70% of which is supplied by Central and South America, is currently undersupplied, and is expected to expand at roughly 6% per year. In order that Jamaican shrimp and prawn supplies may compete successfully in both export and domestic markets, they must supply a product which reaches the market place with reliably high quality and in consistent amounts.

Based on the tentative financial evaluation, an investment of about J$ 100,000 per farm (1 ha) will be required for the shrimp pond culture from which 7,920 lbs of shrimps would be produced, and return per farm per year will be about J$ 27,000 in case of sales to domestic market at a price of J$ 15/lb. The expected return would be larger than that in the external trade, i.e. to USA and Europe. Therefore, shrimp culture in Jamaica is considered to be viable even for the domestic market.

6.4.3 Present shrimp culture in Jamaica and in the Project area

There are two shrimp culture enterprises in Jamaica, BRUMDEC at Black River Upper Morass and Jamaica Aqua-Farms Ltd. at Ferris Cross. The BRUMDEC shrimps (Macrobrachium rosenbergii), introduced from Israel, have been bred successfully on a commercial basis, while the local Macrobrachium species has disappeared from its culture ponds. BRUMDEC is negotiating with USA interests for the exporting of cultured shrimps. On the other hand, since 1982 Jamaica Aqua-Farms Ltd. has reopened the Macrobrachium rosenbergii hatchery and is now offering postlarvae for sale. However, the total production of the above enterprises is still short of the expected target.

At present, shrimp catch and resources in the Project area are considered to be balanced. There is the possibility of increasing wild shrimp resources however in the Project area by means of stocking which could result in a considerable seasonal increase in shrimp catch.

6.4.4 Recommended development plan

Taking the above conditions into consideration, it is proposed that a National Aquaculture Research and Extension Center be established in the Project area. The purpose of the Center would be to protect fishermen's livelihood, to introduce fisheries development in the Lower Morass, and to improve the protein intake in Jamaican diet. The Center will be managed by IFU under MOA and be functionally divided into the following four departments:

1) Production Department:

The Production Department would be functionally divided into two sections, Hatchery and Production Sections. It is recommended that the species cultured in the Center should to be mainly Macrobrachium rosenbergii. Aquaculture of the indigenous shrimp species, such as M. acanthurus, should also be encouraged and it is desirable to attempt the stocking trial of the species.

2) Research Department:

The Research Department would be composed of two sections, Biology and Aquaculture Sections. The purpose of the Biology Section will be to gather knowledge of the biology of the wild and introduced shrimp in the Project area. Fishery statistics would be collected and analyzed by this section. The following researche should be initiated in the Aquaculture Section:

- Shrimp culture in rice fields,
- Shrimp/fish mixed culture,
- Research on the possibility of using rice bran as feed for the cultured species, and
- Research on the ecology of the shrimp species and their aquaculture.

3) Marketing Department:

The Marketing Department would be established to get information on marketing and/or how to promote the aquaculture venture in order to formulate a guideline on aquaculture in Jamaica.

4) Training and Extension Department:

This Department will be established to provide general assistance to fishermen such as technical training in aquacultural methods and distribution of shrimp/fish fry, etc.

It is proposed that the Center should be constructed in on the Holland area, on the right bank of the Black River. The Hatchery Section, however, would be constructed in the Black River Estuary near the Black River town market.

7. ENVIRONMENTAL ASSESSMENT

7.1 Impacts of the Project

The impacts of the Project upon the environment can be considered in terms of altered hydrological regimes, use of fertilizers and agro-chemicals and altered the vegetation as well as pre-emption of habitats.

The changing hydrological regimes of the Black River and the Broad River will cause changes in the vegetation cover within the agricultural development area. In fact, approximately 80% of the Typha hummocky swamp and Cladium/Sagittaria association in the upper reach of the Broad River basin will be changed into paddy fields. However, the entire hummocky swamp, in the Middle Quarters River, the major natural forests and the herbaceous swamp in the Black and Y.S. Rivers and the southern part of the Lower Morass will be preserved without damage.

Agro-chemicals such as pesticides and herbicides are essential in intensive commercial rice culture, but the use of these chemicals should be carefully controlled to minimize their impact. It is proposed that use of such chemicals should be subject to a standard equivalent to the Standard for Safe Application of Chemicals in Japan. Since mangrove and swamp forest which provide major habitats of aquatic and non-aquatic birds, were excluded from the Project, the impact of the Project on birds is expected to be minimal. Since major habitats of the american crocodile are concentrated in the southern part of the Lower Morass, there is likely to be little effect on their habitats as a result of the agricultural development.

7.2 Areas to be Preserved

The following areas are estimated to be of high priority for conservation.

(1) The area of the swamp forest and hummocky swamp along the Middle Quarters River, the Y.S. River and the Black River

The swamp forest and the the surrounding areas contain unique forests and herbaceous swamps and riparian communities. No equivalent of these formations exists elsewhere in Jamaica. Furthermore, the surroundings of the Y.S. River and the Middle Quarters River and the forest area

provide habitats for rare and endemic bird species. Besides, these are the most important areas for inland fisheries. Accordingly they should be conserved for inland fishery, and as a sanctuary for birds and plant associations.

(2) The area of the Cladium - Sagittaria association, including the aquatic vegetation in the upper reach of the Broad River and the Blue Holes

This area has many plant species next to the swamp forest and contains an unique aquatic vegetation because of the transparent water coming from the Blue Holes. Its unique ecosystem has not been studied fully, but the herbaceous swamp, the aquatic vegetation and the water quality including the transparency, should be protected strictly from any kind of development and human disturbance.

(3) The area of mangrove forests

These areas occupy an important position in the ecosystem of the Lower Morass. At present mangrove forests remain in the southwestern part of the Lower Morass are patchy due to various human activities and destruction including fires, felling trees for timber, stripping bark for dyes and cultivation. Therefore, the conservation and the further recovery of these areas will be indispensable for the management of the wetland.

7.3 Multi-purpose Development for Sustainable Growth as a National Park

The Black River Lower Morass fulfills all the criteria for a national park in Jamaica. The wet land mentioned in the Section 7.2 is recommended to be properly conserved as a national park in which wetland management will be practised for the multiple use including the preserved area and cultivated areas.

