THE REPORT OF IMPROVEMENT PLAN FOR PANJAM COMMUNITY DEVELOPMENT PROGRAMME IN INDIA

JULY, 1970

OVERSEAS TECHNICAL COOPERATION AGENCY
GOVERNMENT OF JAPAN

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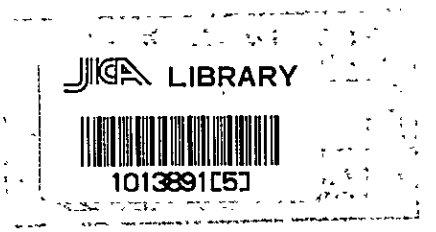

OVERSEAS TECHNICAL COOPERATION AGENCY
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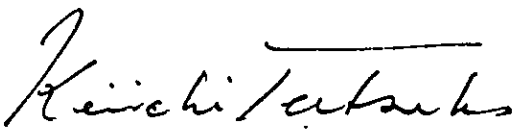
Preface

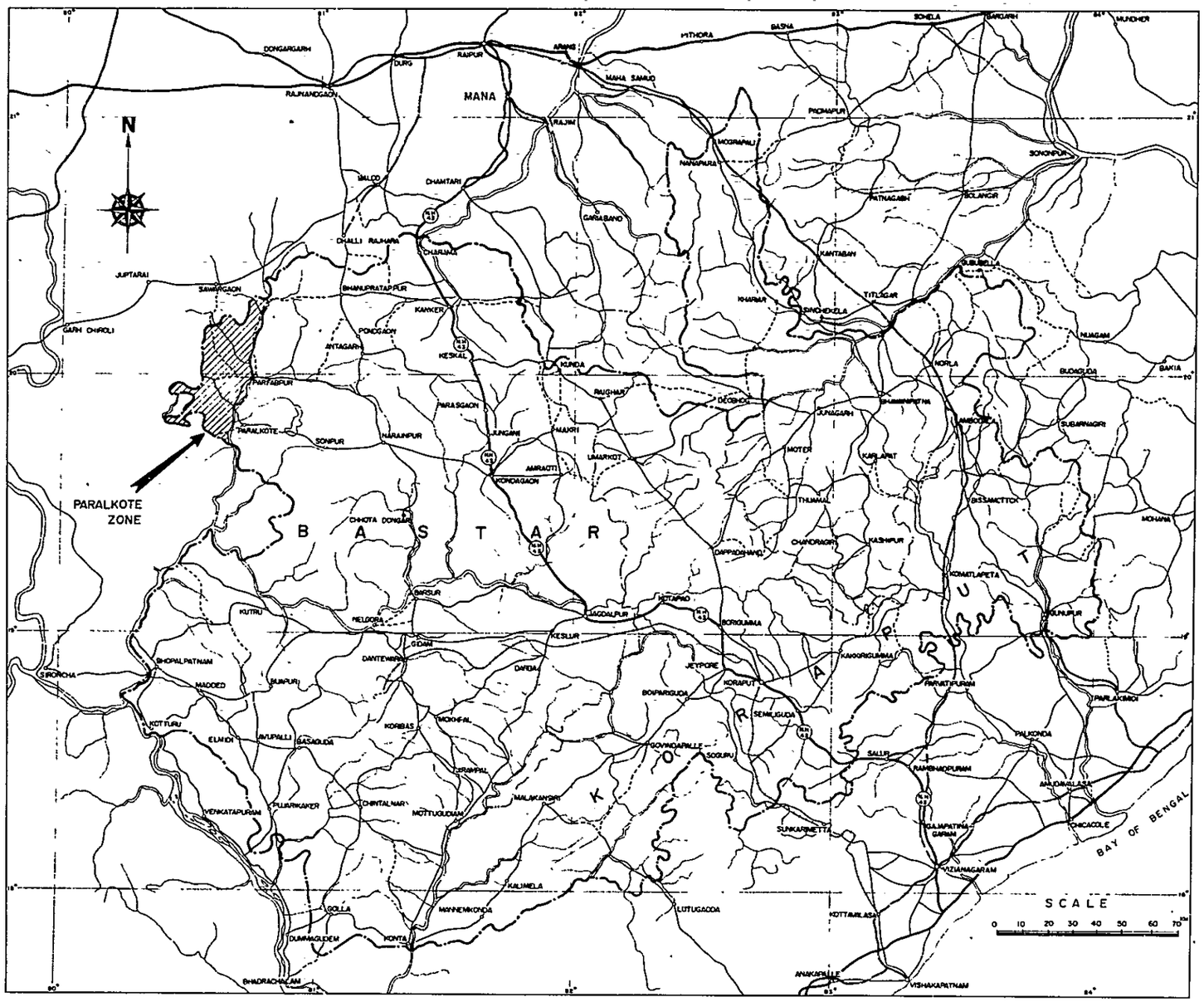
Under the entrust of the Ministry of Foreign Affairs, the Overseas Technical Cooperation Agency despatched a team for the detailed survey of Dandakaranya Development Programme, consisted of a group of experts from almost all agricultural fields. The survey team scrutinized how the Japanese Government can contribute to develop most efficiently this newly-borne vast area, focusing its objective on how to enhance the present agricultural productivity through our technical cooperation. The result of this detailed survey as summarized in this report, together with one issued previously as "fundamental survey report of agricultural development in Dandakaranya" proved feasibility and urgent necessity of the cooperation to be rendered by us. We sincerely hope that through this survey results our agricultural cooperation in this area will be realized as soon and as effectively as possible, so that we can deepen mutual friendship between our two nations.

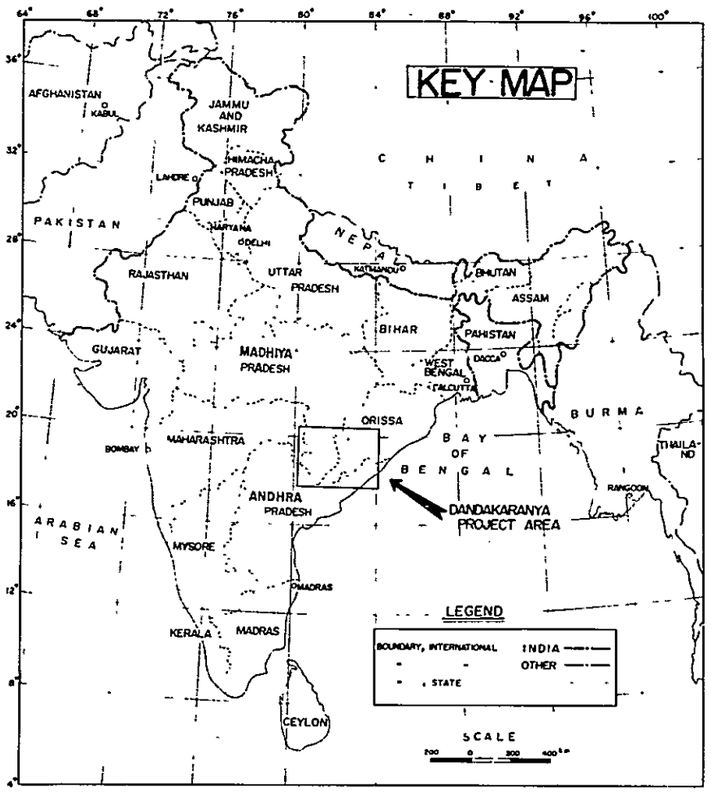


(Keiichi Tatsuke)
Director General,
Overseas Technical Cooperation
Agency, Tokyo

Fig

LOCATION MAP OF PARALKOTE ZONE IN DANDAKARANYA PROJECT





L E G E N D

- BOUNDARY OF DANDAKARANY PROJECT AREA
- BOUNDARY OF DISTRICT OR STATE
- RAILWAY
- NATIONAL HIGHWAY
- MINOR ROAD
- TRACK ROAD
- RIVER

REPORT OF IMPROVEMENT FOR PAKHANJORE COMMUNITY DEVELOPMENT PROGRAMME

CONTENTS

VOLUME I. DEVELOPING PLAN FOR PAKHANJORE COMMUNITY

Chapter 1. Introduction

Chapter 1. Introduction

1.1. Objective of the Report

This report consists of two parts - Part 1 describing the results of a survey with respect to the feasibility of improving 500 acres of paddy field fed on the water of Pakhanjore tank at Paralkote in Dandakaranya, India and 120 acres of upland field on the plateau extended along the main irrigation canal, and Part 2 describing a plan for the development of villages, worked out on the basis of a detailed survey of final design for two villages, PV 13 and 14, selected as the bases for the development of the above mentioned 500 acres of field.

The development of this area has been under way since 1960, forming a link in the chain of the Dandakaranya District Development Project under the direct control of the Central Government of India. The first settlement plan has already been carried out, and the settlers are gradually setting down.

The settlers, who are refugees from East Pakistan, have a strong desire to develop the area, but their farming techniques and infrastructure require much more improvement. In this connection, the Government of India has asked Japan for her cooperation in the development of this area in order to make it a model area for the development of the Dandakaranya district. Japan, therefore, has sent a survey team several times, and has had it negotiate with the Government of India.

The present survey team has been dispatched in order to establish a concrete plan based on the results of the preliminary surveys mentioned above.

The survey team has completed the report based on various data, measurements and valuable experience which are collected, took and acquired while they were surveying the site for about 80 days from November, 1969 to February, 1970.

The survey team submits the report to the Governments of India and Japan on its own responsibility and hopes that it will be a guide of the two Governments in executing the project for the development of this area.

It is also to be noted that the report is completed in full Accordance with Japanese delegation and the Indian specialists who joined in the survey on various fields, and the government officials who extended close assistances to the survey team on the spot.

The survey team is confident that the teamwork of the Japanese specialists and the Indian officials built on their mutual understanding and friendship made the short term survey at Paralkote very successfully but has to admit that there is not a little calling for further investigation.

1.2. Background of the Project

The present project is the comprehensive regional development scheme of the Dandakaranya district, which has been taken up for materializing one of the Indian Government's major policies to provide the refugees from East Pakistan with a stable life in the area and also help indigenous natives of the area to live in a better way.

The Central Government of India set up the Dandakaranya Development Authority in 1958 under the control of the Ministry of Rehabilitation and Labour in order to carry out the project.

The development of this district was started in 1960, and development plans have during these ten years been drawn up for the areas of Umarkote, Paralkote, Raighar and Malakangiri extending over the territories of the States of Orissa, Madya Pradesh and Andra Pradesh. Since then, the Indian Government has been making its effort by itself to the development of the area.

The immigration was started in 1963 and the first stage of it has been completed.

The Dandakaranya Development Authority, belonging to the Ministry of Rehabilitation and Labour in New Delhi, and has its development headquarter

at Koraput in the Dandakaranya district. The Authority also has its local centers of operation in each area, where they are directly in charge of executing the project.

The Central Government of India invests 500 lakh of rupees in the Dandakaranya Project every year in order to carry out the project and construct the main roads in the above mentioned four areas. Judging from the various respects, this is a realy large-scaled project, and the Indian Government displays much enthusiasm for its execution. But since the project has to cover a vast area and is still in its initial stage of progress, the Government's investment is concentrated to major civil construction works, such as dam construction, excavation of the main irrigation canal and road works, and is not enough for terminal facilities. Consequently, no farmer can earn yet an expected income by the crop from the six acres of land given to him at the time of immigration.

In the development of the Paralkote area, the Development Authority invests about one hundred lakh of rupees a year out of which about eighty lakh of rupees is spent in constructing the Paralkote dam and its main irrigation canal. Since they came into this area, the farmers have been trying their utmost to develop the agriculture of this area eagerly in an attempt to make their second home country, but the growth of their farm production has recently come to a standstill.. Few of the settlers have abandoned their farms which are situated in the depth of thick forests and where they came as refugees with determined resolution that they cannot find any other place to settle down.but the district.

This district is located in the rainy zone of India, and the annual rainfall amounts to 1,800 to 2,000 mm. As most of the rainfalls in the Kharif season from May to September, rain fed single crop is accomplished at least during that season. Accordingly, people can maintain the minimum standard of living by this single crop without relying on an irrigation dam. This advantage in the natural condition together with the advantage of allotted own land of six acres allows the people in this district to earn a higher level of income a year than the average farmer in India does.

It is, however, necessary to make more investment in infrastructure and improve agricultural techniques to a further degree in order to stabilize farming operations in this district. The farmers in this district, who are free from the convention of the caste system common to villages in India and the lands of the tenant system, are willing to accept technical assistance for the improvement thereof with a large potential for successful development, as compared with the other parts of India.

The survey team has come to the conclusion that if the Japanese Government renders technical cooperation as recommended by the team dispatched to India in 1969, the development of the district will be probably successful in the long run in spite of many foreseeable difficulties.

1.3. Basic Concept of the Project

(a) Execution of the Project

The project will be executed in accordance with the agreement signed by the Governments of India and Japan. The Government of India desires the Government of Japan to begin to extend cooperation as quickly as possible. In compliance with this desire, the survey team recommends to the Japanese Governments that the agreement be signed and delivered within April, 1970 so that Japan can dispatch a number of specialists to India before its rainy season of this year breaks.

(b) Objective of the Project

1) It is an objective of the project to develop the villages PV 13 and 14 situated along the main irrigation canal from the Pakhanjore tank, including the land improvement on the right bank of the canal. Another objective is to make a model upland farming area by constructing upland irrigation facilities through the adjacent plateau covering about 120 acres. The project aims finally to make the land consolidation, establish the farm management best suited for the district and organize the farmers cooperative in order to increase the production and improve the farmers' standard of living whereby they can engage in farming under stable conditions.

2) In order to achieve the foregoing objectives, it is necessary to establish agricultural cooperative comprising both the natives and the immigrants, reinforce its organization as a fundamental community in daily life, make it into such a cooperative as every farmer can actively take part in, and furthermore, teach the farmers how to manage the cooperative by themselves. What the farmers of the district eagerly want is the timely water supply in an adequate amount during the dry season and proper drainage during the rainy season. This calls for the improvement of the irrigation canals and the drainage systems, and the consolidation of the land.

3) It is important that the following investment should be made by the Indian Government with its own funds for successful completion of the project, the result of which will effect on further developments of the neighbouring villages.

Chapter 2. Present Conditions of Pakhanjore Community

Chapter 2. Present Conditions of Pakhanjore Community

2.1. Natural Conditions

2.1.1. Location and topography

Pakhanjore district is located at the center of Paralkote zone which is situated on the northwest of the Dandakaranya project area, and is in 20°N. and 81°E.

Pakhanjore belongs to the administrative districts of PV 55, Sohagaon, PV 42 PV 13, PV 14 and PV 43 of Baster district in Madya Pradesh province.

The area spreads on the left bank of Anjari river at the elevation of about 300 m and the slope of 1 to 30, and its shape is about 2 km in width by about 8 km northwest to southeast. Upland of the area forms zonal rock hill.

2.1.2. Condition of PV and its area

PV 42, PV 13, PV 14 and PV 43 are newly reclaimed land and they are arranged for village lots to be along a road centering a tank and a well, but Traibal village in Sohagaon are not divided.

PV 42, PV 13 and PV 43 are lack in water as they are situated on hilly land, while Traibal and PV 14 are situated in low land to be supplied with water from Pakhanjore irrigation canal.

It is 10 km distance along the road from Pakhanjore to PV 43 where is the lowest reach in the area.

The area of each PV is measured by rivers and roads as border line on a map as is given in Table 2.1.2-1.

Table 2.1.2-1 Area of Each PV in Pakhanjore in acre

Name of village	Number of farm house	Acreage	Cultivated area
Traibal	7	661	136
PV 42	69	818	414
PV 13	45	1,049	270
PV 14	47	530	258
PV 43	65	992	390
Total	233	4,050	1,468

Culivated area is equivalent to 36% of the whole area as is shown in Table 2.1.2-2, and uncultivated area is composed of dense forests.

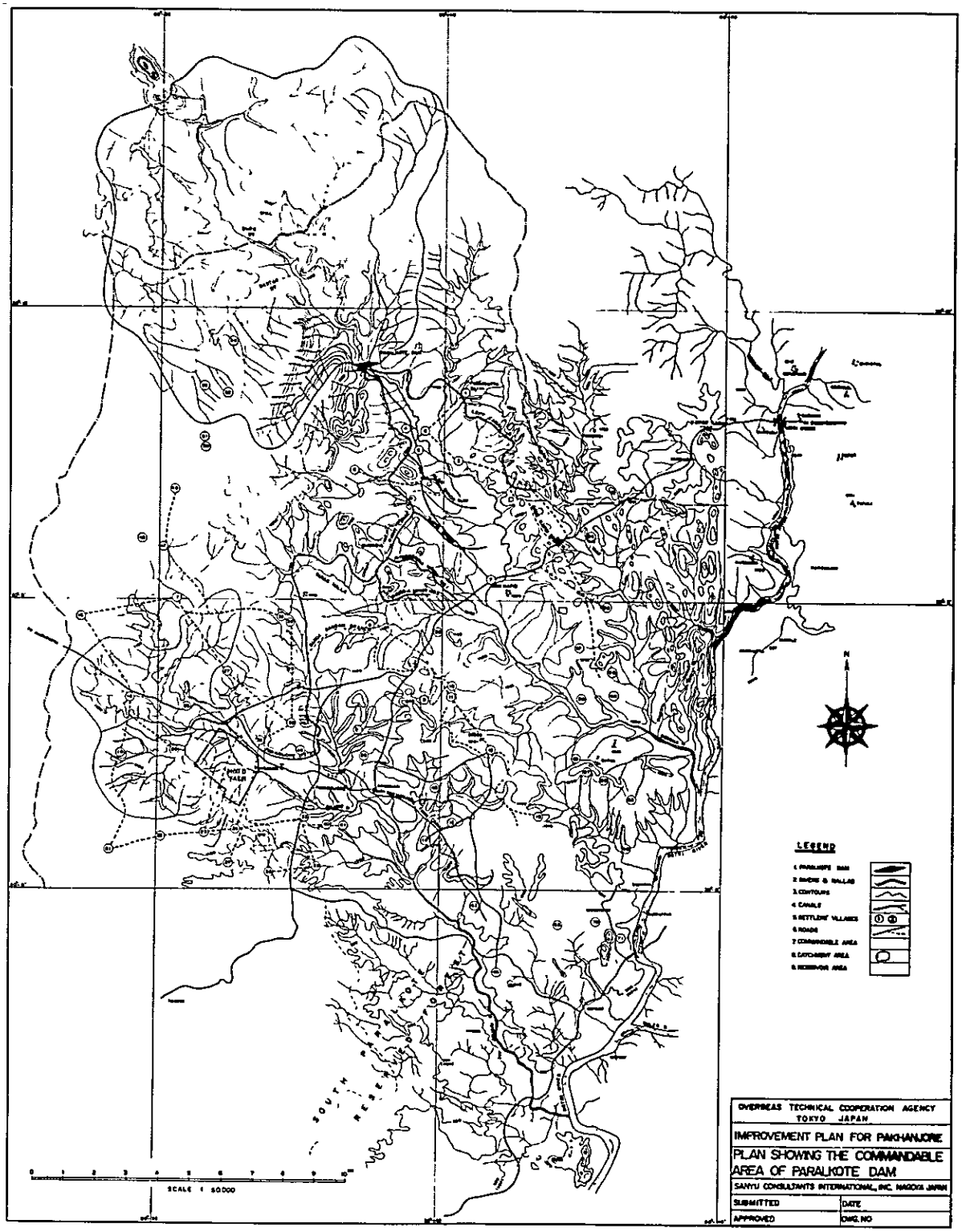
Table 2.1.2-2 Cultivated Area in acre

Name of village	Rainy Season			Dry season	Whole area
	Irrigation	Non-Irri.	Sub-total		
Traibal	100	36	136	20	136
PV 42	46	368	414	30	414
PV 13	50	220	270	43	270
PV 14	140	118	258	116	258
PV 43	233	157	390	20	390
Total	569	899	1,468	229	1,468

One farm household has 2 acres of paddy fields and 4 acres of upland fields, totaling 6 acres, on an average.

In PV 42, out of 69 of farm households, 30 of farmers possess irrigated paddy fields and the rest do not.

In PV 13, out of 45 of farm households, 4 farmers do not own their farm land.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TOKYO JAPAN
IMPROVEMENT PLAN FOR PAKHANJORE
PLAN SHOWING THE COMMANDABLE AREA OF PARALKOTE DAM
SANYU CONSULTANTS INTERNATIONAL, INC. NAGOYA JAPAN
SUBMITTED
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PV 14, out of 47 of farm households, 41 of farmers own 6 acres of paddy fields and 6 are side-work farmers with 2 acres of paddy fields.

In PV 43, only 20 acres of paddy fields are irrigable in the dry season. Irrigation canals catch water from mountains and make it a source for irrigation in the rainy season, and the tanks serve as a water source in the dry season because of no river discharge.

In Tribal and PV 14, main irrigation canals are utilized for vegetables and fruits irrigation, along with paddy irrigation, and both districts seems rather rich than other districts.

2.1.3. Meteorology and hydrology

(1) Meteorology

Being affected by the monsoon, a year is divided into 4 seasons that is, the former monsoon (April to May) with a little rainfall and highest temperature, the monsoon (June to September) in which about 90% of averaged annual rainfall of 1,700 mm is seen, the latter monsoon (October to November) with a little rainfall, and winter (December to March) with little rainfall and lowest temperature.

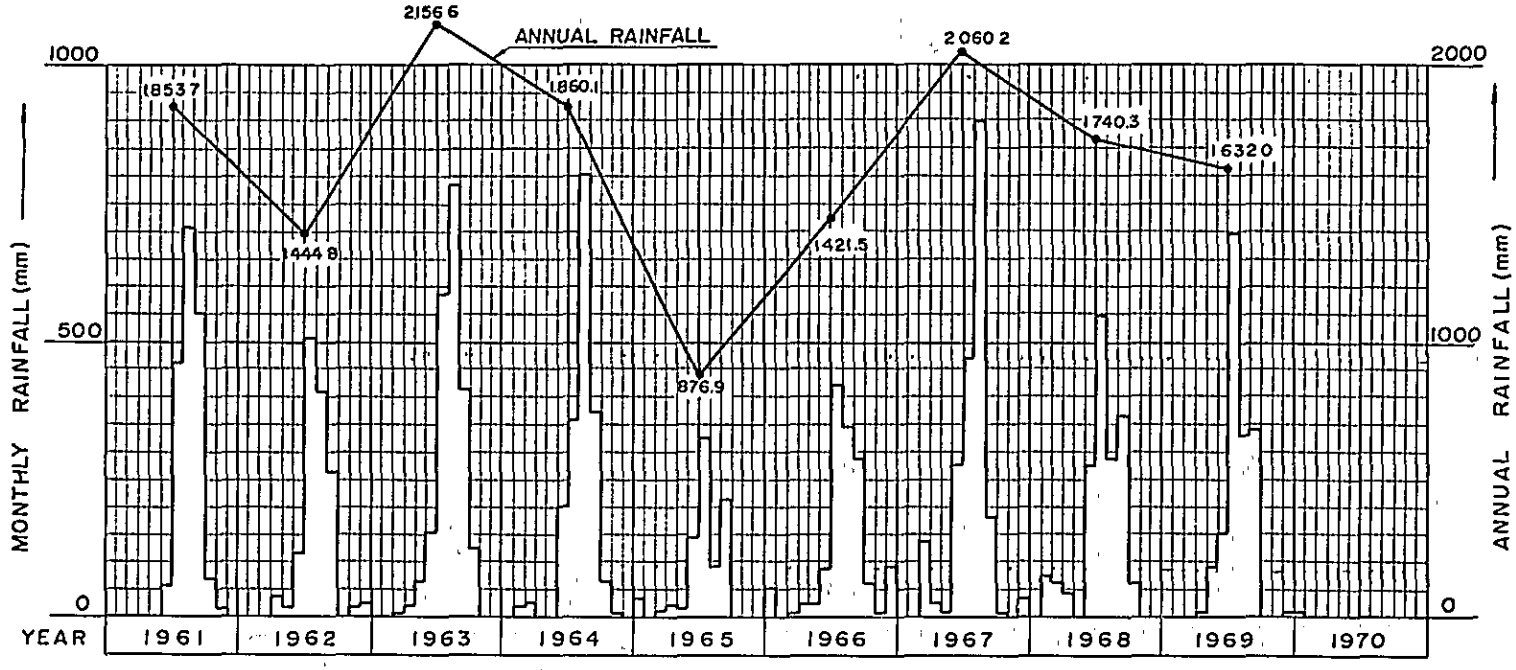
The agricultural products in this area are much affected by rainfall conditions such as amount, beginning and monthly fluctuation of rainfall owing to insufficient irrigation facilities.

Fluctuation of daily temperature and rainfall are illustrated in Fig. 2.1.3-1 and 2.1.3-2.

(2) Hydrology

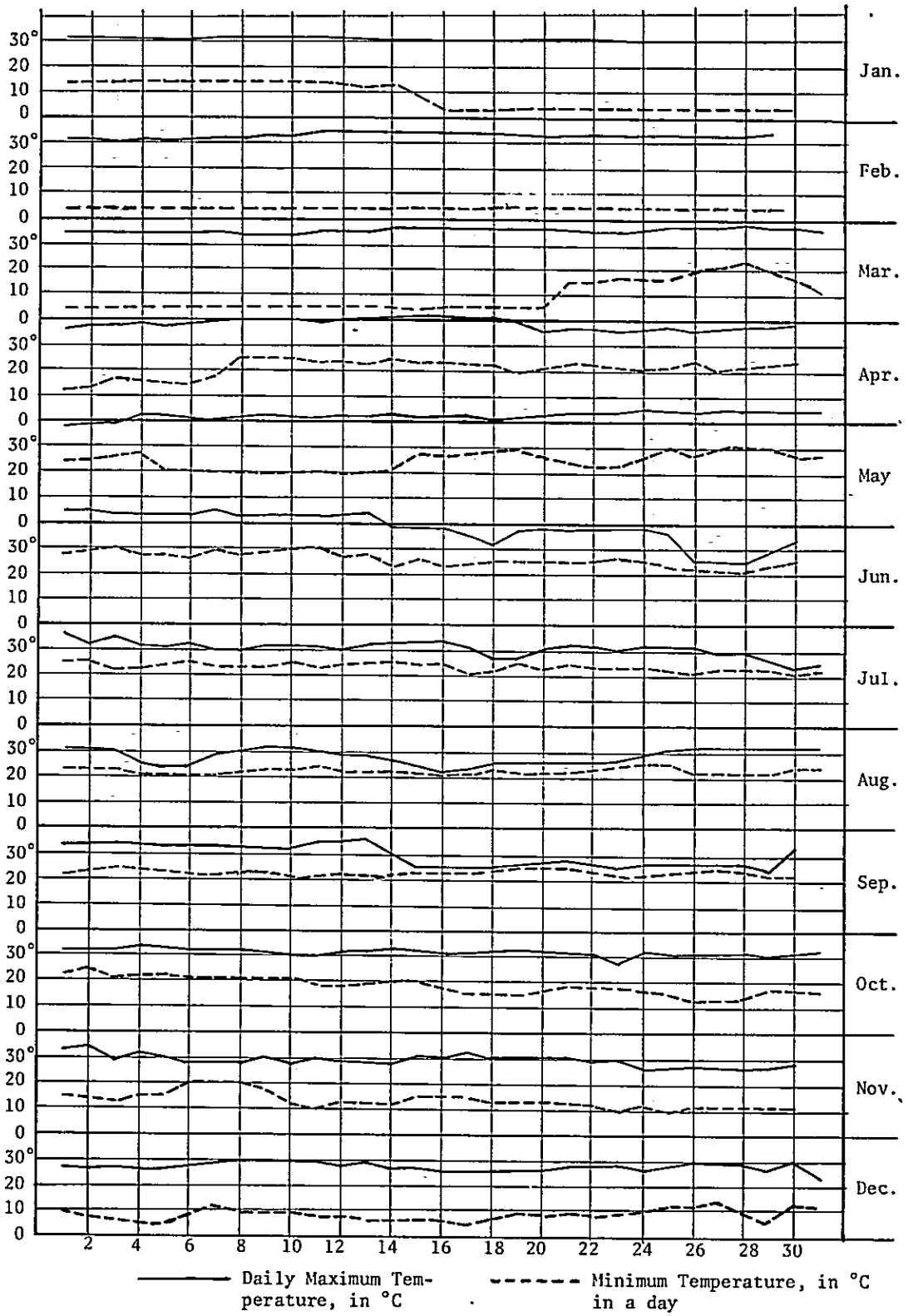
No continuous observation data concerned with base flow of Anjari Nalla are available. As the soil and topographic conditions in the

Fig 2.1.3-1 RAINFALL FLUCTUATION AT MIXED FARM



	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Total Apr. - Sep.	Annual
1961	-	-	-	-	-	58.0	457.1	706.2	550.2	69.6	12.6	-	1,771.5	1,853.7
1962	-	0.5	0.4	38.1	16.6	168.4	507.8	406.0	264.2	-	18.4	24.4	1,401.1	1,444.8
1963	-	-	4.0	21.4	65.2	157.2	584.0	786.4	415.1	123.3	-	-	2,029.3	2,156.6
1964	-	23.0	25.0	-	-	206.5	360.1	801.8	371.9	66.8	5.0	-	1,740.3	1,860.1
1965	35.6	-	10.2	23.0	19.5	144.8	329.0	99.8	215.0	-	-	-	831.1	876.9
1966	56.0	-	5.1	24.3	24.2	85.5	420.2	345.9	293.4	61.0	9.0	96.9	1,194.5	1,421.5
1967	-	-	140.8	27.9	10.2	282.8	471.3	899.0	187.7	3.6	-	36.9	1,878.9	2,060.2
1968	-	76.2	69.5	46.3	-	276.4	549.3	291.9	368.7	62.0	-	-	1,532.6	1,740.3
1969	-	-	-	5.0	94.0	154.0	695.1	329.4	342.0	-	3.0	9.5	1,619.5	1,632.0
Average	10.2	11.1	28.3	20.7	25.5	170.4	486.0	518.5	334.2	42.9	5.3	17.6	1,555.3	1,671.8

Fig. 2.1.3-2
Flactuation of Daily Maximum & Minimum Temperature at Paralkote Zone



Pakhanjore area are not much different from that of Mixed Farm, the unit base flow of 0.804 ℓ/sec/sq. km in Mixed Farm could be applicable for the estimation of the base flow from the catchment area of 15.02 sq.km for Pakhanjore Tank.

2.1.4. Soil

The soil of Paralkote area is classified into the following 6 series according to the soil texture.

1. Kapsi series
2. Alore series
3. Pakhanjore series
4. Krohbeda series
5. Harangarh series
6. Deoda series

The soil of Pakhanjore project area belongs to Pakhanjore soil series, which is acidic and poor in productivity, mainly attributable to the shortage of organic matter and humus. The soil amendment of Pakhanjore series might be possible by applying a large quantity of organic matter and green manure. Fertilization of Potassium compound to this soil would not be so effective because Pakhanjore soil series is rich in mica, on the other hand, the response from phosphorous application might be much higher.

2.2. Social Conditions

2.2.1. Characteristics of the Villages

The villages to be developed with Japanese cooperation are dotted along the main road in the Paralkote area which is about 7 to 10 km east of Pakhanjore, and the center of administration for Paralkote and adjacent areas. These villages are numbered PV 13, PV 14, PV 42 and PV 43 (PV standing for Pakhanjore village) based on the immigration program. According to the general conception, PV does not have any function that the "village" as an administrative unit has, but should more suitably be called just an inorganized community. The PV's are located between the main road and the Pakhanjore tank, and each village comprises 50 to 60 houses.

Each village has been formed in accordance with the basic immigration program of DDA, and is equipped with the minimum facilities for the living of the villagers. Each PV has a tank for living, two artesian wells and two pump wells, which provide the necessary amount of water to each house. The houses are built to a uniform design after the East Pakistani style, and each house comprises a wooden, bamboo and claywalled, slate or zinc board roofed main building of brick foundation (mostly having three rooms), and a separate kitchen, a shed, a shelter for domestic animals, a work-yard in front of the main building and a homestead, each house is arranged on an 800 square-yard site. At the center of a PV is located a public square for gathering and playing, a primary school and other facilities.

The villagers are cooperating with one another in such work as the repairs of roads, but are hardly working together in respect of agriculture, though they apparently used to do so at the beginning. The only exception to this is some mutual help observed among relatives or those who are very intimate with each other. There is no indication, however, among the villagers that the evils of the caste system hinders the development of the villages.

When direct technical cooperation is going to be extended to a particular village, it is needless to say that the objective of such cooperation is to give proper guidance according to the type and nature of that particular village, develop its functions and improve the livelihood of the farmers constituting the village. In this connection, the PVs have the following distinct features:

(a) They are all villages composed of settlers, under the direct control of the Government.