Because of the particular scientific interest of the Lower Morass forest, herbaceous swamp and wildlife, ecological studies should be encouraged and careful attention should be given to the remaining natural environment. It is important to conduct a sound baseline survey followed by periodic monitoring to assess the general impact of agricultural development, since rice development is becoming important in Jamaica for self-sufficiency in food supply.

The biological uniqueness for genetic resources in the Lower Morass is remarkably high. Comprehensive legislation as well as a Standard for Safe Application of Chemicals and National Park Act are urgently required for the conservation of the natural environment.

8. PROJECT EVALUATION

8.1 General

The economic feasibility of the Black River Lower Morass Agricultural Development Project was assessed through the economic internal rate of return (EIRR). The sensitivity analysis was made assuming changes in accrued benefits, build-up and project cost. Then the financial evaluation was carried out by following two ways; farm budget analysis to assess the net reserve of the settlement farm both on mineral and peat soils and the analysis of financial projections of the Farm Development Company and of the Project as a whole to evaluate their repayment capacity on the basis of the estimated fund requirement with assumed terms of the anticipated loan and the expected revenue from the Project. The socio-economic benefit and environmental impacts from the implementation of the Project and their effects on the regional development were also studied.

8.2 Economic Evaluation

8.2.1 Economic cost

The economic costs estimated at 1984 price level of the Project comprise the costs for (1) preparatory works, (2) civil works including on-farm facilities, (3) administrative expenses, (4) engineering services, (5) operation and maintenance equipment and (6) physical contingency of 10%. The land aquisition costs, cost for farm guidance, price contingency and transfer payments are not included in the economic costs. The shadow exchange rate (SER) of 1.02 was applied to the economic costs. The total economic construction costs of the Project were estimated to be J$136.0 million equivalent to US$33.3 million. In addition to the above costs, the annual operation and maintenance costs and the replacement costs for irrigation and drainage facilities were included in the economic costs as shown in Table 15.

8.2.2 Project benefits

The incremental agricultural benefits are the difference in net production value between "with project" and "without project". The annual incremental benefits will increase year by year to reach its

maximum in the 13th year of the Project implementation. The total economic annual incremental benefits will amount to about J$33.3 million (US$8.1 million) at full development (3,080 ha) as shown in Table 14.

8.2.3 Economic internal rate of return (EIRR)

The economic internal rate of return (EIRR) was calculated based on the economic benefit and cost flows. The result shows that the Project is economically feasible with an EIRR of 13.3% (see Table 15).

8.2.4 Sensitivity analysis

The sensitivity analysis was made with respect to changes in annual irrigation and drainage benefits, project costs, and over-runs in the agricultural development schedules. The following five possible conditions were tested:

	Conditions	EIRR (%)	SI*
1)	Base case	13.3	-
2)	20% cost increase and benefit as scheduled,	11.6	0.6
3)	20% benefit decrease and cost as scheduled,	10.6	1.0
4)	20% cost increase and 20% benefit decrease,	9.1	-
5)	2 years over-run in the agricultural development schedule	10.8	-
6)	2 years over-run in the agricultural development schedule and 20% cost increase.	9.5	-

*: SI = Sensitivity Indicator
= (change in EIRR)/(EIRR of Base case x % change in Condition)

From the above results, the economic feasibility of the Project is most sensitive to the change in benefits. Therefore, to maintain its economic feasibility, careful management will be required for attaining the anticipated benefits.

8.3 Financial Evaluation

8.3.1 Financial cost

Based on the current market prices and costs as of 1984, the financial cost of the Project was estimated to be US$54.3 million, comprising US$36.5 million in foreign currency and US$17.8 million in local currency as described in Sub-section 4.8.2 (see Table 8). In this estimate physical contingencies of 10%, and the price contingencies of 5% per annum for foreign currency and 10% per annum for local currency were added to the direct cost. Table 9 shows the annual disbursement schedule of the said financial cost.

8.3.2 Capacity to pay

In the evaluation of project feasibility from the financial view point of the farmers, average farm budget analyses both on mineral soil and peat soil were made with future projections under the Project conditions as shown in Table 16. The net reserve of a small farmer working in the Project was J$21,310 on 3.0 ha of mineral soil and J$25,390 on 5.0 ha of peat soil.

8.3.3 Water charge

It is desirable that a water charge per hectare be imposed on farm land to cover operation and maintenance cost and the replacement cost of equipment utilized in the drainage and irrigation system. The annual operation and maintenance cost of the drainage and irrigation system was estimated to be J$4.4 million (see Annex N) which is equivalent to about J$2,000/ha. This corresponds to about 28% on mineral soil and 39% on peat soil of the net annual reserve of each farmer. The water charge of J$2,000/ha/annum was considered to be within the capacity of the farmers to pay, and would not serve as a disincentive to production. This charge was taken to be the project revenue in the financial evaluation of the Project.

8.3.4 Repayment capability of the Farm Development Company

The financial evaluation of the Farm Development Company was made for recovery of the capital cost of the farm machinery and workshop. In

examining the repayment capability, it was assumed that the capital required for implementation would be arranged under the following conditions:

1) Capital cost of farm machinery and workshop: The capital will be financed by the Holding Company at an assumed interest rate of 4.75% per annum for a repayment period of 25 years including a grace period of 7 years.
2) Water charge: The amount of this charge will be J$2,000/ha/annum the same as small farms.

A repayment schedule for the capital cost of farm machinery and workshop was prepared as shown in Table 17. This indicates that the direct revenue from the benefit of the mother farm and from hire of farm machinery can cover the necessary annual repayments, except during the initial operation stage. Hence, it is considered that some financial arrangements like a subsidy from the Government will be indispensable for implementation during the initial operation.

8.3.5 Repayment capability of the Project

The financial evaluation of the Project was made by examining the repayment capacity for the capital cost of the Project. In examining the repayment capability, it was assumed that the capital required for the project implementation would be arranged under the following conditions:

1) Foreign currency portion: The capital will be financed through the arrangements by the Government at an assumed interest rate of 4.75% per annum for a repayment period of 25 years including a grace period of 7 years.
2) Local currency portion: The capital will be invested by budget allocation of the Government with no repayment.

A repayment schedule for the foreign currency portion was prepared as shown in Table 18. This indicates that the direct revenue from the Farm Development Company and small farmers cannot cover the annual repayment of the fund, except for farm machinery cost, operation and maintenance cost and replacement cost, consequently the repayment of the fund has to be made by the Government.

8.4 Socio-economic Benefits

Various socio-economic benefits are expected to result from the implementation of the Project. There are:

1) Foreign exchange saving: Rice production in Jamaica is insufficient to meet domestic demand. In 1983, 57,000 tons of milled rice were imported at a cost of J$44.8 million (US$11.2 million). With the Project, local paddy production will be increased by 28,950 tons of dried paddy (15,400 tons of marketable milled rice) per annum. The estimated foreign exchange saving will be approximately J$12.1 million (US$3.0 million) per annum by substituting for imported rice.

2) Demonstration effects: With the completion of the Project, farmers in other agricultural areas as well as those in the Project area will become familiar with modern irrigation and drainage practices and their incentives for adopting improved irrigation and drainage practices will be greatly enhanced. Enthusiasm generated from this success may even shorten the development period of the Project.

3) Increase of employment opportunities: It is expected that the present unemployment in and around the Project area will be reduced by the implementation of the Project. After completion of the Project, more intensive land use resulting from year-round irrigation, drainage, and farm mechanization, will certainly increase employment opportunities. In addition, the Project would provide experience, technical know-how and skills to farmers. These up-graded human resources will provide the motivation for future development in the Parish of St. Elizabeth as well as in Jamaica.

4) Environmental impacts: As shown in Annex L the Project would have minor or negligible impacts on the natural environment providing the use and choice of agricultural chemicals are properly monitored. It is nevertheless essential that such monitoring be carried out on a systematic basis together with monitoring of effects on local biota especially as there are

many existing or potential economic activities in the Black River Lower Morass.

5) Secondary benefits: The implementation of the Project would certainly lead to beneficial changes in the rural economy. The social infrastructure and local transportation system would be improved. This would contribute to the improvement of rural economic activities. The increased crop production in the Project area would stimulate improvement of the marketing system and the agricultural support services.

6) In Summary: Together these benefits will serve to improve the standard of living and the quality of life of the local people and contribute substantially to one of the main objectives of the Project.

8.5 Sustainability

The need is increasing worldwide to adjust land use systems, to improve efficiency of land use, and to prevent environment degradation, so that natural resources may be managed in perpetuity for the benefit of successive generations. From this point of view, the Black River Lower Morass Agricultural Development Project may be expected to produce sustainable benefits indefinitely.

The cropping patterns and drainage systems proposed will avoid degradation of the peat soils. The proposed boundaries of the Project will ensure minimal disturbance to wildlife upon which other proposed land uses will depend. And the proposed monitoring system will ensure that the need for using fertilizers and agricultural chemicals within the development area will not be allowed to affect the wildlife resources outside. These comments do however presuppose that further ecological studies be pursued in the Lower Morass as recommended in Annex L.

TABLES

Table 1 GDP BY ECONOMIC ACTIVITY

(Unit: J$10^6)

Item	1979	%	1981	%	1983	%
1. Agriculture, Forestry	310.0	7.1	395.8	7.2	446.8	6.4
a. Export Agriculture	53.7		63.6		74.6	
- Sugar Cane	33.4		40.5		46.4	
- Others	20.3		23.1		28.2	
b. Domestic Agriculture	154.7		209.8		232.6	
- Root Crops	68.6		90.0		93.1	
- Others	86.1		119.8		139.4	
c. Livestock & Hunting	81.9		97.6		105.4	
d. Fishing	3.3		3.7		5.3	
e. Forestry & Logging	16.4		21.1		28.9	
2. Mining & Quarrying	622.5	14.2	543.5	9.9	278.7	4.0
a. Bauxite & Quarrying	614.9		536.0		267.8	
b. Quarrying incl. Gypsum	7.6		7.5		10.9	
3. Manufacture	694.4	15.9	851.8	15.6	1,273.8	18.3
4. Electricity & Water	89.6	2.0	91.3	1.7	163.5	2.3
5. Construction & Installation	311.3	7.1	365.9	6.7	566.8	8.1
6. Transportation and Communication	250.9	5.7	267.8	4.9	386.7	5.5
7. Distributive Trade	759.0	17.4	1,094.9	20.0	1,370.7	19.7
8. Financial Institutions	165.6	3.8	309.0	5.7	957.0	6.5
9. Real Estate	368.8	8.4	505.3	9.2	675.6	9.7
10. Government Services	565.5	12.9	754.9	13.8	1,001.4	14.4
11. Miscellaneous Services	191.9	4.4	240.3	4.4	299.5	4.3
12. Household, etc.	47.1	1.1	47.4	0.9	56.8	0.8
13. Less Imported Service	102.4		170.2		226.9	
Total	4,274.2	100.0	5,297.7	100.0	6,750.4	100.0

Source: Economic and Social Survey Jamaica, 1983

Table 2 DISTRIBUTION OF SOIL UNITS IN PROJECT AREA

Soil Sub Group	Soil Mapping Unit	Map Symbol	Soil Series (Soil Phase)	Project Area	Area to be Developed			
					Holland	Black River	Broad River	
						Left	Right	Left
Typic Eutrorthox	1	73	Chudleigh clay loam	23	0	0	0	0
〃	9	83	Anglesey clay loam	197	0	0	0	0
〃 -Lithic Ustorthents	1a	73/77*	〃 -Bonnygate clay loam	331	0	0	0	0
Udic Haplustalfs	2	74	Lucky Hill clay loam	36	0	0	0	0
〃 -Lithic Ustorthents	2a	74/77	〃 -Bonnygate clay loam	82	0	0	0	0
Lithic Ustorthents	3	77	Bonnygate clay loam	35	0	0	0	0
〃 -Typic Eutrorthox	3a	77/73	〃 -Chudleigh clay loam	18	0	0	0	0
Typic Quartzipsamments	5	150	Hodges sand	49	0	0	0	0
〃 -Typic Chromusterts	5a	150/204	〃 -Fourpath sandy loam	99	0	0	0	0
Typic Chromusterts	6	151	Cashew clay loam	187	0	22	0	0
〃	6a	151/203	〃 -Fourpath clay	62	0	0	0	0
〃 -Typic Chromuderts	12	151/94v	Cashew clay loam - Carron Hall clay	48	0	0	0	0
〃	7	203	Fourpath clay	1,293	107	124	0	0
〃	7a	203/151	〃 -Cashew clay loam	24	0	0	0	0
〃	13	203/94v	Fourpath - Carron Hall clay extremely rocky	67	0	0	0	0
〃	8	204	Fourpath sandy loam	537	0	0	0	0
〃 -Typic Quartzipsamments	8a	204/150	〃 -Hodges sand	130	0	0	0	0
〃	11	108	Holland clay	304	204	0	0	0
〃	4	94	Carron Hall clay loam - extremely rocky	46	0	0	0	0
〃	4v	94v	Carron Hall clay loam	504	0	0	0	0
Aquic Halpludolls	10	9	Wellen clay	304	170	0	0	0
〃 -Hemic Troposaprists	10a	9/Hla	〃 -Broad River Peat	86	86	0	0	0
Aeric Tropaquepts	14	I2	Black River clay	463	51	200	0	0
Hemic Troposaprists	15	Hla	Broad River peat	2,035	62	450	604	467
Hydric Tropohemists	16	Hlb	Morass Peat - high decomposition phase	1,488	0	298	396	533
Hydric Tropofibrists	16a	Hlc	〃 -low decomposition phase	903	0	0	0	0
Typic Sulfihemists	16b	Hls	〃 -sulfidic phase	1,144	0	0	0	0
	Forest			915	0	106	0	0
	Town			40	0	0	0	0
			Total	11,450	680	1,200	1,000	1,000