1) The farmers came to these villages as settlers at the same time, and are engaged in their farming work under the same conditions.
2) They are eager to increase production from their farms.
3) There is no division of the villagers into various social classes.
4) There is an atmosphere of democracy and independency among the villagers.
5) The Government is still the owner of the land.
6) Each house has a considerably large piece of farm land (6 acres).

(b) The farmers are refugees from East Pakistan.

1) They are well unified into a community.
2) They adjust themselves to the Government's instructions.
3) Most of them are young.
4) They inherit the agricultural techniques of East Pakistan and furthermore have few negative customs.
5) They have neat habits and prefer to live a rational life, probably due to the Moslem influence.

(c) The farm production of the PV's considerably differs from one village to another, depending on the physical conditions such as the availability of water during the dry season. Above all, the size of the irrigable paddy fields in a particular village which governs the size of farm production of that village differs from village to village, depending on its land conditions. The same problem exists within each village where the size of irrigable paddy fields owned by each house considerably differs from one house to another.

It is a serious desire of every farmer to secure a sufficient amount of irrigation water, and in this connection, the farmers are expected to cooperate rather enthusiastically in establishing a cooperative body for securing water, e.g., a cooperative association for water utilization.

(d) There is no strong connection between the PV's in any respect. It will take long before several PV's are consolidated and formed into a real village as an administrative unit.

2.2.2. Dandakaranya Development Plan and Settlement Conditions

The Dandakaranya Development Project comprises the development of four zones, i.e., Paralkote, Umarkote, Malakangiri and Raighar. The development of this area began with the transfer of 79,742 acres of land from the State of Madya Pradesh to the Dandakaranya Development Authority, out of which about 43,050 acres was found suitable for agriculture by the land servey.

Settlement began in November, 1960, when 646 farm-houses came to live in Chkote Kapsi, followed by settlement of 700 houses into 15 places during the period of about one year. By 1963, a total of 2,255 houses settled into a total of 45 places. At that time, no more settlers were capable of being accepted, but the survey made in 1964 as to the possibility of further settlement proved such possibility subject to the development of the north-eastern and western parts of the area, which was consequently carried out.

As a result, a total of 5,395 houses settled in 115 places by 1969.

Villages Opened and Farm-House Immigrated as Listed by Years

Year	Villages Opened	Farm-Houses Immigrated
1960 - 61	15	700
1961 - 62	19	981
1962 - 63	11	574
1963 - 64	7	359
1965 - 66	6	345
1966 - 67	22	863
1967 - 68	14	737
1968 - 69	21	836
Total	115	5,395

Note: The list does not include the 74 native houses which settled in 13 villages.

The Dandakaranya Development Authority allotted to each house six acres of farm land (consisting of four acres of paddy field and two acres of upland field) and 800 square yards of land for a housing lot.

The settlers built their houses by themselves with a loan of about 1,700 rupees from the Authority.

In addition, each house received the following loans from the Authority:

For work cattle	450 rupees
For milk cows and calves	150 rupees
For farm implements	100 rupees
For seed, manure and agricultural chemicals	290 rupees
For weeding work	25 rupees
Total	1,015 rupees

Furthermore, the Authority provided each household with a subsidy in the amount equal to the standard cost of living for the first harvesting period after its settlement, a half of that cost for the second period and one-fourth thereof for the third period.

An area equal to 25% of the developed farm land was made open for the natives, and 74 houses settled in that area by 1965. The Authority has been paying to each house of such natives a subsidy of 2,600 rupees, and it is also possible for each house to get a loan of about 2,800 rupees for building a residence and proceeding with its farm operations.

The settlers at present have only the right to use the land allotted to them, including the land on which their house lies, and do not hold the ownership thereof.

2.2.3. Residents

It goes without saying that the majority of the residents in the PV's are farmers. The working population and job composition of a certain village are broken down as follows:

Table 2.2.3-1

Fermers	74 persons	69.2%
Wage workers	20	18.7
Carpenters	7	6.5
Primary school teachers	2	1.9
Merchants	2	1.9
V.L.W.	1	0.9
Fisherman	1	0.9
Total	107	100.0

The population of the farm house-hold in the four PV's totals 1,090, each family consisting of 4.8 members on an average. Children occupy about 55% of the whole population, and as regards adults, the number of men is slightly larger than that of women.

2.2.4. Tribal (Natives)

The Tribal of Pakhanjore live in the form of a community similar to that of the settlers, in an area along the upper portion of the stream flowing into the Pakhanjore tank. They are mainly engaged in livestock raising, agriculture, manufacture of jars or working for wages. There does not seem to be any appreciable difference between the Tribal and the settlers in their way of living, except the way they dress and decorate themselves. Contrary to the General trend in India, there is little conflict between the Tribal and the settlers in Paralkote, partly because the Tribal occupy a smaller percentage of the whole population in this area than anywhere else. The Tribal participate in trading on a bazaar day.

The Tribal live close to a jungle, but are more favored in the quality of land available for agriculture than the settlers. They have a meat-eating habit, and can apparently withstand heavy work.

They are not appreciably inferior to the settlers in the level of agricultural techniques. If their farming conditions are improved, they are expected to develop steadfastly their agriculture.

The Tribal consider that they are given less aid by the Government than the settlers area, and are in great hopes for more aid toward the future. Their farms are situated along the upstream of the main canal flowing out from the Pakhanjore tank, so that they can rather easily receive a supply of water from this canal during the dry season.

2.2.5. Education and Public Facilities

(a) Education

The Dandakaranya Development Authority has been placing special emphasis on the education of the settlers' children who are supposed to grow up into the driving force for further development of their area.

One primary school has been established in every three to four villages, and manned with one or two teachers, by whom pupils in the first to fifth grades are being taught by turns as if in a private school of old Japanese education system. Education at primary school level is compulsory, and is fully paid for by the Authority.

School is taught in Hindi, which is the official language of India and the subjects being taught are language, mathematics, history, science and art. School buildings, facilities, textbooks, etc. are not good enough, nor is the educational level very high.

Nevertheless, the interest the villagers take in education is so high that nearly 100% of their children who have reached school age attends school regularly. This area has a senior high school, too, though the extent of the pupils who are promoted to high school is still low owing to their economic ability. The number of the students enrolled at the high school has, however, reached 300, including the both sexes, and the students who come from distant places are admitted to the entry of a dormitory.

The villagers who come from East Pakistan speak Bengali in their daily life, but many of them understand Hindi. There are fewer illiterates in this area than in any other part of India.

In general, the villagers in this area seem to be at a higher educated and cultural level than those in any other Indian villages.

(b) Public Facilities

Roads have been built for communication within the villages in accordance with the settlement programme. Also, there exist passages leading to other villages and fields.

Each village has a gathering place combined with a playground, though not yet fully equipped or arranged. A plan of furnishing the villagers with a set of articles for valley-ball and football, musical instruments, etc. has been devised in order to encourage them to play sports or music on their free time, but has not yet been put into practice.

There is a public hall in every eight to ten villages. But the villagers seldom use it because the hall is not very conveniently located for access from any village, and also because those villages have not yet been socially developed to such an extent that people belonging to as many as eight to ten different villages feel free to have an assembly together.

At present, assemblies are usually held by and between two or three villages, and people are using a school building for an assembly. Thus, the public halls are not being used for their primary purpose, but some of them are at present used as a fertilizer warehouse.

(c) Welfare Facilities

There is a hospital in Pakhanjore, which has an X-ray system, thirty beds and an ambulance car and provides free examination and treatment to the residents of the region.

The hospital is manned with a doctor, three nurses and several assistant nurses, and is capable of surgical, internal and maternity examination and treatment. There is a pharmacist in every two villages, who tends and prescribes medicines for mild cases.

(d) Other Facilities

1) Roads

Truck roads having a total length of 45 miles are provided to connect this area with other areas and also to enable transportation between the principal points within the area. In addition, roads having a total length of 160 miles are available for providing linkage between the villages. Both roads are covered with gravel.

2) Communication

There are no communication facilities in this area, which causes inconvenience to the administrative communications through the villages. At present, automobiles or similar vehicles are used to transfer communications from the central organ to the local organizations. Communications with other areas are regularly conducted by means of the wireless system provided at the zonal headquarters, but such communications are restricted to those between the areas within the district being developed under the present project. Communications with areas beyond the limits of the districts are first sent to the Development Headquarters in Koraput, which in turn relay them to another public communication network. There is a post office in this area, which is engaged in mail, savings and other services.

3) Electricity and Water Service

There is still no complete electric or water service available in this area. An independent electric power plant generates power and send it to the hospital and a part of other public facilities in order to supply electric light to them at night. The supply of power for general use is presently available up to Bhanupratappur which is 40 miles from this area, and plans are under way to extend the power transmission line and also the telephone service line into this area within the current year. The hospital's small water service facilities of the simplified type are the only ones of the kind present in this area. People drink water from the artesian wells.

2.3. Economic Conditions

2.3.1. General Description of Farmers' Economy

The total gross agricultural production of all the villages served by the Pakhanjore tank, i.e., PV13, 14, 42 and 43, for the past year amounts to about 6.6 lakhs of rupees, out of which about 11% or 73,300 rupees in value was produced during the dry season in 1968 - 69 and the remaining 89% or 586,300 rupees in value during the rainy season in 1969. The output per household differed to some extent from one house to another; it was bigger in PV 13 and 14, while being small in PV 42 and 43.

Table 2.3.1-1 Gross Agricultural Production of Vaillages Served by the Pakhanjore Tank

	Dry Season (1968-69) in 1,000 rupees	Rainy Season (1969) in 1,000 rupees	Total in 1,000 rupees	Per Household in rupees	in 1,000 yen
Total	73.3	586.3	659.6	2,890	≒ 140
PV 13	25.3	138.6	163.9	3,640	≒ 175
14	30.1	159.2	189.3	3,800	≒ 183
42	17.9	182.2	150.0	2,180	≒ 104
43	-	156.3	156.4	2,870	≒ 138

Ratio of Commercialization of Farm Product

The results of a hearing survey indicate that about 3.4 lakhs of rupees or 51.6% of the entire production have been commercialized instead of being consumed by the farmers themselves. But if it comes to rice only, the rate of commercialization is as low as 32.5% This means that the present economic status of the farmers in this area is just a little above the stage of self-sufficiency.

Production Cost and Rate of Income

The cost of production required all over the area is estimated at about 40,000 rupees (or 170 rupees per house), 47% of which is spent on manure, 14% on agricultural chemicals, 17% on agricultural implements and 22% on other materials.

Table 2.3.1-2 Production Cost

Total	Break-down			
	Manure	Agricultural Chemicals	Agricultural Implements	Others
Rs. 39,500	46.7%	13.9%	17.3%	22.1%

The rate of agricultural income which is calculated on the basis of the above production cost and gross production cost, and gross production is about 94%. This figure indicates that the farm work is mostly being done by human labor in this area.

Gross Income of a Farm-House

The gross income of each house averages about 3,400 rupees including some from stockbreeding and from a job other than farming. This amount is about 30% greater than the average gross income of the farm-houses in Paralkote which is 2,544 rupees. Out of 3,400 rupees, 85% is earned from farming, 9% from stockbreeding and 5.5% from other sources.

Table 2.3.1-3 Gross Income of Farm-House

From Farming	From Stockbreeding	Sub-Total	From Other Jobs	Grand Total
Rs. 2,893	Rs. 315	Rs. 3,208	Rs. 185	Rs. 3,393
85.3%	9.3%	94.5%	5.5%	100%

If the amount of 185 rupees in this table is earned from wage labor, which makes two rupees a day, it follows that the farmers do two different kinds of labor for about 93 days.

Cash Income of a Farm-House

This is roughly calculated as follows:

The sum of the income from farming and that from stockbreeding, i.e., 3,208 rupees, multiplied by the rate of commercialization, i.e., 51.6%,

makes 1,655 rupees, to which the income of 185 rupees from other jobs is added. The amount of 1,840 rupees thus obtained is considered as the average cash income of a farm-house. The production cost amounting to 170 rupees is deducted from 1,840 rupees, and the resultant figure of 1,670 rupees is the average net income in cash.

Living Cost of a Farm-House

The average living cost in cash per house is estimated at 1,318 rupees, out of which 878 rupees or two-thirds is spent on seasonings and food. The farm products and stock eaten by the members of the house amount to 1,553 rupees (3,208 rupees less 1,655 rupees). Accordingly, the cost of food totals 2,431 rupees. The total cost of living including both purchase from outside and consumption of self-products is 2,871 rupees; hence, the Engel's factor of the farm-house amounts to as high as 84.7% on an average.

Table 2.3.1-4 Living Cost of Farm-House

Total	Self-sufficient food component	Purchase from Outside				
		Seasonings	Clothes	Daily Necessities	Personal Ornaments, etc.	Sub-Total
Rs.2,871	Rs.1,553	Rs.878 (66.6%)	Rs.188 (14.2%)	Rs.166 (12.6%)	Rs.86 (6.5%)	Rs.1,318 (100%)
100.0%	84.7%		6.5%	5.8%	3.0%	

The foregoing description of the farm-house economy based on factual figures will hereinafter be more generally supplemented.

Some of the immigrant farmers employ annual employees to have them help their farm work (or in the area where the Tribals are predominant they employ the immigrants as annual employees), and some others apparently rely on temporary employees for the agricultural work. And some others seem to buy the rice for their own consumption. In a certain village, eight houses out of 49 are said to employ a number of annual employees, who are being paid 80 rupees a month. About 60% of the houses seem to be relying

more or less on temporary employees for help during the rainy season. Some of the settlers run a store of daily necessities in their village, act like a merchant at a bazaar, go on a peddling tour, or go to work at a dam construction site.

It is unavoidable that failure to do the right work at the right time due mainly to labor shortage, bad weather, damage by blight and insects, shortage of water, etc. make the agricultural income more or less unstable. As a natural consequence, the farmers are inclined to put their energies into jobs other than farm work. At the same time, it is an undeniable fact that their skill in farm work and management is inherently not high enough to keep their income stable. Thus, various degrees of difference are observed to exist among the farmers with respect to the level of agricultural techniques, income and standard of living. It is anticipated that such difference among the farmers will become greater and greater in proportion to the growth of agricultural production and the expansion of commercialization of farm products.

2.3.2. Farm Products and their Marketing

It is paddy that is the most important product in the area served by the Pakhanjore tank, whether during the rainy or dry season. As shown in the table below, the production of paddy during the last year amounted to 1,750 tons, which is worth about 4.2 lakhs of rupees or 71% of the gross agricultural production. The second largest is til, amounting to 110 tons or 1.02 lakhs of rupees, which occupies 15% of the entire gross production. The third is maize, which amounted to 110 tons, and 33,000 rupees or 5% of the whole farm production. Other major products of the area are mesta, araha and wheat.

Table 2.3.2-1 Quantity and Value of Farm Products

Rainy Season (1969)

Name of Product	Quantity Produced (tons)	Value (in thousand rupees)	Percentage in Value (%)
Paddy	1,570	418.6	63.5
Maize	68	18.2	2.8
Sesame (Til)	109	101.6	15.4
Kenaf	64	25.7	3.9
Araha (Bean)	55	22.1	3.3
Total		586.3	88.9

Dry Season (1968-69)

Name of Product	Quantity Produced (tons)	Value (in thousand rupees)	Percentage in Value (%)
Wheat	15	7.8	1.2
Paddy	185	49.4	7.5
Hy. maize	46	14.7	2.2
Vegetables	3	1.3	0.2
Pea	trace	trace	0.0
Gram	trace	trace	0.0
Total		73.3	11.1
Grand Total		659.5	100.0

All of these products are sold at the Pakhanjore Bazaar, except about 70% of the paddy which is consumed by the farmers and their families. A bazaar is held at Kapsi nearby, too, but only on a much smaller scale than at Pakhanjore. The annual deal at the bazaar in Pakhanjore amounts to about 39.7 lakhs of rupees, or over eleven times as much as the volume of the farm products sold by the four villages served by the Pakhanjore tank, i.e., about 3.4 lakhs of rupees. Every Wednesday, the farmers bring their products collected or prepared during the preceding week to the site of a bazaar, carrying them on the head, shouldering them by means of a pole

and baskets or in a bullock cart. The majority of the edible products produced by the farm-houses in this area are presently being consumed by themselves or somebody else within the area, while the kenaf, til and products of similar nature are delivered outside of the area through merchants or the Agricultural Cooperative Association.