*73/77 : This symbol shows the complex soil type. The area occupies two third by the former(73)and one third by the latter(77).

Table 3 DISTRIBUTION OF LAND CAPABILITY CLASSES FOR RICE CULTURE IN PROJECT AREA

(Unit: ha)

Land Capability	Land Class	Project Area	Area to be Developed				Total
			Holland Estate	Black River Left	Broad River Right	Broad River Left	
Suitable	II	3,240	567	146	0	0	713
"	III	3,016	113	650	604	467	1,834
Marginal	IV	2,144	0	298	396	533	1,227
Unsuitable	V	2,095	0	0	0	0	0
" (Forest)	VIII	915	0	106 1/	0	0	106
Town		40	0	0	0	0	0
Total		11,450	680	1,200	1,000	1,000	3,880

Remarks: 1/: Land of this forest consists of mainly mineral soils. Land class therefore would be changed to class III/IV after drainage improvement and clearing.

Table 4 DISTRIBUTION OF LAND CAPABILITY CLASSES FOR UPLAND CROPS IN PROJECT AREA

(Unit: ha)

Land Capability	Land Class	Project Area	Area to be Developed				Total
			Holland	Black River Left	Broad River Right	Broad River Left	
Suitable	II	3,240	567	146	0	0	713
"	III	920	51	200	0	0	251
Marginal	IV	4,235	62	450	604	467	1,583
Unsuitable	V	2,100	0	298	396	533	1,227
" (Forest)	VIII	915	0	106	0	0	106
Town		40	0	0	0	0	0
Total		11,450	680	1,200	1,000	1,000	3,880

Table 5 PRESENT LAND USE

(Unit: ha)

Item	Category								Ratio to the Whole Area (%)
	Sugar Cane	Grass-land	Forest/ Bush	Trees/ Village/ Grassland	Upland Crop/ Grassland	Paddy/ Swamp	Swamp	Total	
I. Black River Right Bank									
1. Within area to be developed									
- Holland Estate	310	100	-	-	-	100	170	680	6.0
2. Without area to be developed									
- Holland Estate	600	100	-	-	-	10	310	1,020	8.9
- Other area	-	190	300	10	50	20	270	840	7.3
3. Sub-total	910	390	300	10	50	130	750	2,540	22.2
II. Estuary and Middle Quarters									
1. Within area to be developed	-	-	-	-	-	-	-	-	0.0
2. Without area to be developed	-	630	460	20	10	-	1,560	2,680	23.4
3. Sub-total	-	630	460	20	10	-	1,560	2,680	23.4
III. Black River Left Bank									
1. Within area to be developed									
- Hatfield	-	170	60	-	60	-	10	300	2.6
- Styx River	-	-	-	-	-	-	400	400	3.5
- Frenchman & Holiday-Pen	-	-	100	-	-	-	400	500	4.4
2. Without area to be developed	-	560	200	90	260	-	-	1,110	9.7
3. Sub-total	-	730	360	90	320	-	810	2,310	20.2
IV. Broad River Basin									
1. Within area to be developed									
- Broad River Right Bank	-	20	-	-	-	-	980	1,000	8.7
- Broad River Left Bank	-	-	-	-	-	-	1,000	1,000	8.7
2. Without area to be developed	10	990	540	80	300	-	-	1,920	16.8
3. Sub-total	10	1,010	540	80	300	-	1,980	3,920	34.2
V. Total									
1. Within area to be developed	310	290	160	-	60	100	2,960	3,880	33.9
2. Without area to be developed	610	2,470	1,500	200	620	30	2,140	7,570	66.1
3. Project area	920	2,760	1,660	200	680	130	5,100	11,450	100.0

Table 6 PROPOSED FERTILIZER AND CHEMICAL APPLICATION

I. Fertilizers

Time of Application	Type of Fertilizer	Amount of Fertilizer (kg/ha)	Active Ingredient (kg/ha) N	P_2O_5	K_2O
RICE					
(Mineral Soil)					
Basal	12.24.12	200	24	48	24
Tillering stage	Diam. Phos[1/] (18.46.0)	70	13	32	-
	Urea (45%)	74	33	-	-
Panicle formation stage	Urea (45%)	67	30	0	0
	Murate of potash (60%)	60	-	-	36
Total			100	80	60
(Peat Soil)					
Basal	Triple superphosphate (45%)	222	-	100	-
	Murate of potash (60%)	50	-	-	30
	Copper sulphate	9	-	-	-
Total				100	30
SOYA BEAN					
(Mineral Soil)					
Basal	Triple superphosphate (45%)	249	-	112	-
	Murate of potash (60%)	112	-	-	67
Total				112	67

II. Chemicals

Crop	Common Name	(Trade Name)	MT[2/]	TAA[3/]	Rate per ha
	(Herbicide)				
Rice	bentiocarb	(Saturn)	OS	B	5.7 ℓ
	2,4 D	(2,4 -D)	OS	A	2.9 ℓ
Soya Bean	diphenamid	(Dymid)	OS	A	5.0 kg
	bentazon	(Basagran)	OS	A	2.5 kg
	(Pesticide)				
Rice	trichlorphon	(Dipterex)	DS	B	1.5 kg
	fenitrothion	(Sumithion)	OS	B	0.6 ℓ
	mancozeb	(Dithane)	OS	A	1.7 kg
Soya Bean	monocrotophos	(Nuvacron)	OS	A	10 ℓ

Remarks: 1/: Diammonia phosphate

2/: MT: Mammalian Toxicity
OS: Ordinary substances
DS: Deleterious substances

3/: TAA: Toxicity to Aquatic Animals

Table 7 MAJOR FACILITIES IN EACH ALTERNATIVE PLANS

Description	Unit	Alternative Case		
		Case 1	Case 2	Case 3
1. Source of Irrigation Water		Black river and Y.S. river		
2. Gross Irrigable Area	ha	3,880	2,880	1,280
3. Net Irrigable Area	ha	3,080	2,280	1,480
4. Y.S. Intake Weir				
4.1 Design discharge	m^3/sec	0.45	0.45	0.45
5. Lacovia Pump Station				
5.1 Design discharge	m^3/sec	3.42	2.27	1.12
5.2 Pump diameter	mm	700	700	500
5.3 Number of pump sets	set	3	2	2
6. Length of Main Irrigation Canal	km	17.2	8.4	8.4
7. Length of Secondary Irrigation Canal	km	31.6	30.1	21.4
8. Drainage Pump Station				
8.1 Number of pump station	place	4	3	2
8.2 Total discharge	m^3/sec	25.6	20.6	13.9
8.3 Pump diameter	mm		800	
8.4 Number of pump sets	nos.	15	12	8
9. Length of Dikes	km	28.5	22.8	17.1
10. Length of Main Drain Canal	km	41.2	33.0	26.0
11. Length of Catch Drain	km	19.9	4.0	0
12. On-farm Development	ha	3,080	2,280	1,480
13. Length of Main Road	kW	35.2	24.8	16.1
14. Length of Secondary Road	kW	83.4	64.2	46.7

Table 8 SUMMARY OF INITIAL INVESTMENT COST

(Unit: US$10^3)

	Item	Foreign Currency	Local Currency	Total
I.	Construction Cost			
1.1	Direct Construction Cost			
	Holland Area	2,460	1,570	4,030
	Black River Left Bank Area	5,060	2,390	7,450
	Broad River Right Bank Area	3,840	1,770	5,610
	Broad River Left Bank Area	3,870	1,910	5,780
	Office & Quarters	720	780	1,500
	Observation Wells	50	20	70
	Conservation of Environment	100	100	200
	Sub-total	16,100	8,540	24,640
1.2	O & M Equipment	830	0	830
1.3	General Expense	0	650	650 1/
1.4	Land Acquisition	0	730	730
1.5	Engineering Service	2,930	1,110	4,040 2/
	Sub-total	19,860	11,030	30,840
1.6	Physical Contingency	1,990	1,100	3,080
	Sub-total	21,850	12,130	33,980
1.7	Price Contingency	4,370	5,090	9,460
	Sub-total	26,220	17,220	43,440
II.	Farm Guidance Service	2,790	180	2,970
III.	Farm Machinery (see Annex G)	7,470	440	7,910
IV.	Total (I + II + III)	36,480	17,840	54,320
V.	Post Harvest Facility (see Annex G)	10,830	860	11,690
VI.	Social Infrastructures (see Annex F)	-	5,610	5,610
VII.	Grand Total (IV + V + VI)	47,310	24,310	71,620

Remarks: 1/: Including environmental monitoring cost.
2/: Including cost for investigation and computer model simulation analysis of post project ground water inflow.

Table 9 ANNUAL DISBURSEMENT SCHEDULE OF CAPITAL COST

(Unit: US$10^3)

Item	1st Year		2nd Year		3rd Year		4th Year		5th Year		6th Year		7th Year	
	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
I. Construction														
1.1 Direct Construction Cost														
Holland Area	0	0	586	384	1,287	682	587	502	0	0	0	0	0	0
Black River Left Bank Area	0	0	999	340	2,259	901	1,414	854	390	290	0	0	0	0
Broad River Right Bank Area	0	0	0	0	1,007	346	1,249	546	973	450	610	429	0	0
Broad River Left Bank Area	0	0	0	0	829	232	1,293	605	1,039	500	708	569	0	0
Office & Quarters	0	0	720	780	0	0	0	0	0	0	0	0	0	0
Observation Wells	0	0	54	23	0	0	0	0	0	0	0	0	0	0
Conservation of Environment	0	0	20	20	20	20	20	20	20	20	20	20	0	0
Sub-total	0	0	2,379	1,547	5,402	2,181	4,563	2,527	2,422	1,260	1,338	1,018	0	0
1.2 O & M Equipment	0	0	0	0	0	0	430	0	0	0	400	0	0	0
1.3 General Expense	0	58	0	106	0	114	0	123	0	123	0	123	0	0
1.4 Land Acquisition	0	360	0	370	0	0	0	0	0	0	0	0	0	0
1.5 Engineering Services	580	220	470	180	470	180	470	180	470	180	470	172	0	0
Sub-total	580	638	2,849	2,203	5,872	2,475	5,463	2,830	2,892	1,563	2,208	1,313	0	0
1.6 Physical Contingency	58	64	285	220	587	248	546	283	289	156	221	131	0	0
Sub-total	638	702	3,134	2,423	6,459	2,723	6,009	3,113	3,181	1,719	2,429	1,444	0	0
1.7 Price Contingency	32	70	321	509	1,018	901	1,295	1,445	879	1,050	826	1,114	0	0
Sub-total	670	772	3,455	2,932	7,477	3,624	7,304	4,558	4,060	2,769	3,255	2,558	0	0
II. Farm Guidance Service	0	0	0	0	509	29	535	32	562	35	590	39	596	49
III. Farm Machinery	0	0	1,565	220	2,007	110	0	0	3,895	113	0	0	0	0
IV. Grand Total	670	772	5,020	3,152	9,993	3,763	7,839	4,590	8,517	2,917	3,845	2,598	596	49