Raipur is believed to be the best market outside the area, where a fairly profitable trade is expected if the products are directly shipped to and sold there, but the size of production is not yet large enough to allow much to be placed on the market at Raipur. Raipur has a population of about 300,000, and is about 160 miles from Pakhanjore. The road is paved along about half the distance between the two towns, which are linked to each other by the bus service available twice a day and also by the truck service available to a certain extent. Bilai, a town of mines, has a population of about 35,000, and is 70 miles from Pakhanjore. The conditions of the road from Pakhanjore to Bilai are not bad, and bus and truck services are also available. Very close to Bilai, there is another town of mines named Dawairajera, which supplies iron ores and coal to the former. The latter's population is about 15,000. At a distance of 250 miles from Pakhanjore, there is a town named Raigarh, where bags and mats are made of kenaf. About twenty-five thousand people live in the urban part of this town.

These towns will have to be evaluated as promising markets for food and raw materials as the farm production increases and the means of transportation is developed and improved.

2.3.3. Living Standard of Inhabitants and their Desire

(a) Food

Each family spends 2,431 rupees on food a year on an average, which comes to somewhere between 347 and 486 rupees per capita. Thus, food occupies a very high percentage in the cost of living here in this area, i.e., 84.7% on an average. They live on paddy, wheat and hy. maize, and eat those which they themselves produce. The nutrition they take is far from suffi-

cient, and malnutrition is the cause of illness they most often suffer from. Members of the survey team who visited the houses in this area witnessed a sick person lying in bed in every five to ten houses. The coarseness of food which they eat may be obvious from the following list of the kitchen utensils which they use:

Kitchen Utensils Possessed by Standard House (Probably, of the Upper Middle Class)

Name	Quantity Possessed
Iron cookpot	3
Bowl	5
Platter (enameled)	3
Plate	4
Scoop	1
Overturner for frying	1
Water jar	3
Bucket	2
Bamboo basket	1
Stone block for chopping	1

Cooking is done in a thatch-roofed, bamboo-walled shed separate from the main house. This shed generally measures about two and a half meters by four meters. There is a hearth at the same level as the earth floor, and adjacent the hearth is a stand on which water jars are placed. They do not have a cooking stand, but stoop down on the earth floor when doing cooking. Water is drawn from an artesian well, and carried in a jar or bucket to the cooking shed.

(b) Clothes.

Adults generally wear simple clothes such as shirts and saris, but some children do not have anything on the upper half of their body. Both adults and children mostly have bare feet, and few wear sandals. They have several

every day clothes and some holiday clothes, though they have so few clothes that all the clothes owned by a particular family can even be put in one or two wooden cases measuring approximately 40 cm by 80 cm each. There is no other container for clothes. If it comes to bedding, only the favored few have mattresses and that thin ones, and generally, people sleep on a thin sheet laid on the earth floor.

(c) Housing

The main house is built of wood and earth, and the central room adjacent the entrance approximately measures four meters square and is sandwiched between two smaller rooms approximately measuring three meters by five. A paddy tank is placed on the higher-leveled floor of each of the two smaller rooms. The central room has a small altar in one of its corners in some houses, and serves as the main bedroom. One or both of the smaller rooms are usually used as a bedroom. The floors of the rooms are all of earth, and are 40 to 50 cm above the ground level. The houses are all of single-story, and roofed with slates or zinc plates. The paddy tanks are of bamboo-reinforced, earth construction, and are around one and a half meters both in diameter and in depth.

Several houses have one or two beds and chairs. Recesses made in the walls of the rooms are being used for shelves. These are all the furniture they have in their houses. The rooms are divided by earth walls, and have no door at their entrance. Each room has a window, but the wooden cover provided on the window prevents both ventilation and lighting.

Each house has an entrance each on its front, right and left sides, the entrances being provided with wooden doors. The houses are kept neat and clean.

(d) Desire

The immigrants have a strong desire to improve their standard of living, but do not seem to be extraordinary but very sound in their way of thinking.

Many of them want to raise their income to somewhere between four and five thousand rupees in the not distant future, while there are some who aim at six thousand rupees. The amount of an adequate income largely depends on the size of a particular family, and therefore, does not permit a general statement. They are much interested in acquiring advanced farming techniques and introducing better implements as they believe an elevated standard of farm production to be the key to a better life. During their stay in the villages, members of the survey team often heard people express their desire to undergo training or visit farms in Japan if they are favored with chances. They, however, do not seem to be desirous of having a broader knowledge of various things in the world. If the mass-media come to permit them to know much about the outer world, their desire in general will be enhanced, and their productive energies kindled.

2.4. Present Situation of Organization

2.4.1. Village administration

Each PV is the terminal unit of administration. The village chief and deputy chief are elected democratically by villagers at every three years. All the important problems of each PV are decided by villagers' votes. Thus the autonomous system is tentatively enforced upon each PV, but villagers' action is on the developing way, and practically it seems that they are still in the conventional inclination of being governed by authority's will.

Such social activities as the road improvement, road repair, building of houses, maintenance & control of community wells are now being carried out by villagers as one of the community activities.

2.4.2 Cooperative society and its activity

At present there is a cooperative society called "Paralcote Marketing Society" (hereinafter called P.M.S.) which is organized for the welfare of the Paralcote district. It is only a short time since this P.M.S. was

established in 1968, so the members are 1,100 persons which means only 20%. of about 5,400 villagers in the Paralcote district. The reason of such a low rate of joining the P.M.S. is said to be due to the short time since the foundation as well as farmer's less investment and inability of sharing payment, but there seems some other reasons are involving - the detail is set forth in the paragraph "Plan of Cooperative Society." From the villages in the Pakhanjore tank District 22 farmers joined the P.M.S. i.e., 11 persons from the PV14 district and 11 persons from the PV 42 district.

The P.M.S. is carrying on business in selling several kinds of products and in purchasing farming materials. The business scope may be estimated by the dealing results in the last one year. Sales - the handling amount was about 115,000 Rupees. Of this 115,000 Rupees the shipment from the Pakhanjore tank district was 13,750 Rupees, Hy Maize 100,000 Rupees, Sesame 15,000 Rupees and Araha (pigeon pea) some amount. Purchasing - the handling amount was about 148,000 Rupees. Of this 148,000 Rupees, the purchase for the Pakhanjore tank district was 11,800 Rupees, in which fertilizer 133,000 Rupees, Hy Maize seed 15,000 Rupees (Yen 12, 124).

Since the P.M.S. is in its early days and no fully stabilized yet, it is now under the care and guidance by the officials in charge of the district agriculture. There is no exclusive wholesale market nor similar facilities provided yet. The staff officers of the P.M.S. are not elected nor full time staff are appointed yet. Thus everything is in the state to grow in the future. It can be said natural, because the agricultural production in Paralcote has recently attained to a level to meet the demand in the district and their commercial activity is no more than a primitive state to carry products into bazaar on their heads. In the future, however, when agricultural production expands and commercial activity develops more active, farmers will realize the necessity of the P.M.S. and its management will be carried out positively by farmers.

As for the other society, there is a fishermen's society called "Jaliban Society" that consists of 58 members but there is no farmer who joined this "Jaliban Society" from the Pakhanjore village. This fishery society is showing little activity and its fishing techniques are not

still advanced. There is another consumers' society organized by the Government Staff called "Staff Consuming Society," but it is showing no noteworthy activity at present.

2.5. Actual Condition of Agriculture

2.5.1. Cultivated field and farming in PV13

According to the practical data obtained on the field investigation, the cultivated area in this PV13 is 270 acres including 43 acres of paddy field which are irrigable directly from the Pakhanjore tank through the trunk canal. In this village, 45 farmers have been working up the farming in systematic management gradully to the present self-sustaining stage since they settled and started farming in 1961.

The PV13 has irrigable field, 1 acre for one farmer on the average. Out of these farmers 4 farmers possess 2 acres respectively but 4 farmers who settled later have no irrigable field yet. A typical farmer's field in this PV13 is shown in the following table. The extreme fragmentation of the field is one of the causes of the labour shortage.

Block	Area (acre)	Number of plot	Area on average	Distance from house (meter)	Soil Condition
1	2.00	16	0.14	2,200	Half way up a hill and soil condition is poor
2	1.20	6	0.2	400	Dry sand field
3	0.70	3	0.23	200	Near pond and suitable for rice growing
4	0.30	3	0.27	200	Beside a pond but upland and suitable for dry field.
5	1.00	4	0.25	1,000	Good dry field suitable for cultivating beans

As seen in the above table, the cultivated field 6 acres are dispersed sporadically far and side into 5 small blocks of about 0.25 acres. Furthermore, the farthest field is remoted more than 2,000 meters from farm-

house without noteworthy path, so it is very inconvenient to transfer farming materials.

Crops and Productivity

The crops generally cultivated by farmers and their income are as tabulated hereinafter.

"A" farmer

Summer (Kharif) cropping in the rainy season

Crop	Cultivated area (acre)	Yield per acre (maund)	Unit cost (Rupee)	Benefit per acre (Rupee)	Yield per area (maund)	Gross income per area (Rupee)
Rice	2.5	30	24	720	75	1,800
Hy. maize	0.15	33	20	660	0.5	10
Kenaf	1.00	3	30	90	3.0	90
Sesame (Til)	5.00	..... Yield was less				
Total	8.65					Rs. 1,900

Winter (Rabi) cropping

Crops	Cultivated area (acre)	Yield per acre (maund)	Unit cost (Rupee)	Benefit per acre (Rupee)	Yield per acrea (maund)	Gross income per area (Rupee)
Rice	1.00	50	24	1,200	50	1,200

Gross income : Summer (Kharif) cropping Rs. 1,900
Winter (Rabi) cropping Rs. 1,200
Total Rs. 3,100

Production cost :

Crop	Fertilizer (Rupee)	Labor (Rupee)	Farming (Rupee)	Total (Rupee)
Rice	180	105	40	325
Hy. Maize	20	-	5	25
Total	200	105	45	350

Net income	:	Income	Rs. 3,100
		Production Cost	Rs. 350
		Net Income	Rs. 2,745

"B" farmer (superior farmer)

Summer (Kharif) cropping in the rainy season

Crop	Cultivated area (acre)	Yield per acre (maund)	Unit cost (Rupee)	Benefit per acre (Rupee)	Yield per acre (maund)	Gross Income per area (Rupee)
Rice	1.3	50	24	1,200	65	1,560
Kenaf	1.0	5	30	150	5	150
Hy. Maize	0.3	13.3	18	239	4	72
Sesame (Til)	2.0	0.5	65	35	1	65
Gram	0.7					
Total	5.7					Rs. 1,847

Winter (Rabi) cropping

Crop	Cultivated area (acre)	Yield per acre (maund)	Unit Cost (Rupee)	Benefit per acre (Rupee)	Yield per acre (maund)	Gross Income per area (Rupee)
Rice	1.0	55	24	1,320	55	1,320

Gross income	:	Summer (Kharif) cropping	Rs. 1,847
		Winter (Rabi) cropping	Rs. 1,320
		Total	Rs. 3,167

Production cost :

Crop	Fertilizer (Rupee)	Labor (Rupee)	Farming (Rupee)	Total (Rupee)
Rice	100	250	20	370
Hy. Maize	50	-	10	60
Total	150	250	30	430

Net Income	:	Gross Income	Rs. 3,167
		Production Cost	Rs. 430
		Net Income	Rs. 2,737

Judging from the above data of the yield by the A and B farmers, the benefit made by rice is generally high. Especially it is in the rice cultivation in the dry season in which a high yield is realized as 50 - 55 mounds per acre. This high yield seems to be due to the fact that the cultivation is made in such small scale cultivating area of only 1 acre, and due to the cultivating variety IR-8 that is called "High Yielding Species", and also due to the comparatively careful cultivation.

The yield of upland field crops is generally low. This is due to the cultivation depending upon uncertain rainfall. As for the Hy. Maize and Til the yield would sometimes be practically nothing by drought damage if the sowing period is delayed and no rain would fall during their growth period.

In this village the purchase cost of fertilizer per farmer is 110 Rupees. If nitrogen fertilizer is assumed to be 2 Rupees 50 paise, the 110 Rupees are equivalent to 44 kg of nitrogen fertilizer and this is enough for cultivating one acre of rice field. The other crops are cultivated without applying fertilizer. The farming cost is about 35 Rupees on an average per farmer.

The investment for the farming materials is extremely low, i.e., 30 Rupees for farming implements and 50 Rupees for the other materials. The farmer's thinking directly heard from some farmers is "we don't want to give fertilizer, because the rain might wash it away." This tells the low level of their farming economy.

2.5.2. Cultivated field and farming in PV14

According to the data obtained from Indian Government Authorities, the total cultivated field of the PV14 district is 258 acres in which 116.32 acres are irrigable field and 141.68 acres are upland field.

In this PV14 district, 47 farmers settled and working diligently in farming. Of these 47 farmers, 41 farmers are exclusively engaged in farming 6 acres but the 6 farmers are farming only 2 acres and have side jobs. Generally speaking each farmer possesses 6 acres including a homestead - (0.36 acre the premises including homestead), 2.7 acres upland field and 3 acres irrigable field which may be said to be more irrigable field than that of the other PV areas. Moreover, this irrigable field is expanding wide and far on the southern side of the village, that is a favored groundplot condition for farming management.

The investigation team had no chance to practically inspect the dispersing condition of this cultivated field, but in this irrigable area expanding in front of the village, each farmer possesses 3 acres of irrigable field and 2 blocks of upland fields. The main crops which are now being cultivated are as follows.

"A" farmer

Summer cropping in the rainy season

Crops	Cultivated area	Yield per acre	Unit cost	Benefit per acre	Yield per area	Gross income per area
	(acre)	(maund)	(Rupee)	(Rupee)	(maund)	(Rupee)
Rice	3.0	50	24	1,200	150	3,600
Kenaf	0.7	12	30	360	8	240
Araha (Bean)	1.0	4	30	120	4	120
Total						Rs. 3,960

Winter (Rabi) cropping in the dry season

Crops	Cultivated area	Yield per acre	Unit cost	Benefit per acre	Yield per area	Gross income per area
	(acre)	(maund)	(Rupee)	(Rupee)	(maund)	(Rupee)
Wheat	1.3	2.3	40	92	3	120
Hy.maize	0.5	14.0	20	280	7	140
Green pea	0.3	10.0	40	400	3	120
Mustard	0.7	-	-	-	10 kg	-
Beans	0.15	-	-	-	10 kg	-
Total						Rs.380

Production cost :

	Fertilizer (Rupee)	Farming (Rupee)	Labor (Rupee)	Total (Rupee)
Summer cropping in the rainy season	100	50	380	530
Winter cropping in the dry season	150	-	100	250
Total	250	50	480	780

Net Profit :

Gross income	Rs. 4,340
Farming Cost	Rs. 780
Net profit	Rs. 3,560

"B" farmer

Summer (Kharif) cropping in the rainy season

Crop	Cultivated area (acre)	Yield per acre (maund)	Unit cost (Rupee)	Benefit per acre (Rupee)	Yield per area (maund)	Gross income per area (Rupee)
Rice	2.3	50	24	1,200	1.5	2,760
Sesame (Til)	3.3	1	65	65	3.5	231
Total	5.6					2,991

Winter (Rabi) cropping in the dry season

Crop	Cultivated area (acre)	Yield per acre (maund)	Unit cost (Rupee)	Benefit per acre (Rupee)	Yield per area (maund)	Gross income per area (Rupee)
Rice	0.8	25	24	600	20	480
Total	0.8					480

Gross income : Summer (Kharif) cropping in the rainy season Rs.2,991
Winter (Rabi) cropping in the dry season Rs. 480
Total Rs.3,471

Production cost :

	Fertilizer (Rupee)	Farming Cost (Rupee)	Labor (Rupee)	Total (Rupee)
Unhulled rice (Kharif)	200	45	500	745
Unhulled rice (Rabi)	80	-	-	80
Total				825

Net Profit :

Gross income	Rs. 3,471
Production Cost	Rs. 825
Net Profit	Rs. 2,646

In consideration of the condition of cultivated crops by the above 2 typical farmers, it is well understood that in the rainy season, the rice crop is showing a considerably high yield about 50 maunds on the average by introducing IR-8. Such upland field crops as mesta, araha and til are showing low yield. This may be judged to be a decrease due to overgrown weed. In the dry season, even though the A farmer planted over 35 acres, but gross income resulted only 380 Rupees that is merely 100 Rupees per acre. Especially, the yield of mustard and green pea 20 kg in one acre is extremely low. The question to be considered about this low yield is an insufficient irrigation water. The A farmer complains that "Water was insufficient in the latter part of growing period." The B farmer also cultivated rice in 0.8 acre but the yield per acre is showing 25 maunds per acre which is just the half of the summer cropping in the rainy season. Generally speaking, the rice crops should show more yield in the dry season than that in the rainy season but in this P.V.14 district, the resultant data are showing a decrease due to short irrigation water during the growing period.