Remarks: F.C.: Foreign Currency
L.C.: Local Currency

Table 10 REQUIRED NUMBER OF MACHINERY AND EQUIPMENT

Machinery & Equipment	Holland	Hatfield Styx River	Frenchman Holiday-pen	Broad R. Right B.	Broad R. Left B.	Total
Disc harrow (16" x 16)	8	11	10	19 + 2*	19	69
Rotary harrow (2.2m width)	8	7	5	10 + 2	10	42
Land leveller (1.8m width)	5	5	4	7 + 2	7	30
Ridger (2 row)	8	3	-	+ 1	-	12
Cultivator (3 row)	5	2	-	+ 1	-	8
Tractor (32 Hp)	14	13	10	19 + 3	19	78
Cage wheel (pair)	-	7	10	19 + 3	19	58
Combine harvester (2.5m width 75 Hp)	8	8	6	11 + 1	11	45
Power sprayer (10 - 15 lit./min)	30	19	14	27 + 5	27	122
Manual seeder (1 row)	19	11	14	27 + 5	27	103
Dump truck (2 ton)	5	5	3	6 + 3	6	28

Remarks: *: Figures followed (+) are spare numbers of machinery reserved at the mechanical service center (Broad River Right Basin).

Table 11 CAPACITY OF DRYING AND STORAGE FACILITIES

	Paddy Field (ha)	Paddy Yield (tons/ha)	Production per Crop (tons)	Max. Paddy Harvested per day (tons)	Capacity		
					Receiving (tons/hr)	Drying (tons/hr)	Storage (tons)
Holland	560	5.5	3,080	102	15.3	25.5	2,400
Hatfield & Styx River	520	-	2,560	84	12.6	21.0	2,000
(Hatfield)	(220)	(5.5)	(1,210)	-	-	-	-
(Styx River)	(300)	(4.5)	(1,350)	-	-	-	-
Frenchman & Holiday-pen	400	4.5	1,800	61	9.2	15.3	1,400
Broad River Right Bank	800	4.5	3,600	110	16.5	27.5	2,800
Broad River Left Bank	800	4.5	3,600	110	16.5	27.5	2,800
Total	3,080	-	14,640	-	-	-	11,400

Table 12 PRICE OF FARM PRODUCTS AND INPUTS

(Unit: JS)

	Unit	Financial Price/1 (1984)	Economic Price/2 (1995)
I. Farm Products			
1. Paddy	kg	1.1	1.5
2. Soya bean	kg	1.3	2.4
3. Sugar cane	ton	54	68
4. Gungo pea	kg	5.4	6.2
5. Peanut	kg	4.8	5.4
6. Corn	kg	1.3	1.4
7. Yam	kg	1.1	1.2
8. Cassava	kg	0.5	0.6
II. Farm Inputs			
1. Seed			
- Sugar cane	kg	50.0	72.9
- Gungo pea	kg	6.6	7.5
- Peanut	kg	9.9	11.3
- Corn	kg	3.3	3.8
- Yam	kg	1.5	1.7
- Cassava	100 Sticks	3.0	3.4
- Paddy	kg	1.2	1.7
- Soya bean	kg	2.7	3.0
2. Fertilizer			
- DAP	kg	1.0	2.2
- TSP	kg	0.9	1.7
- Urea	kg	0.9	2.1
- Muriate of potash	kg	0.7	1.4
- 12 - 24 - 12	kg	0.8	1.1
- Copper sulphate	kg	2.2	3.1
3. Agro-Chemical			
- Benticarb	lit	15.0	19.8
- 2,4 - D	lit	14.5	19.1
- Diphenamid	kg	56.0	73.9
- Bentazon	kg	21.9	28.9
- Trichlorphon	kg	51.6	68.1
- Fenitrothion	lit	25.5	33.6
- Mancozeb	kg	0.2	0.3
- Monocrotophos	lit	66.1	87.2
4. Labour			
- Family	MD	-	15.8/3
- Hired	MD	22.5	22.5
5. Farm Machinery			
i) Mineral Soil			
- Disk harrow	hr	22.7	23.3
- Rotary harrow	hr	29.5	30.8
- Land leveller	hr	33.1	34.8
- Ridger	hr	26.6	27.6
- Cultivator	hr	27.9	29.1
- Combine harvester	hr	99.4	107.6
- Power sprayer	hr	9.5	9.9
- Dump truck	hr	35.2	36.3
ii) Peat Soil			
- Disk harrow	hr	28.0	29.1
- Rotary harrow	hr	29.3	30.6
- Land leveller	hr	32.8	34.4
- Combine harvester	hr	138.2	150.6
- Power sprayer	hr	9.5	9.9
- Dump truck	hr	40.4	42.1

Remarks: /1: These data are based on "Cost of Production" Data Bank, MOA and obtained from JCTC, and CIF Price of Kingston.

/2: Calculated from the data given in "Price prospects for Major Primary Commodities", IBRD December 1983.

/3: Economic Price of family labour cost is assured 70% of the price of hired labour.

Table 13 ANNUAL NET PRODUCTION VALUE PER HA WITH PROJECT CONDITION

I. Economic

(Unit : J$)

	Cost of Farm Input	Cost of Farm Operation	Gross Production Cost	Gross Production Value	Net Production Value
I. Mineral Soil					
1. Small Farm					
Spring Rice	1,236	974	2,210	8,366	6,156
Fall Rice	1,236	900	2,136	8,366	6,230
Soya Bean	2,063	918	2,981	5,943	2,962
Total	4,535	2,792	7,327	22,675	15,348
2. Mother Farm					
Spring Rice	1,236	1,068	2,304	8,366	6,062
Fall Rice	1,236	1,008	2,244	8,366	6,122
Soya Bean	2,063	1,025	3,088	5,943	2,855
Total	4,535	3,101	7,636	22,675	15,039
II. Peat Soil					
1. Small Farm					
Spring Rice	957	1,122	2,079	6,845	4,766
Fall Rice	957	997	1,954	6,845	4,891
Total	1,914	2,119	4,033	13,690	9,657
2. Mother Farm					
Spring Rice	957	1,206	2,163	6,845	4,682
Fall Rice	957	1,088	2,045	6,845	4,800
Total	1,914	2,294	4,208	13,690	9,482

II. Financial

	Cost of Farm Input	Cost of Farm Operation	Gross Production Cost	Gross Production Value	Net Production Value
I. Mineral Soil					
1. Small Farm					
Spring Rice	754	711	1,465	6,050	4,585
Fall Rice	754	613	1,367	6,050	4,683
Soya Bean	1,450	632	2,082	3,250	1,168
Total	2,958	1,956	4,914	15,350	10,436
2. Mother Farm					
Spring Rice	754	1,026	1,780	6,050	4,270
Fall Rice	754	973	1,727	6,050	4,323
Soya Bean	1,450	992	2,442	3,250	808
Total	2,958	2,991	5,949	15,350	9,401
II. Peat Soil					
1. Small Farm					
Spring Rice	610	867	1,477	4,950	3,473
Fall Rice	610	736	1,346	4,950	3,604
Total	1,220	1,603	2,823	9,900	7,077
2. Mother Farm					
Spring Rice	610	1,148	1,758	4,950	3,192
Fall Rice	610	1,040	1,650	4,950	3,300
Total	1,220	2,188	3,408	9,900	6,492

Table 14 NET INCREMENTAL BENEFIT

(Unit: J$10^3)

Description	Mineral Soil		Peat Soil				Total
	Holland	Hatfield	Styx River	Frenchman & Holliday Pen	Broad River Right	Broad River Left	
I. Annual Net Production Value							
1. Without Project	263	41	-	-	-	-	304
- Sugar cane	273	-	-	-	-	-	273
- Rainfed rice	-10	-	-	-	-	-	-10
- Upland crops	-	41	-	-	-	-	41
2. With Project	8,169	3,377	2,881	3,843	7,691	7,691	33,652
a) Small farm							
- Spring rice	2,216	1,354	1,001	1,382	2,860	2,860	11,673
- Fall rice	2,243	1,371	1,027	1,418	2,935	2,935	11,929
- Soya bean	1,066	652	-	-	-	-	1,718
Sub-total	5,525	3,377	2,028	2,800	5,795	5,795	25,320
b) Mother farm							
- Spring rice	849	-	421	515	936	936	3,657
- Fall rice	1,224	-	432	528	960	960	4,104
- Soya bean	571	-	-	-	-	-	571
Sub-total	2,644	-	853	1,043	1,896	1,896	8,332
II. Annual Net Incremental Benefit	7,906	3,336	2,881	3,843	7,691	7,691	33,348

Table 15 ANNUAL ECONOMIC COSTS AND BENEFIT FLOW

(Unit: J$10^3)

Year	Construction Cost	O & M Cost	Replacement Cost	Total Cost	Benefit
1	3,870	0	0	3,870	0
2	21,115	0	0	21,115	0
3	37,646	1,640	0	39,286	718
4	37,400	2,669	0	40,069	6,216
5	20,090	3,559	0	23,649	8,426
6	15,879	4,449	0	20,328	11,346
7	0	4,449	0	4,449	15,558
8	0	4,449	1,312	5,761	18,761
9	0	4,449	0	4,449	22,073
10	0	4,449	0	4,449	25,784
11	0	4,449	0	4,449	29,694
12	0	4,449	0	4,449	32,250
13	0	4,449	403	7,852	33,348
14	0	4,449	0	4,449	33,348
15	0	4,449	0	4,449	33,348
16	0	4,449	0	4,449	33,348
17	0	4,449	0	4,449	33,348
18	0	4,449	1,312	5,761	33,348
19	0	4,449	0	4,449	33,348
20	0	4,449	0	4,449	33,348
21	0	4,449	0	4,449	33,348
22	0	4,449	0	4,449	33,348
23	0	4,449	24,137	28,585	33,348
24	0	4,449	0	4,449	33,348
25	0	4,449	0	4,449	33,348
26	0	4,449	0	4,449	33,348
27	0	4,449	0	4,449	33,348
28	0	4,449	1,312	5,761	33,348
29	0	4,449	0	4,449	33,348
30	0	4,449	0	4,449	33,348
31	0	4,449	0	4,449	33,348
32	0	4,449	0	4,449	33,348
33	0	4,449	3,403	7,852	33,348
34	0	4,449	0	4,449	33,348
35	0	4,449	0	4,449	33,348
36	0	4,449	0	4,449	33,348
37	0	4,449	0	4,449	33,348
38	0	4,449	1,312	5,761	33,348
39	0	4,449	0	4,449	33,348
40	0	4,449	0	4,449	33,348
41	0	4,449	0	4,449	33,348
42	0	4,449	0	4,449	33,348
43	0	4,449	24,137	28,585	33,348
44	0	4,449	0	4,449	33,348
45	0	4,449	0	4,449	33,348
46	0	4,449	0	4,449	33,348
47	0	4,449	0	4,449	33,348
48	0	4,449	1,312	5,761	33,348
49	0	4,449	0	4,449	33,348
50	0	4,449	0	4,449	33,348

EIRR = 13.3%

Table 16 FARM BUDGET ANALYSIS

	Planting/ Harvesting Area	Gross Income				Gross Outgo			Net Reserve
		Unit Yield	Production	Unit Price	Total Value	Farming Expenses: Unit Production Cost	Farming Expenses: Total Cost	Living Expenses	
	(ha)	(ton/ha)	(ton)	(J$/ton)	(J$)	(J$/ha)	(J$)	(J$)	(J$)
I. Mineral Soil									
Spring rice	3	5.5	16.5	1,100	18,150	1,465	4,395	-	-
Fall rice	3	5.5	16.5	1,100	18,150	1,367	4,101	-	-
Soya bean	3	2.5	7.5	1,300	9,750	2,082	6,246	-	-
Total	-	-	-	-	46,050	-	14,742	10,000	21,308
II. Peat Soil									
Spring rice	5	4.5	22.5	1,100	24,750	1,477	7,385	-	-
Fall rice	5	4.5	22.5	1,100	24,750	1,346	6,730	-	-
Total	-	-	-	-	49,500	-	14,115	10,000	25,385

Table 17 CASH FLOW STATEMENT OF THE FARM DEVELOPMENT COMPANY

(Unit: J$10^3)