In this P.V. 14 district an average investment per farmer is as follows, fertilizer 90 Rupees, agricultural chemicals 25 Rupees, farming implement 30 Rupees and the other miscellaneous 50 Rupees in which the fertilizer and the agricultural chemicals are shown lower investment than those of the P.V.13 district.

2.5.3. Cultivated field and farming in PV42

The total area of cultivated fields in the PV42 district is 414 acres. In this PV42 district, 69 farmers settled and are engaged in farming since they started settling in 1861 and at present it seems that they find their self-sustaining ways in somehow or other.

A total cultivated area per farmer is 6 acres including the premise and homestead 0.36 acre and the remaining 5.64 acres of a cultivated field. Out of these 69 farmers 30 farmers possess 1 acre of irrigable field but the remaining 39 farmers have no irrigable field and depending upon rain water.

In this PV42 district, the cultivated fields are dispersed into 4 blocks as in the other PV districts, and the state of cultivated field and its dispersing condition of a typical farmer is as follows.

Block	Area (acre)	Number of plot	Average acre of a plot (acre)	Distance from house (meter)	Remarks
1	0.7	3	0.23	1,000	Irrigable and mainly for rice crop
2	1.5	20	0.07	100	Situated lower than near pond and soil is good
3	1.2	12	0.1	2,000	Dry-field and mainly for til
4	2.25	23	0.1	500	For dry field crop but cropping is resulted unsatisfactory

The irrigable field 0.7 acre in the above Table is remoted about 1,000 meters from the farm-house and no noteworthy farming path is open yet from farm-house to field.

The cropping and the farmer's income by a mean farmer in this PV42 district are as follows.

A certain farmer 45 years old, a family of 9 persons, settled in 1963.

Summer (Kharif) cropping in the rainy season

Crop	Cultivated area (acre)	Yield per acre (maund)	Unit cost (Rupee)	Benefit per acre (Rupee)	Yield per area (maund)	Gross income per area (Rupee)
Rice	3.00	20	24	280	60	1,200
Hy. Maize	0.15	... Less yield due to seldom rain and too late sowing				
Sesame	0.7	0.7	30	21	0.5	15
Kenaf	2.0	0.25	65	17	0.5	33
Total	5.85					Rs. 1,248

Winter (Rabi) cropping in the dry season

Crop	Cultivated area (acre)	Yield per acre (maund)	Unit cost (Rupee)	Benefit per acre (Rupee)	Yield per area (maund)	Gross income per area (Rupee)
Rice	0.7	26	24	480	18	432

Gross income : Summer (Kharif) cropping in the rainy season Rs.1,248
Winter (Rabi) cropping in the dry season Rs. 432
Total Rs.1,680

Production cost :

Crop	Labor (Rupee)	Total (Rupee)
Rice	225	225

Breakdown of labor cost
Rice planting labourer 60 mandays
Harvesting labourer 15 mandays
] 75 mandays x 3 Rupees = 225 Rupees

Net profit :

Gross income	Rs. 1,680
Production cost	Rs. 225
Net profit	Rs. 1,455

In the farm management of this farmer, the yield of paddy rice is low. This is mainly due to the shortage of irrigation water and to no fertilizer cultivation in both rainy and dry seasons.

As for the species, the IR-8 is generally introduced, but its yield is very low showing about 20 maunds per acre. Since planted with all the 60 mandays labourers, an increased yield should have been raised at least twice of the present results if fertilized in proper application and in proper time.

As for the dry-field crops, the yield of Hy. Maize, Mesta and Til are low. The reason is that the sowing and planting was compelled to carry out at one stroke in an early raining season and in consequence the soil preparation for planting was inevitably rough. Consequently the field was so much overgrown with weed by abundant rain added with blessed temperature that the farmer failed to weed out even with some manpower.

In this PV42 district, an average farming investment per farmer is; fertilizer 75 Rupees, farming cost 20 Rupees, farming implements 30 Rupees and the other miscellaneous 30 Rupees, farming implements 30 Rupees and the other miscellaneous 30 Rupees, which are showing less in comparison with those in PV13 and PV14 districts.

The reason why the investment in fertilizer is especially lower than that of the other PV13 and PV14 is that the cultivation and cropping were mainly in the rainy season and difficult to control overgrowing weed and the elaborately applied fertilizer resulted to help weed grow arbitrarily and crops could not absorb fertilizer. Farmers say that "The fertilizer will be washed away by rain even if applied elaborately."

2.5.4. Cultivated field and farming in PV43

The total cultivated field area in this PV43 district is said to be 390 acres. In this PV43 district, 50 farmers settled in 1963, 10 farmers in 1966 and 5 farmers in 1967, since then they have been enduring in scanty self-sustaining farming depending on rain water.

In this district, the field is dispersed into 3 blocks of irrigable field, dry-field and remote field. Taking an example of a farmer, the dispersing condition is as follows.

Block	Area	Number of plot	Average area per plot	Distance from house	Remarks
	(acre)		(acre)	(meter)	
1	2.0	18	0.11	200	Situated near an irrigation pond and suitable for rice crop
2	2.85	19	0.15	3,600	Suitable for dry-field for cultivating maize, sesame and beans
3	0.85	4	0.21	3,200	It takes 2 hours from home and left uncultivated.

In this PV43 the irrigable field is located in the distance about 5,000 meters from farm-house and the soil seems to be comparatively fertile and good for rice crops.

The dry-field is located in the distance about 1,000 meters from the farm-house. The soil texture is a sandy loam which is infertile but nothing is cultivated in the dry season, and covered with overgrown weed just like a waste-land. Supposing to start planting and cropping in the rainy season it is doubtful if farmers can cultivate really with those primitive plows and farming tools by the help of thin bullocks.

Another remote field is located in the distance about 3,200 meters and since it takes 2 hours from farm-house on foot, it is left uncultivated.

According to the data submitted by an Indian Authorities the crop and yield in this PV43 district are as follows.

Cropping in the rainy season

Crop	Cultivated area (acre)	Gross yield income (maund)	Yield per acre (maund)	Gross profit (Rupee)
Rice	336	5,509	16.3	110,180
Hy. Maize	18	215	11.9	4,300
Kenaf	35	224	6.4	6,720
Sesame (Til)	92	425	4.5	29,750
Beans	32	180	5.6	5,400
Total	514			Rs.156,350

NOTE: The sesame and beans were cultivated in group with rice.

The cropping system and income yielded by a mean farmer in this PV43 district are as follows.

A certain farmer, 36 years old, a family of 9 persons, settled in 1963.

Cropping in the rainy season

Crop	Cultivated area (acre)	Yield per acre (maund)	Unit cost (Rupee)	Benefit per acre (Rupee)	Yield per area (maund)	Gross income per area (Rupee)
Rice	3.3	17	24	408	56	1,344
Kenaf	0.66	1.5	30	45	1	30
Sesame (Til)	0.50	4.0	65	260	2	130
Uncultivated	1.34					
Total	5.80					Rs. 1,504

Cropping in the dry season

Crop	Cultivated area (acre)	Yield per acre (maund)	Unit Cost (Rupee)	Benefit per acre (Rupee)	Yield per area (maund)	Gross income per area (Rupee)
Hy. Maize	1.00	5	20	100	5	100

Gross income in the rainy season		Rs. 1,504
Gross income in the dry season		Rs. 100
Total		Rs. 1,604
Production cost:	Fertilizer cost	Rs. 225
Net profit :	Gross income	Rs. 1,604
	Production cost	Rs. 225
	Net profit	Rs. 1,379

The greatest problem in this PV42 district is to ensure an irrigation water. As seen in the above farming results, Hy. Maize is showing extremely low yield as 5 maunds in one acre. This extremely low yield was due to the drought damage by the shortage of water occurred during the growing period in which maize ceased vivid growing but only weed grew about 2 feet.

rice is also showing low yield. This was due to rice blight that generated in growing period but no counter measures was practiced against pest control.

The farming investment of a mean farmer in this PV42 district is only 60 Rupees of fertilizer which is very low in comparison with that of the other villages.

2.5.5. Irrigable field and farming of tribal farmer

According to the data obtained by an Indian Authorities the total area of the tribal villages locating in the district Pakhanjore Tank is 136 acres including irrigable field 45 acres.

In this tribal village 7 tribal farmers are cultivating in both old and new method or in considerably advanced way even though they cannot get rid completely of primitive farming.

Almost all the cultivated fields that sporadically located in this tribal village are surrounded by woods. Being reclaimed lands, many

stumps of cut-trees are seen being left as they are in the field or some fields are covered with overgrown weed. On the other hand, paddy fields are completely levelled and prepared, the soil is cultivated deep enough and well fertiled suitably for rice crop.

Generally, the cultivated fields are scattering around the farm-houses but no noteworthy farming path is cut through nor the land consolidation of the field is made yet. According to the data submitted by an Indian Authorities the farming condition in his tribal village is as follows.

Tribal farmer	Family member	Labor	Cultivated area	Cropping in the rainy season in 1969			Cropping in the dry season (1969 - 1970)		
				Crop	Cultivated	Yield	Crop	Cultivated	Yield
A	6	3	62	Rice	33	165	Rice	9	*U C
				Hy maize	0.5	6	Rape	0.3	*D P
				Pulse	3	Nil	Wheat	0.5	*U C
B	10	5	21	Rice	15	90	-	-	-
				Ragi	1	1	-	-	-
				Pulse	1	0.5	-	-	-
C	8	2	7	Rice	5	8	-	-	-
D	4	2	5	Rice	5	40	-	-	-
E	5	1	11	Rice	5	32	-	-	-
F	8	3	22	Rice	12	35	Wheat	2.5	*U C
				Ragi	1	0.5	-	-	-
				Kodo	3	1	-	-	-
G	3	2	8	Rice	5	28	-	-	-
				Pulse	2	10 kg	-	-	-

NOTE: * UC means under cultivation
DP means damaged by pest

General crops are showing extremely low yield. The probable cause of this low yield may be due to: -

a. Insufficient land adjustment and preparation
b. Sowing or planting is of usual seed species
c. Let-grow-alone after sowing
d. Cultivation without fertilizer
e. No control against pest and vermin

As seen in the above table, the rape-seed cultivated in 0.3 acres by the farmer is damaged of Aphid attack and showing complete failure but no counter measures against such a damage were taken at all.

Ox-dung-compost is used for homesteads which are palisaded with bamboo and located near each farm-house but generally no fertilizer is used.

When the investigation team visited a village chief, they could see by chance the planting condition of rice in the dry season. In this rice planting the species IR-8 and high yielding species were used, and ideal young plants with 5.5 leaves were being transplanted in proper planting time. Moreover, the land level was nearly in perfect condition, and well fertilized by applying about 1,000 kg fertilizer per acre after plowing. The investigation team estimated that wonderful yield might be resulted if such manuring operation was continued. However, the investigation team heard that the yield turned out about 30 maunds or 40 maunds at the most. This might be due to the let-grow-alone system without continuing manuring operation after planting.

On the other hand, the rice cropping in the rainy season is also showing extremely low yield only 5 - 6 maunds per acre. This poor yield is turned out from the primitive cultivation of scattering seed-rice without making a perfect preparation of field and also due to the let-grow-alone farming waiting rain water, and only harvesting when all rice plants come into ears.

In an effort of developing agriculture, the Indian Government Authorities are taking good care of farmers by distributing superior grade seeds and established a demonstration farm for practical manuring method giving their helping hand to develop and enlighten the farmers' agriculture.

When the investigation team visited this tribal village, the team received hearty welcome by the villagers headed by the village chief. They made the following petition to the investigation team.

a. We are the native farmers born in this district, but the Government Authorities are giving every kind of help to develop the

settlers' farming more than ours and we are always left behind, so we hope the Government will extend the same help to our farming as is always extended to settlers.

b. Fertilizer is necessary for increased yield of crops but we cannot afford to purchasing it at high cost. It is hoped that the counter measure should be considered.

c. We will execute our utmost to develop and improve our farming so we hope the Government Authorities will extend their help and guidance.

Judging from the above positive intention, the farming development should be more fruitful than expected if they are well helped and guided with new techniques.

2.6. Farmer's Agricultural Economy

2.6.1. Typical farmer

Set forth in this paragraph are the outline of actual condition of farm-houses which we picked up at random among the various class farmers. but may be said to be a certain class representing rather upper class who possesses cultivated acreage 5.7 - 6 acres respectively.

"A" farmer in PV14

Name of householder	:	S.B. 30 years old, Graduated from 7 year course of elementary school.
Settled	:	in 1961
Family	:	7 persons, adult 3 and child 4
Labor force	:	2 persons
Farming implement	:	Plow, Harrow, Dheuki, Shovel, Akushel, Kudhal, 1 set each
Domestic animal	:	Adult milk cow 2 heads, Adult bullock 2 heads, Calf 1 head

Farming production

Crops	Cultivated area (ha)	Yield (kg)	Monetary value (Rupee)	Cash income (Rupee)	Production Cost (Rupee)
Rice	1.2	5,625	3,750	1,250	102
Kenaf	0.4	113	90	90	50
Hy. maize	0.4	-	-	-	-
Beans	0.28				

Gross income		Rs. 3,840
Farm production cost		Rs. 152
Cash income		Rs. 1,340
Income of side job		none
Living cost	Rs. 1,110	Rs. 3,610
Estimate of self consumption of crop	Rs. 2,500	

"B" farmer in PV13

Name of householder	:	N.S.H. 23 years old, Graduated from 3 year course of middle school.
Settled	:	In 1961
Family	;	9 persons ... grandmother, parents, householder, wife, brother 3, daughter 1
Labor force	:	3 persons
Farming implement	:	Sickle 4, Plow 2, Dheuki 1, cultivator 1 Hoe 1, Ox-cart 1.
Domestic animal	:	Adult milk cow 2 heads, Adult bullock 1 head (one bullock dead lately) Domestic fowl 1
Farming production		

Crop	Cultivated area (ha)	Yield (kg)	Monetary value (Rupee)	Cash income (Rupee)	Production Cost (Rupee)
Rice	1.4	3,260	2,088	-	460
Hy. maize	0.4	375	450	450	
Kenaf	0.4	450	360	360	
Sesame (Til)	0.2	19	33	33	
Beans	Cultivated in group		-	-	

Gross income	Rs. 2,931
Production cost	Rs. 460
Cash income	Rs. 843
Income of side job (Dam construction)	Rs. 600
Living expense (cash)	not clear
Estimated amount of self-consumed crops	Rs. 2,088
Economical surplus	not clear

"C" farmer in PV13

Name of householder	:	S.B. 60 years old, No history of school
Settled	:	In 1961
Family	:	7 persons (adult 5, child 2)
Labor force	:	2 persons
Farming implement	:	Sickle 2, Plow 2, Harrow 2, Dheuki 1, Hoe 1, Small hand-cart 1
Domestic animal	:	bullock 1 head (one bullock dead 6 months ago)

Farming production:

Crop	Cultivated area	Yield	Monetary value	Cash income	Production Cost
	(ha)	(kg)	(Rupee)	(Rupee)	(Rupee)
Rice	1.0	2,810	1,800	600	205
Hy. maize	0.06	19	10	10	25
Kenaf	0.4	113	90	90	-
Sesame (Til)	0.52	-	No yield due to too late sowing and less rain in August		
Rice	0.4	1,875	1,200	1,200	125

Gross income		Rs. 3,100
Production cost		Rs. 355
Cash income		Rs. 1,360
Income of side job	None	
Living expense	990	Rs. 2,190
Estimated self-consumption of crop	1,200	
Economical surplus		Rs. 15

"D" farmer in PV14

Name of householder	:	R. B. 35 years old. Finished 5 year course of elementary school
Settled	:	In 1961
Family	:	7 persons, (adult 3, child 4)
Labor	:	1 person
Farming implement	:	Sickle 1, Plow 1; Harrow 1, axe 1, Hoe 1
Domestic animal	:	Adult milk cow 1 head, Young calf 3 heads, Adult bullock 2 heads.

Farming production

Crop	Cultivated area	Yield	Monetary value	Cash income	Production Cost
	(ha)	(kg)	(Rupee)	(Rupee)	(Rupee)
Rice	0.92	5,625	3,600	2,160	745
Kenaf	1.32	112	262	262	-
Sesame (Til)	0.32	700	480	480	80

Gross income		Rs. 4,342
Production cost		Rs. 825
Cash income		Rs. 2,902
Income of side job (peddling)		Rs. 1,000
Living expense	2,000	Rs. 3,440
Estimated self-consumption of crop	1,440	

2.6.2. Farmers' intention and expectation

Almost all the farmers are of blight looking faces despite their low income and living levels. They have some intention to improve agricultural management and to increase income as well. Their deep concern is irrigation water saying "When we can use enough water to realize rice cropping even in the dry season." The kind of crop which they always think of is rice if they are in the position to irrigate enough water. Especially they think of such superior species of I.R.8 and Tai-chung, vegetables and land Kenaf. As for the farming equipment they ask for such tilling equipment as plows, harrows, cultivators, mowers as well as agricultural chemicals

and always ask for better implements saying that "Isn't there any improved farming machines" or "I have not seen new implements but want to see". This tells the fact that they seem to be not enough enlightened on mechanized farming. In some districts, however, a farmer said "I want to learn the technique to increase farming products by using some advanced farming equipment." This will tell the fact that farming would progress in the future. A farmer whose bullock died, is asking for another bullock. Some farmer said "I want a hand cart - for instance a wheel barrow - to transport farming goods." Some farmers have wooden carts of their own hand make. This tells their deep desires for handy carts.

The farmers are satisfied with the given land area distributed to them by the Government Authorities yet there are still some areas which are left uncultivated due to the far distance without any irrigable water and also there is no noteworthy farming path cut through from their houses to field.

As for fertilizer and agricultural chemicals almost all farmers have not enough fertilizer nor agricultural chemicals. One of the reasons is that they can not afford enough to purchase.

They have some concern about the cooperative society but at present feel no immediate concrete necessity yet. They think the cooperative soceity is good but practically think that they can go in somehow or other without participating in the society. When they asked what they would expect by joining the cooperative society, they replied that they hope the society would sell farming products at high prices and would purchase necessary materials at cheap prices. Some farmer said they want a common use of farming equipment and implements. In this community their farming opinions are diversed, some farmers say they want to crop individually, some farmers disagree to the common work, because all the participants are not always dilligent.

As for the current living condition, all farmers may be classified into two living levels - the one is on "Probably satisfactory" level and

the other is on "not so satisfactory" level. The farmers who live on satisfactory level like the D farmer in the preceding paragraph is very few. The income standard that a majority of farmers desire may be 4,000 to 5,000 Rupees while some farmers require 3,000 to 6,000 Rupees. It may be that the way of thinking is relatively realistic and practical.

As for the education of children, they have an earnest desire to make their sons (except those who have to succeed to their farther's farming) doctors or pharmacists.

The farmers' present expectation from the Government is said to be the following eight problems in which the priority is disregarded.

a. To pave the farming pathes with stone in the village or if possible with asphalt.
b. To provide the irrigation facilities around each farm-house or for all farming fields if possible.
c. To make a drainage plan in the rainy season
d. To introduce improved or new farming equipments and implements
e. To complete education facilities
f. To promote social education
g. To expand the education of agricultural techniques.

2.6.3. Investment in production material

The investment in various materials for farming production is about 170 Rupees in value per farmer i.e., 30 Rupees per acre which means only 6% of the gross production amount. This 170 Rupees consists of 80 Rupees (47%) for fertilizer, 24 Rupees (14%) for agricultural chemicals, 30 Rupees (17%) for farming implements, and the remaining 38 Rupees (22%) for the other miscellaneous. Every farmer knows well that the fertilizer and agricultural chemicals consumed so far are still less and that more rich crops will result by more increased investment. The fertilizer now used is inorganic fertilizer but no organic fertilizer is used. Such organic

fertilizer as rice straw should be used for improving and maintaining the soil fertility. Compost is not prepared and stable-dung is not available because all domestic animals are kept loose.

It may be necessary to pay a special consideration to raise the soil fertility of this district where no fertile soil will flow in by periodical flood like the Ganze Basin in Bengal. Since the application of agricultural chemicals is less and the pest control equipment are not enough, the pest control is left much to be desired. There are a few knapsack type sprayer and handcart type sprayer but it seems apparently that pest control is impossible with less equipment. The present condition being such, a necessity is to increase the investment in agricultural chemicals and equipment enough for pest control.

2.6.4. Production measures and labor distribution

The farming implements and equipments which settlers possess are very simple ones in a few kinds and as a whole all settlers have the same things in number and kinds. The spades and cattle power plows are the main ones which are not used for tilling operation and each farmer possesse the following implements.

a. 1 or 2 spades, blade width about 2.1 cm, handle length 73 cm.
b. Cattle power plows drawn by 2 bullocks by means of a yoke 223 cm. The plow dimension - 30 cm iron blade fixed to a crooked wooden arm. The length from blade edge to handle end about 106 cm. Each farmer has this plow but such a simple plow can only scratch the soil but is impossible to turn round the soil.
c. One mattock, blade width 46 cm, handle length about 80 cm, width 30 cm. It looks like a ladder. This is used for preparing paddy field. For harvesting - each farmer possesses the following implements.
d. 2 - 5 pieces of semicircular sickles. Blade length about 25 - 30 cm, the handle 15 cm. The upper class farmers keep many sickles more than necessity. These excessive sickles may be necessary for hired laborers.

e. Wooden plank, width about 30 cm, length 1 m. They use this wooden plank for threshing ear crop.
Besides, each family has the crowbar, bamboo windows, bamboo bars with wooden hooks to gather up straw, manpower rice hulling machine (foot stepping type) and Dheuki, and stone mills are used for grinding grains to fine powder. The bullock carts for transportation are only several sets in the village.

Almost all farmers raise at least 2 bullocks which are usually used for transportation or in cultivation. One or two milk cows are also kept in each farm-house. These domestic animals ramble round the open fields to eat dry grass in a group in the daytime and return to respective stall of owners' farm-house. Children take charge of watching the roaming bullocks in the daytime.

The settlers raise no other domestic animals than bullocks, while the tribal farmers keep sheep, cocks baside the above said bullocks. Some wild pigs are seen in the village but not so many as the bullocks.

The manpower of each settler is 1 or 2 persons or 3 persons at the most. Women are engaged in nursing or infants, cooking and the other house work but not engaged in the outdoor labor. A farmer said that he would not want to let his housewife go to outdoor work because she had much house works in addition to the women's duty of rice hulling and the work with Dhueki. In the tribal village it seems that women work in the field and may be working harder rather than men.

The rainy season is a precious period to grow crops within a limited term, all farmers must work restlessly. Even with restless work, it seems not so easy to manage about 5 acres completely with insufficient manpower. An adequate period of farming time is thus limited, a necessity is to complete the sowing and planting within a short period of time and as soon as a rainy season comes all farmers at once go out to cultivate their own field. No such farming method as the community planting is not employed yet but only thing is the mutual aid with each other among brother or

blood relation. Extremely busy farmers used to hire temporary manpower. They say that about 60% farmers used to employ temporary laborers. In a certain village 8 farmers out of 49 farm-houses used to hire temporary laborers a year. The yearly employees are mainly tribals or some vagrant settlers. The wage for yearly employees is said to be 80 Rupees per month which seems to be high in comparison with an average level.

In the dry season, almost all the fields are left unclutivated because of less water but a small-scaled field about 1 acre is located close to farm-house. The farming operation is carried out in this small-scaled field during the dry season. During this dry period of time, the cropped rice stacked near farm-houses are threshed by striking against the wooden plank and threshed ears are steamed and kept in a tank which is made with mud and bamboo within each farm-house. Another farming operation during the dry season is of the land kenaf. The land kenaf is soaked in a tank of the village and unsheathed after drying them in direct sunbeam. There is no more operation than the above, so farmers used to go for side jobs as the dam construction, and some farmers go to the bazaar once a week to open barbar's. On an average they are engaged in such a side job for about 90 or 95 days.

2.7. Existing State of Agricultural Facilities

2.7.1. Irrigation facilities and the state of water utilization

In Pakhanjore district there are two irrigation facilities, a main irrigation canal of 9,840 m and Pakhanjore tank reservoir to store rain-fall water in the rainy season.

The dimension of Pahkanjore tank reservoir is described as follows.

Table 2.7.1-1 Pakhanjore Tank Reservoir

Item	Quantity	Remarks
Effective capacity of reservoir	2,467 x $10^3 m^3$	
Dam height	12.80 m	
Catchment area	15.02 km^2	
Reservoir area	2.35 km^2	
Designed discharge	0.453 m^3/s	16 c.v.s.
Full water level	EL 307.238 m	(1,005 feet)

Runoff coefficient of the catchment area is measured to be 75%, and evaporation from free water surface is assumed as stated in Table 2.7.1-2.

Table 2.7.1-2 Averaged Monthly Evaporation in mm

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
Evaporation (mm)	180.8	216.4	396.2	560.8	796.0	382.0	169.2	155.4	145.3

Oct.	Nov.	Dec.	Total
173.2	159.5	148.8	3,483.6

Cross sectional area of the main canal was decided with conveyance losses of 15% and longitudinal slope of 1 to 7,000.

Table 2.7.1-3 Main Canal Dimension

Item	Quantity	Remarks
Length	9,839 m	Free-board of 0.61 to 0.46 m
Bottom width	2.44 to 1.22 m	Side slope of 1 to 1
Water depth	0.58 to 0.43 m	
Discharge	0.457 to 0.134 m^3/s	
Velocity	0.38 to 0.30 m/s	

Main structures for the canal are stated in the following Table. 2.7.1-4

Table 2.7.1-4 Main Structures

Item	Quantity	Remarks
Aqueduct	1	ϕ800 mm (2.5 feet)
Siphon	6	-ditto-
Closed conduit	6	-ditto-
Turnout	34	5 made of concrete

The area irrigated by the tank reservoir is 470 acres as shown in Table. 2.7.1-5

Table 2.7.1-5 Irrigated Area in Acre

Name of village	Paddy field	Remarks
Tribal	65.8	
PV 42	28.5	
PV 13	70.6	
PV 14	177.5	
PV 43	34.3	
PV 55	93.0	lift irrigation area

The standard cropping pattern and water requirements for each crop are shown in Table 2.7.1-6 and 2.7.1-7.

Table 2.7.1-6 Standard Cropping Area

Season	Name of crops	Cropping ratio %
Kharif	Paddy	60
	Lesser Millet	10
	Oilseeds and Groundnuts	10
	Sugarcane	5
	Garden Crops	10
	Miscellaneous	5
Rabi	Wheat	15
	Dalna Paddy	5
	Pulse	10
	Sugarcane	5
	Garden Crops	5
	Miscellaneous	10

Table 2.7.1-7 Water Requirements in mm

Season	Month	Paddy	Sugar-cane	Lesser Millet	Ground-nuts	Garden crops	Wheat	Pulse	Miscel-laneous
Kharif	Jan.		254			76			
	Feb.		254			76			
	Mar.		254			76			
	Apr.		254			102			
	May	5	254	102	102	178			102
	Jun.	122	254	102	102	178			102
	Jul.	356	254	102	102	178			102
	Aug.	356	254	102	102	178			102
	Sep.	254	254	102	102	152			102
	Oct.	178	203	51	51	127			51
	Nov.	127	203			127			
	Dec.		254			127			
	Total	1,398	2,946	561	561	1,575			561
Rabi	Jan.	254					89	77	26
	Feb.	254					89	51	26
	Mar.	305					89		26
	Apr.	203					89		26
	May								
	Jun.								
	Jul.								
	Aug.								
	Sep.								
	Oct.								
	Nov.	51							
	Dec.	102					89	77	77
	Total	1,169					445	205	181

The existing agricultural facilities do not seem functioning well, and improvement plans for the facilities could be summarized as follows,

1. To increase the storage capacity of the tank by improvement of the spillway, to raise the full water level, for the purpose of saving lack of irrigation water.

2. To readjust the cross sectional area of some part of the canals owing to sedimentation of sand.

3. To construct transitional canals before and behind of the aqueducts, siphon and closed conduits.

4. To lower the sill elevation of No.6 closed culvert.

5. To improve the dimension works by setting gates or reconstructing them to concrete structures for rational water supply, and also to set check gates in the main canal for rational diversion.

6. To reconstruct the inlet devices to catch water effectively from mountains.

7. To install a pumping station for upland irrigation.

8. To provide service roads for maintenance and operation of the canals.

2.7.2. Fields

Size of farmland blocks is small, about 10 m by 10 m, and its shape is out of trim, that cause uneffective farming. In many of farmland blocks difference in height of 0.2 to 0.3 m can be seen, that cause uneffective irrigation.

In order to save the defects of farmland blocks stated above, read-

justment of field, enlargement of a farmland block area to be rectangular, making a farmland surface even, is necessary.

Plot-to-plot irrigation method due to shortage of terminal canals result in uneffective irrigation.

2.7.3. Roads

The existing unpaved road with 5 m width seems to be in good condition. Wooden bridges are being reconstructed to the concrete bridge.

Farm roads are less than 4 m in width and they are in bad condition. As there are no bridges or culverts at a point of intersection of the farm road and the canal, traffic is inconvenient.

It is required for traffic and transportation in the area to construct farm roads at the same time of readjustment of farmland.

Chapter 3. Farm Management Plan

Chapter 3. Farm Management Plan

3-1. Basic Conception of Farm Management Plan

3-1.1. Water for irrigation and drainage

It is water that constitutes one of the biggest factors in planning farm management in this area. That is to say, torrential rainfall which is beyond anybody's imagination in the rainy season and shortage of water to the extreme degree in the dry season pose a great problem.

As regards cropping in the dry season, it is necessary to work out a reasonable cropping plan with the unit water consumption, kinds of crops and the crop area properly combined.

3-1-2. Land

The farm land belonging to each farm household consists of a remote land, upland and irrigable field which are located apart from one another, creating waste in labor in the farm management. This is, however, unavoidable from the distribution status. Such being the case, the crops most suitable for the respective land should be cultivated, i.e. a combination of crops which do not require much care-taking for a remote land and crops which require rather high degree of intensive cultivation should be considered.

Furthermore, such basic land arrangements as construction of agricultural roads, irrigation and drainage waterways and farmstead reclamation should be completed.

3-1.3. Labor

Although the number of workers per farm household is statistically

2.5 men, in practice, they comprise one man as a substantial worker with women, children and old men and women are not working much. It is, therefore, not easy to cultivate 6 acres of land with such a small labor force using only two buffalos. This situation calls for necessity of having some degree of combination of extensive agriculture and intensive agriculture. Furthermore, from the standpoint of labor distribution, a combination between labor and work system comprising preparation of a rice nursery, sowing of direct-sowing rice plants, sowing of upland crops, rice transplantation and fertilization control in their order is important in farm management.

Moreover, utilization of machinery can be considered in future, but in this case an emphasis will be placed on soil preparation at the beginning of the rainy season, so that such practices as common use and or hiring of tractors are desirable.

Furthermore, prevention and removal of blight and noxious insects are indispensable for increasing the yield by cultivating excellent varieties, and then mechanization of such prevention and removal should also be considered.

3-1-4. Production Materials

a. Fertilizer

A setup capable of supplying proper fertilizers for each crop should be established.

b. Agricultural chemicals and materials for preventing and removing blight and noxious insects

When the yield is to be increased by fertilizing an excellent variety, there will occur more damages are likely to occur ocean blight and noxious insects.

Countermeasures and arrangements for supplying materials to meet such situation should also be properly taken into consideration same as in the case of fertilizer.

c. Weedicides

Since weeding constitutes a great problem for upland crops cultivated in the rainy season, guidance should be given so that tilling and sowing techniques in which weedicide are used can be established in future.

3-1-5. Techniques

Establishment of cultivation techniques will be carried out in the Mixed Farm, but this should be also displayed in farmers' fields within each village. For this purpose, about 5 persons comprising younger generation and men at the prime of life should be selected for training in cultivation techniques for about a year while managing their own farms. And farmers within the P.V. should be encouraged to follow such examples so as to improve their techniques.

3-1-6. Selection of Farm Products as viewed from Distribution Aspect

In view of the absence of consuming area around villages, such farm products as are storable and convenient in transportation are preferable, so that cereal crops should be cultivated as the main product in the initial stage.

Once farmers in general acquire basic knowledge in agricultural techniques and farmers' organization such as Agricultural Cooperative Society are formed, farmers will come to study joint marketing and marketing channels and also introduce garden crops.

3-2. Cropping Pattern

The 6 acres of farm land which one farm household is alloted is, in principle, based on the standard of 2 acres of irrigable field, 2 acres of upland and 2 acres of remote land. Based on this standard, a cropping pattern is examined as follows.