Year	Cash Outflow							Cash Inflow				Balance	Accumulation
	Capital Cost	Loan Repayment 1/		O & M Cost	Replacement Cost	Water Charge	Total	Fund	Revenue		Total		
		Interest	Principal						Benefit from Mother Farm	Hire of Machinery			
1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	7,140	339	0	0	0	0	7,479	7,140	0	0	7,140	-339	-339
3	8,468	741	0	811	0	400	10,420	8,468	356	507	9,331	-1,089	-1,428
4	0	741	0	1,990	0	800	3,531	0	955	2,967	3,922	391	-1,037
5	16,032	1,503	0	2,503	0	800	20,838	16,032	1,307	2,967	20,306	-532	-1,569
6	0	1,503	0	2,503	0	1,600	5,606	0	1,796	4,355	6,151	545	-1,024
7	0	1,503	0	2,503	800	1,600	6,406	0	2,362	5,744	8,106	1,700	676
8	0	1,420	1,754	2,503	1,290	1,600	8,567	0	2,969	5,744	8,713	146	822
9	0	1,336	1,758	2,503	0	1,600	7,197	0	3,612	5,744	9,356	2,159	2,981
10	0	1,253	1,758	2,503	5,400	1,600	12,514	0	4,339	5,744	10,083	-2,431	550
11	0	1,169	1,758	2,503	4,760	1,600	11,790	0	4,991	5,744	10,735	-1,055	-505
12	0	1,086	1,758	2,503	800	1,600	7,747	0	5,387	5,744	11,131	3,384	2,879
13	0	1,002	1,758	2,503	10,260	1,600	17,123	0	5,519	5,744	11,263	-5,860	-2,981
14	0	919	1,758	2,503	0	1,600	6,780	0	5,519	5,744	11,263	4,483	1,502
15	0	835	1,758	2,503	2,440	1,600	9,136	0	5,519	5,744	11,263	2,127	3,629
16	0	752	1,758	2,503	0	1,600	6,613	0	5,519	5,744	11,263	4,650	8,279
17	0	668	1,758	2,503	800	1,600	7,329	0	5,519	5,744	11,263	3,934	12,213
18	0	585	1,758	2,503	4,250	1,600	10,696	0	5,519	5,744	11,263	567	12,780
19	0	501	1,758	2,503	4,760	1,600	11,122	0	5,519	5,744	11,263	141	12,921
20	0	418	1,758	2,503	2,440	1,600	8,719	0	5,519	5,744	11,263	2,544	15,465
21	0	334	1,758	2,503	8,970	1,600	15,165	0	5,519	5,744	11,263	-3,902	11,563
22	0	251	1,758	2,503	800	1,600	6,912	0	5,519	5,744	11,263	4,351	15,914
23	0	167	1,758	2,503	1,290	1,600	7,318	0	5,519	5,744	11,263	3,945	19,859
24	0	84	1,758	2,503	0	1,600	5,945	0	5,519	5,744	11,263	5,318	25,177
25	0	0	1,758	2,503	2,440	1,600	8,301	0	5,519	5,744	11,263	2,962	28,139

Remarks: 1/: Interest; 4.75%
Grace period; 7 years
Repayment period including grace period; 25 years

Table 18 CASH FLOW STATEMENT OF THE PROJECT

(Unit: J$10^3)

Year	Cash Outflow							Cash Inflow					Balance
	Capital Cost		Loan Repayment 3/		O & M Cost	Replacement Cost	Total	Fund		Revenue		Total	
	F.C 1/	L.C 2/	Interest	Principal				F.C	L.C	Development Company	Small Farmer		
1	2,680	3,088	127	0	0	0	5,895	2,680	3,088	0	0	5,768	-127
2	20,080	12,608	1,081	0	0	0	33,769	20,080	12,608	339	0	33,027	-742
3	39,972	15,052	2,980	0	1,600	0	59,604	39,972	15,052	1,141	120	56,285	-3,319
4	31,356	18,360	4,469	0	2,604	0	56,789	31,356	18,360	1,541	2,040	53,297	-3,492
5	34,068	11,668	6,087	0	3,472	0	55,295	34,068	11,668	2,303	2,040	50,079	-5,216
6	15,380	10,392	6,818	0	4,340	0	36,930	15,380	10,392	3,103	2,840	31,715	-5,215
7	2,384	196	6,931	0	4,340	0	13,851	2,384	196	3,103	4,440	10,123	-3,728
8	0	0	6,439	7,978	4,340	1,280	20,037	0	0	4,774	4,440	9,214	-10,823
9	0	0	6,060	7,974	4,340	0	18,374	0	0	4,694	4,440	9,134	-9,240
10	0	0	5,681	7,974	4,340	0	17,995	0	0	4,611	4,440	9,051	-8,944
11	0	0	5,303	7,974	4,340	0	17,617	0	0	4,527	4,440	8,967	-8,650
12	0	0	4,924	7,974	4,340	0	17,238	0	0	4,444	4,440	8,884	-8,354
13	0	0	4,545	7,974	4,340	3,320	20,179	0	0	4,360	4,440	8,800	-11,379
14	0	0	4,166	7,974	4,340	0	16,480	0	0	4,277	4,440	8,717	-7,763
15	0	0	3,788	7,974	4,340	0	16,102	0	0	4,193	4,440	8,633	-7,469
16	0	0	3,409	7,974	4,340	0	15,723	0	0	4,110	4,440	8,550	-7,173
17	0	0	3,030	7,974	4,340	0	15,344	0	0	4,026	4,440	8,466	-6,878
18	0	0	2,651	7,974	4,340	1,280	16,245	0	0	3,943	4,440	8,383	-7,862
19	0	0	2,273	7,974	4,340	0	14,587	0	0	3,859	4,440	8,299	-6,288
20	0	0	1,894	7,974	4,340	0	14,208	0	0	3,776	4,440	8,216	-5,992
21	0	0	1,515	7,974	4,340	0	13,829	0	0	3,692	4,440	8,132	-5,697
22	0	0	1,136	7,974	4,340	0	13,450	0	0	3,609	4,440	8,049	-5,401
23	0	0	758	7,974	4,340	23,548	36,620	0	0	3,525	4,440	7,965	-28,655
24	0	0	379	7,974	4,340	0	12,693	0	0	3,442	4,440	7,882	-4,811
25	0	0	0	7,974	4,340	0	12,314	0	0	3,358	4,440	7,798	-4,516

Remarks: 1/: Foreign Currency
2/: Local Currency
3/: Interest; 4.75%
Grace period; 7 years
Repayment period including grace period; 25 years