Crops for the rainy season:	
° Irrigable field (Low land)	Rice,- transplanting (High yield variety)
° Dry field (Medium-height land)	Rice,-direct-sowing (Up land rice) Maize, Kenaf
° Remote land (Upland)	Beans, Sesame (Til)
Crops for the dry season:	
° Irrigable field (Low land)	Rice,- transplanting (High yield variety)
" (Medium-height land)	Wheat, Maize, Rape
" (Upland)	Vegetables

Many plants including bananas, papayas and mangos are planted around a house and they are growing well even without care-taking. If these plants of better varieties and of the same qualities are produced, a considerable cash income will result. Especially, mangos are promising.

The profitability due to the cropping pattern and improved cultivation for each P.V. is shown below.

Note: The area under the plan in which irrigation is available was made the object of examination for the crops for the dry season.

3-2-1. Cropping Pattern and Benefit for P.V. 13

Total arable area	270 acres
Irrigable area	130 acres
Number of farm households	45

Crops for the rainy season;

Crops	Acreage	Cropping ratio	Yield per acre	Unit Price per maund	Benefit per acre	Total yield	Total benefit
	(acre)	(%)	(maund)	(Rupee)	(Rupee)	(maund)	(Rupee)
Rice	143	52.7	50	24	1,200	7,150	171,600
Maize	23	8.8	40	20	800	920	18,400
Kenaf	47	17.5	14	30	420	658	19,740
Sesame(Til)	57	21.0	6	75	450	342	25,650
Total	270						235,390

Crops for the dry season;

Crops	Acreage	Cropping ratio	Yield per acre	Unit Price per maund	Benefit per acre	Total yield	Total benefit
	(acre)	(%)	(maund)	(Rupee)	(Rupee)	(maund)	(Rupee)
Rice	23	18	60	24	1,440	1,380	33,120
Wheat	46	35	40	40	1,600	1,840	73,600
Rape	33	26	20	50	1,000	660	33,000
Potato	12	9	150	25	3,750	1,800	45,000
Beans	16	12	10	30	300	160	4,800
Total	130						189,520

Total benefit:

Crops for the rainy season	Rs. 235,390
Crops for the dry season	Rs. 189,520
Total	Rs. 424,910

3-2-2. Cropping Pattern and Benefit for P.V.'14

Total arable area	258 acres
Irrigable area	177 acres
Number of farm households	47

Crops for the rainy season;

Crops	Acreage	Cropping ratio	Yield per acre	Unit price per maund	Benefit per acre	Total yield	Total benefit
	(acre)	(%)	(maund)	(Rupee)	(Rupee)	(maund)	(Rupee)
Rice	135	32	50	24	1,200	6,750	162,000
Sesame(Til)	47	18	6	75	450	282	21,150
Kenaf	47	18	14	30	420	658	19,740
Beans	8	3	10	30	300	80	2,400
Maize	21	9	40	20	800	840	16,800
Total	258						222,090

Crops for the dry season;

Crops	Acreage	Cropping ratio	Yield per acre	Unit price per maund	Benefit per acre	Total yield	Total benefit
	(acre)	(%)	(maund)	(Rupee)	(Rupee)	(maund)	(Rupee)
Rice	31	17	60	24	1,440	1,860	44,640
Wheat	62	35	40	40	1,600	2,480	99,200
Rape	62	35	20	50	2,250	1,240	62,000
Potato	22	13	150	25	3,750	3,300	82,500
Total	177						288,340

Total benefit:

Crops for the rainy season	Rs. 222,090
Crops for the dry season	Rs. 288,340
Total	Rs. 510,430

3-2-3. Cropping Pattern and Benefit for P.V. 42

Total arable area	414 acres
Irrigable area	39 acres
Number of farm households	69

Crops for the rainy season;

Crops	Acreage	Cropping ratio	Yield per acre	Unit price per maund	Benefit per acre	Total yield	Total benefit
	(acre)	(%)	(maund)	(Rupee)	(Rupee)	(maund)	(Rupee)
Rice	174	42	50	24	1,200	8,000	192,000
Maize	66	16	40	20	800	2,540	50,800
Kenaf	66	16	14	30	420	964	28,920
Sesame(Til)	66	16	6	75	450	396	29,700
Beans	42	9	10	30	300	420	12,600
Total	414						314,020

Crops for the dry season;

Crops	Acreage	Cropping ratio	Yield per acre	Unit price per maund	Benefit per acre	Total yield	Total benefit
	(acre)	(%)	(maund)	(Rupee)	(Rupee)	(maund)	(Rupee)
Rice	39	100	60	24	1,440	2,340	56,160

Total benefit:

Crops for the rainy season	Rs. 314,020
Crops for the dry season	Rs. 56,160
Total	Rs. 370,180

3-2-4. Cropping Pattern and Benefit for P.V.'43

Total arable area	390 acres
Irrigable area	134 acres
Number of farm households	65

Crops for the rainy season;

Crops	Acreage	Cropping ratio	Yield per acre	Unit price per maund	Benefit per acre	Total yield	Total benefit
	(acre)	(%)	(maund)	(Rupee)	(Rupee)	(maund)	(Rupee)
Rice (Water field rice)	129	33	50	24	1,200	6,450	154,800
Rice (Upland rice)	129	33	30	24	720	3,870	92,880
Maize	31	3	40	20	800	1,240	24,800
Kenaf	23	6	14	30	420	322	9,660
Sesame (Til)	78	20	6	75	450	468	35,100
Total	390						317,240

Crops for the dry season;

Crops	Acreage	Cropping ratio	Yield per acre	Unit price per maund	Benefit per acre	Total yield	Total benefit
	(acre)	(%)	(maund)	(Rupee)	(Rupee)	(maund)	(Rupee)
Rice	44	33	60	24	1,440	2,640	6,336
Wheat	44	33	40	40	1,600	1,760	70,400
Maize	23	17	40	20	800	9,200	184,000
Beans	16	12	10	30	300	160	4,800
Potato	7	5	150	25	3,750	1,050	26,250
Total	134						348,810

Total benefit:

Crops for the rainy season	Rs. 317,240
Crops for the dry season	Rs. 348,810
Total	Rs. 666,050

3-2-5. Cropping Pattern and Benefit for Tribal

Total arable area	158 acres
Irrigable area	158 acres
Number of farm households	7

Crops for the rainy season;

Crops	Acreage	Cropping ratio	Yield per acre	Unit price per maund	Benefit per acre	Total yield	Total benefit
	(acre)	(%)	(maund)	(Rupee)	(Rupee)	(maund)	(Rupee)
Rice	95	60	35	24	840	3,325	79,800
Deccan grass	32	20	8	32	256	256	8,392
Maize	16	10	40	20	800	640	12,800
Beans	15	10	8	30	240	120	1,600
Total	158						102,592

Crops for the dry season;

Crops	Acreage	Cropping ratio	Yield per acre	Unit price per maund	Benefit per acre	Total yield	Total benefit
	(acre)	(%)	(maund)	(Rupee)	(Rupee)	(maund)	(Rupee)
Rape	94	60	15	50	750	1,410	70,500
Wheat	48	30	30	40	1,200	1,440	57,600
Rice	16	10	60	24	1,440	960	23,000
Total	158						151,140

Total benefit:

Crops for the rainy season	Rs. 102,592
Crops for the dry season	Rs. 151,140
Total	Rs. 253,732

3-3. Cultivation Control Plan

3-3-1. Paddy Rice Cultivation (Irrigation)

a. Varieties

High-yield varieties IR-8, J-10, Padma

b. Rice Nursery

1. Soil Preparation
   Deep ploughing and elaborate stamping

2. Type of rice nursery
   A combination type in which sowing is done in a upland field condition and after sprouting, water is introduced into only ditches thereby to raise young rice plants.

3. Amount of seeds to be sown
   20 kg per acre

4. Area for rice nursery
   1/20 of the main rice field

5. Fertilization for rice nursery
   N = 20 kg, P = 25 kg, K = 18 kg
   Initial fertilizer comprising N = 15 kg, P = 25 kg and K = 18 kg should be given and 30 days before transplantation, N = 5 kg should be given as an additional fertilizer depending on the growing status of the young rice plants.

6. Nursery period
   Until 5-6 regular leaves come out. (Around 20 days)

c. Main Field

1. Soil preparation for the main field
   Deep ploughing and elaborate stamping

2. Fertilizer
   The all amount of the initial fertilizer comprising N = 30 kg, P = 30 kg and K = 15 kg should be given all the layers of soil.

An additional fertilizer comprising approximately N = 15 kg should be given 2-3 days before the young head forming period according to the growth status.

3. Rice transplantation
The plants should be transplanted straight up so as not to be bent. Shallow water should be present while transplanting.

4. Density in transplantation
The density varies according to the soil and fertilizer conditions, but generally it should be 30 cm between rows and 15 cm between plants.

5. Cultivation and Weeding
This is performed by using Japanese paddyfield tilling wheel. Weedicide can be used for a field in which water can be kept well.

6. Prevention and removal of blight and noxious insects
Proper measures should be taken through early detection of blight and noxious insects.

7. Harvesting
Harvesting at proper time should be encouraged.

3-3-2. Up Land Rice Cultivation (Rain-water)

a. Varieties

Since sowing and harvesting are carried out in the rainy season, the varieties of short growing-period and of high yield should be selected.

° Growing period 95 days
CR.42/38, Bluebale, Dolar, B-76

° Growing period 110 days
Padma, CH-45, N-22

b. Soil preparation

As soon as there is the first rainfall over the field which is drided up in the dry season, tilling and stamping should be carried out selecting a day of suitable temperature, followed by elaborate land levelling.

c. Amount of seeds to be sown
~40 kg per acre

d. Sowing

Sowing should be carried out in drills, with about 30 cm of distance between drills.

e. Fertilizer

Since the varieties can grown much on initial nutrition, they are generally of highly growable varieties on the basic nutrition, emphasis should be placed on the initial fertilizer. The entire amount of the Basal fertilizer comprising N = 20 kg, P = 30 kg and K = 15 kg should be given to all the layers and an additional fertilizer comprising N = 10 kg aroud the period of forming young panicles according to the growing status of the rice plants.

Weeding

- Method using weedicides
  a. 15 kg of granular NIP should be scattered immediately after sowing
  b. 2,400 cc of "Stam" emulsion dissolved in 400 litres of water should be sprayed over the entire surface when a weed has shot 2 regular leaves.

- Manual weeding
  A manual weeding hoe is used

- Weeding using cattle
- Weeding by having a buffalo pull a horse-hoe

g. Harvesting

Although weather may still remain unseasonable immediately after the rainy season, a fine day should be selected and crops be harvested starting with those which are ripe.

Cultivation Control Plan in which Tiller and weedicide are used

a. Varieties

- Varieties of short-halm, multi-offshoot and high bend-resistance

- Varieties of short growing period

Growing period	95 days	Bluebale
"	110 days	Padma

b. Soil preparation and sowing

Sow the seeds of about 40 kg in weight over the entire surface of the untilled field and scatter fertilizer over it. Then, till the soil elaborately to the depth of about 10 cm several times. Make drainage at an interval of about 10 meters.

c. Fertilizer

Initial fertilizer:	Magnesia lime about 1 ton Chemical fertilizer (N=15%, P=18%, K=15%)50kg These fertilizers should be given at the time of sowing so as to pass into deep soil.
Additional fertilizer:	This should be given whenever necessity arises according to the growing status of crops.

d. Weeding

Weedicides are used.

1st time: Spray 4 kg of P.C.P. hydrate or SWEP.M hydrate dissolved into 400 litres of water, immediately after sowing.

2nd time: Spray 2,400 cc of "Stam" Emulsion dissolved into 400 litres, when the weed have shot out 2 leaves.

e. Draining

No water should be kept in the soil during the period from sowing to sprouting. See to that water is properly drained in case of much rainfall.

f. Prevention and removal of damage by blight and noxious insects

To noxious insects, spray "Endrine" or E.P.M. emulsion, to blight, spray "Kitajin Blaesu", to sheath blight of rice plant, spray "Monzet" and to bacterial leaf blight of rice plant spray "Serujion".

3-3-3. Upland Cultivation

The kinds of Upland crops cultivated here include maize, kenaf, sesame (til), beans, ragi and vegetables for limited area in the rainy season and wheat, rape, maize and potato in the dry season.

Excellent varieties should be selected for each crop, with fertilization most suitable for the respective crops performed.

The proper amount of fertilizer to be given each crop is as follows.

Crops for rainy season:

Name of crop	Initial fertilizer			Additional fertilizer	
	N	P	K	1st time	2nd time
Maize	30	30	15	10	5
Kenaf	5	15	10	5	-
Sesame (Til)	5	10	-	5	-
Beans	5	20	-	-	-

Dry season:

Name of crop	Initial fertilizer			Additional fertilizer	
	N	P	K	1st time	2nd time
Wheat	30	32	15	10	10
Rape	10	10	-	-	-
Maize	30	30	15	10	5
Potato	30	30	15	10	10

3-4. Mode of Farm Management

Distribution of labor force constitutes the basis for farm management plan. Farm management plan should be set up so that work may be performed uniformly throughout the year or labor force may be badly needed at one time and not required at another time. This is particularly important due to the natural condition that in the rainy season crops must be cultivated within a limited period.

Most important is the cropping at the beginning of the rainy season. As the local proverb, "Sleep overnight, hungry throughout a year." says, they work hard all through the night for sowing. In order to mitigate this tight situation, the peak period should be minimized as far as possible by properly selecting cropping area. For example, there can be considered a work system for a combination of paddy rice and upland crops comprising preparation of rice nursery for paddy rice followed by sowing and transplanting of upland crops including upland rice which will be completed in 2 weeks, arrangement of main paddy field, weeding in

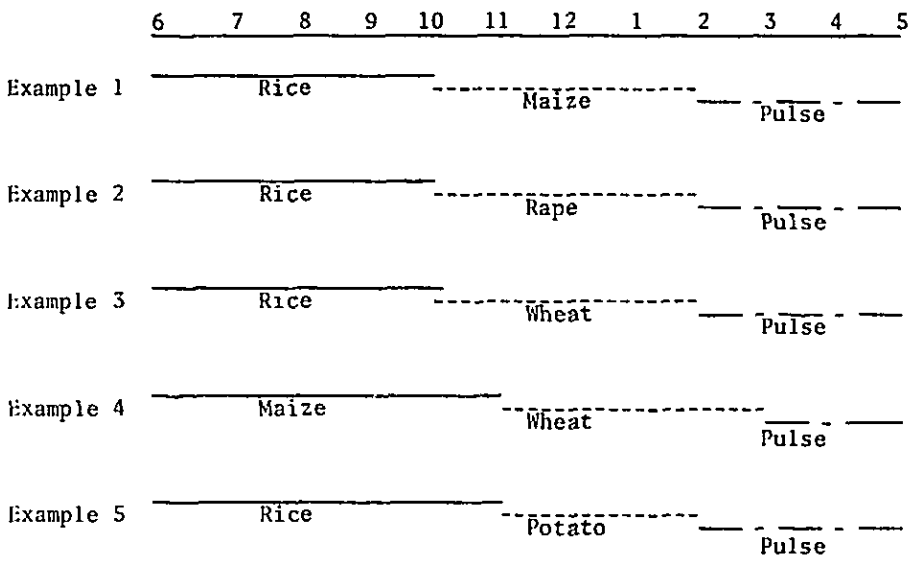
upland and fertilization control for paddy rice and other crops in their order.

Then, when viewed from cropping seasons, it is desirable to have some degree of extensive type of farm management for crops in the rainy season, because of the following reasons, i.e. crops must be cultivated within the limited period of rainy season and moreover there exist potential, unfavorable conditions in which crops are subject to unexpected damages due to torrential rainfall overnight or damages from drought due to discontinuation of rain during the season, however the farm management may be intensified. As against this, in case of upland crops, the farm management can be intensified to a considerable degree if only favorable temperature, land and water are provided and moreover multiple cropping to some extent is possible.

In the circumstances, efforts should be made so as to increase the yield per hour in case of the cropping in the rainy season and the yield per area in case of the cropping in the dry season.

From the standpoint of land utilization, cultivation for multiple cropping is possible, but it must be carried out after careful examination, in view of its close relation with labor and rather small profit for the expenditure incurred. It will be examined by practical experts based on actual experiment and then put to practice.

For information, cropping pattern conceivable for tripple cropping are shown below.



As regards fertilization, in order to enrich the soil fertility, fertilizers comprising organic matters must be given. For that purpose, barnyard manure made of chopped, raw, rice straws or halms of maize or raw halms as they are should be ploughed into the field to supply organic matters to the soil and to enrich its fertility.

Furthermore, availing of the surplus water in the field, cultivate beans as the third cropping for the purpose of freezing nitrogenous fertilizer and also returning the halms produced to the field.

Moreover, as much green manure crops as possible should be raised in the field as far as such conditions as water distribution permit. They should be ploughed into the soil to enrich its fertility.

The kinds and the growing periods in respect of green manure crops are as follows.

Name of green manure crop	Suitable time for ploughing in	Growing period
Dhaincha	Height of grass 90 cm	45 days - 60 days
Sunhemp	Height of grass 90 cm	45 days - 60 days
Cowpea	300 kg (after beans have been harvested)	90 days
Mung	400 kg (")	60 days
Guar	Height of grass 90 cm	60 days
Ipomea	Height of grass 90 cm	60 days
Glricidia	Height of grass 90 cm	60 days

3-5. Labor and Equipment Plan

For the preparation work for sowing, a tiller should be used in addition to the conventional cattle force. And the work should be alloted in such a way that the field is tilled by a tiller and stamping, levelling and ridge making are done by cattle force.

In the sowing period in the rainy season, 5.7 acres of field is tilled per farm household, in case of P.V. 13. The period required for tilling is 3.5 days. From this, it is necessary to allot one tiller for every 3 farm household. Machines for preventing and controlling damages by blight and noxious insects are indispensable. Judging from the tilling condition in the villages, knap sack type machines (for preventing and controlling blight and noxious insects) will be the best. For example, in case of P.V. 13, the total cultivation area for paddy rice including transplanting and direct-sowing varieties is 3 acres, which approximately consistutes a day's work, so that one unit of tiller will be required for 2-3 households.

As regards cultivation work between ridges, it is recommended to use Japanese tilling-wheel for paddy field and rotary tiller for upland.

As adjustment works, a power grain threshing machine should be prepared for paddy rice and a corn sheller for maize.

We must then examine the operating method and maintenance of such machinery. Instead of allowing each farm household to use such machinery, a sort of service association should be set up with a full-time operator employed for operating the machinery.

Besides, we would recommend use of manual machinery including a sowing machine for rice and wheat and a wheel barrow for transporting various materials. The purpose of using a sowing machine is to improve the sowing accuracy and also to facilitate maintenance work. And use of a wheel barrow instead of the conventional method of carrying things on their heads will improve transportation efficiency. (Refer to Table 3-5-1 & 2 and Fig. 3-5-1)

Table 3.5-1 Rice-transplantation

Working	Using Machineries	Efficiency acre/hr	Working Area acre	Total Working Hour hr	Required Working Day day	Restricted Working Day day	Remarks
Seedbed							8 working hours a day
Harrowing	Tiller	0.2	0.15	0.75			Operator 3.5 hr/1 family
Stamping	Tiller	0.15	0.15	1			
Seeding	Manpower, Wheel barrow	0.02	0.15	7.5	1		To seed 3 times in 3 days on condition that they help another work.
Insecticide application	Power sprayer	0.5	0.15	3	0.5		Contracting work for operator
Weeding	Manpower	0.01	0.15	15	2		
Pulling of rice seedlings	Manpower, Wheel barrow	0.002	0.15	75	9.5		
Field							
Harrowing	Tiller	0.2	1.5	7.5	1		Contracting work for operator
Puddling	Animal forces	0.06	1.5	25	3		3 times
Manure distribution	Manpower, Wheel barrow	0.25	1.5	6	1		
Transplantation	Manpower, Wheel barrow	0.02	1.5	75	9.5		
Insecticide application	Power sprayer	0.5	1.5	3	0.5		Contracting work for operator
Intertilling	Manpower, Tautiguruma	0.05	1.5	30	4		
Weeding	Manpower	0.01	1.5	150	19		
Additional fertilization	Manpower, Wheel barrow	0.25	1.5	6	1		
Harvest Transportation	Reaping hook Animal forces)	0.03	1.5	50	6.5		
Adjustment	Power thresher	0.3	1.5	5			five men group work 2 men from each family 3 men from contractor

Table 3.5-2 · Rice-direct sowing and Other Crops

Working	Using Machineries	Efficiency acre/hr	Working Area acre	Total Working Hour hr	Required Working Day day	Restricted Working Day day	Remarks
Harrowing	Tiller	0.2	4.2	21	3		
Stamping	Animal forces	0.06	4.2	80	10		
Ridge	Animal forces	0.1	4.2	42	5.5		
Seeding	Hand operated seed drill	0.1	4.2	42	5.5		
Weeding	Manpower	0.01	4.2	420	52.5		
Intertilling	Tiller	0.3	4.2	14	2		
Insecticide	Power sprayer	0.5	4.2	8.4	1		
Additional fertilization	Manpower	0.25	4.2	16.8	2		
Harvest	Manpower, Animal forces	0.03	4.2	140	17.5		
Adjustment	Power thresher, Corn sheller	0.3 0.3	1.5 0.5	5 1.7			To thresh in usual method for til and mesta

Application of Fertilizer, Agricultural Chemicals and Weedicide in P.V. 13

A. Fertilizer

Fertilizer	3rd Year Kharif	3rd Year Rabi	4th Year	5th Year	Total	Amount
	kg	kg	kg	kg	kg	
Potassium Sulfate 58S	14,300	11,500	25,800	25,800	77,400	
P.C.P. Urea Compound	11,440	1,840	13,280	13,280	39,840	
Urea	6,870	3,580	10,450	10,450	31,350	
Ammonium Sulfate	7,500	2,450	9,950	9,950	29,850	
Superphosphate	12,830	6,140	18,970	18,970	56,910	
Potassium Chloride	1,515	660	2,175	2,175	6,525	
1.B. Compound 604		2,400	2,400	2,400	7,200	

B. Agricultural Chemicals

Agricultural Chemical	3rd Year Kharif	3rd Year Rabi	4th Year	5th Year	Total	Amount
Ruberon : Tablet form	2,860 Tablet	460 kg	3,320	3,320	9,960	
Buraesu : Dust form	1,716 kg	276 kg	1,992	1,992	5,976	
Denapon : Dust form	2,145 kg	345 kg	2,490	2,490	7,470	
E.P.N. : Dust form	1,972 cc	276 cc	2,248	2,248	6,744	
Ekachin : Liquid form	8,550	19,800	28,350	28,350	85,050	
E.M.P. (Ruberon)		920 Tablet	920 kg	920	2,760	
Daijiston : Dust form		96 kg	96 cc	96	288	
Erusan : Liquid form		7,200	7,200	7,200	21,600	

C. Weedicide

Weedicide	3rd Year	4th Year	5th Year	Total	Amount
	g	g	g	g	
Linuron	13,800	13,800	13,800	41,400	

Application of Fertilizer, Agricultural Chemicals and Weedicide in P.V. 14

A. Fertilizer

Fertilizer	3rd Year Kharif	3rd Year Rabi	4th Year	5th Year	Total	Amount
	kg	kg	kg	kg	kg	
Potassium Sulfate 585	13,500	15,500	29,000	29,000	87,000	
P.C.P. Urea Compound	10,800	2,480	13,280	13,280	39,840	
Urea	6,450	5,000	11,450	11,450	34,350	
Ammonium Sulfate	7,200	3,100	10,300	10,300	30,900	
Superphosphate	12,770	7,740	20,510	20,510	61,530	
Potassium Chloride	1,365	1,240	2,605	2,605	7,815	
I.B. Compound	-	4,400	4,400	4,400	13,200	

B. Agricultural Chemicals

Agricultural Chemical	3rd Year Kharif	3rd Year Rabi	4th Year	5th Year	Total	Amount
Ruberon : Tablet form	2,700 Tablet	620 kg	3,320	3,320	9,960	
Buraesu : Dust form	1,620 kg	372 kg	1,992	1,992	5,976	
Denapon : Dust form	2,000 kg	465 kg	2,465	2,462	7,386	
E.P.N. : Dust form	1,872 cc	372 cc	2,244	2,244	6,782	
Ekachin : Liquid form	7,000	24,800	31,800	31,800	95,400	
E.M.P. (Ruberon)		1,240 Tablet	1,240 kg	1,240	3,720	
Daijiston : Dust form		176 kg	176 cc	176	528	
Erusan : Liquid form		13,200	13,200	13,200	39,600	

C. Weedicide

Weedicide	3rd Year	4th Year	5th Year	Total	Amount
	g	g	g	g	
Linuron	12,600	12,600	12,600	37,800	

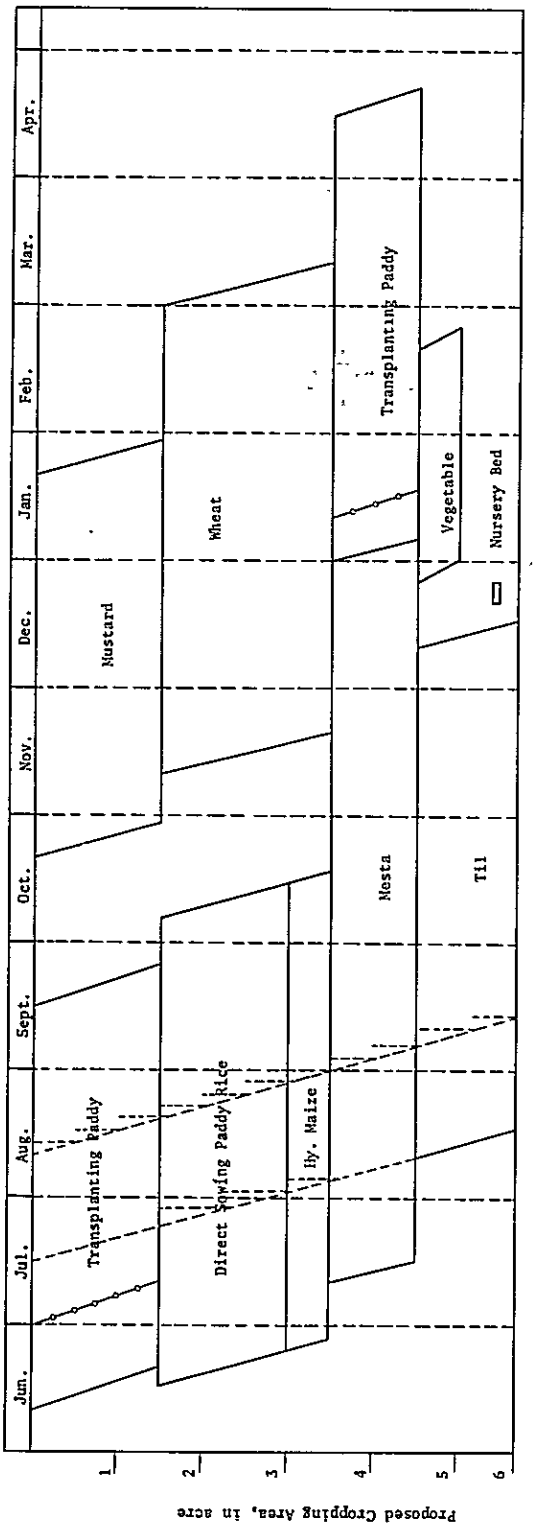


Fig. 3.5-1 Proposed Cropping Pattern in Pakhanjore Project Area

3-6. Balance of Economy of Standard Household

In case new techniques which can be easily introduced are possibly applied at the initial stage to cereals cultivation as the main product on the premise of family labor force, the rough agricultural yield per household after 5 years will be Rs. 9,000 based on the average of 4 P.V. This is 2.8 times the existing yield or an increase by Rs. 5,000. This increase is brought about by an increase in the yield of dry season crops as a result of an increase in the irrigated area, improvement of the cultivation method, improvement of the fertilizing method and an increase in fertilizers, thorough prevention and removal of blight and noxious insects and careful execution of weeding.

In the circumstances, the production cost will remarkably increase, i.e. as shown in Table 3-6-1, it will become Rs. 3,000, which is about 17.5 times the existing cost. After deducting such cost, the net farm benefit will be more than Rs. 5,900, which is about 2 times the existing benefit. As a result, the farm income rate will come down from the exceedingly high rate of 94.6% to 66.3%. The said estimation is based on the assumption that stock-raising is not included in the agriculture and that the scale of the balance of economy is not different from the present.

Table 3.6-1 Outline of Balance of Economy in Standard Farm Household

Classification	Present	Future (after about 5 years)	Increase	Future / Present
	Rs	Rs	Rs.	Times
Rough farm yield*	3,208	8,950	5,742	2.79
Farm production cost*	173	3,020	2,847	17.5
Net farm income	3,035	5,930	2,895	1.95
Income from side business	185	100	Δ 85	0.54
Income for farm household	3,220	6,030	2,810	1.87
Self-consumption of farm products	1,558	2,300	742	1.50
Sales of farm products	1,650	6,650	5,000	3.73
Cash income	1,835	6,750	4,915	3.68
Disposable cash income	1,662	3,730	2,068	2.24
Living cost (Purchase)	1,318	3,300	1,982	2.50
" (Purchase + self-supply)	2,876	5,600	2,724	1.95
Surplus	344	430	86	1.25

Reference	Rate of farm income	94.6%	66.3%
	Ratio of farm products marketed	51.5	74.3
	Ratio of living cost cashed	45.9	58.9

Note: 1. * Includes stock raising

2. An average (per household) of P.V. 13, 14, 42 and 43

The income from side business is expected to decrease to one half that at present since the efforts of the settlers will be concentrated on farming. Therefore, the income per farm household will become about 1.9 times that at present or about Rs. 6,000.

Based on the assumption that the self-consumption increases by 50% serving for improvement of their nutrition intake, the sales of farm products will become 3.7 times that at present or a total of more than Rs. 6,000 with an increase by Rs. 5,000. As a result, the ratio of farm products marketed will increase from 51.5% to 74.3%.

The cash income for a farm household including the sales of farm products and an income from side business will total more than Rs. 6,700. The net cash income obtained after deducting production cost from said cash income will become about 2.2 times that at present or more than Rs. 3,700.

As a result, the living cost of the settlers will become 2.5 times that at present or Rs. 3,300 and the overall living cost with the self-supplying portion included can become about 2 times that of the present level or Rs. 5,600. The ratio of cash purchase in the total living cost will increase from 46% to 59%, with Rs. 430 still reserved for future purchases.

The future values as shown in Table 3-6-1 are the estimation worked out on the assumption that various improvements will have been successfully carried out. In reality, however, with occurrance of unexpected accidents taken into consideration, a range of level between the said estimation and the values 20% - 30% less should be considered as a target on safe side.

3-7. Machinery for Execution of This Plan

A combined use of tiller and cattle is considered as the main produc-

tion factors and the tiller of medium type is selected taking into consideration various conditions including the physiques and the physical strength of the villages, the fields and the agricultural roads.

As to the machine for preventing and exterminating blight and noxious insects, a shouldering portable type for both liquid and powder chemicals is selected so as to suit the field condition and the agricultural roads.

As to grain threshing machine, one with simple construction is selected instead of those having complex mechanism such as automatic feeding device.

Table 3.7-1 Machineries for carrying out the Project

Price: 1,000 yen

Machinery	Specifications	Quantity	Unit Price	Amount	Remarks
Tiller	6-7 HP. Diesel engine, Water-cooled radiator or Condenser, Standard equipments, a set of specialized implements for maintenance, a set of spare parts The following attachments are equipped 1) Paddy field wheel 2) Puddling & land leveling board 3) Tine, Straight tine, and Hatched shaped tine 4) Power take-off 5) Washing apparatus 6) Japanese plow 7) Trailer (500 kg) 8) Sheet cover for parking 9) Pipe wheel	35	180	6,300	(B)35
Engine powered duster with mist sprayer	Knapsack type, Standard equipments, a set of specialized implements for maintenance, including spare parts The following attachments are equipped. 1) Spraying hose (20 m - 30 m) 2) Flame sprayer 3) Grass mover 4) Attachments for spraying	50	15	750	(B)50
Power thresher	Single cylinder type, Efficiency 500 - 1,000 kg/hr Standard equipments, a set of specialized implements for maintenance, including spare parts	10	40	400	(B)10
Corn sheller		5	30	150	(B) 5
Manual seed drill for rice and wheat		100	2	200	(A)100
wheel barrow	One wheel is equipped for spare parts	100	10	1,000	(A)100
A set of implements for maintenance		2 sets	500	1,000	(B) 2
Total				9,800	

Table 3.7-2 Industrial Machineries in Agricultural Districts

Price: 1,000 year

Machinery	Specifications	Quantity	Unit Price	Amount	Remarks
Rice shelling and pearling machine	Efficiency 200 kg/hr, Diesel engine 5-6 HP A set of standard accessary and spare parts	2	200	400	(B)2
Peanut husker	Efficiency 300 kg/hr, Diesel engine 2-3 HP A set of standard accessary and spare parts	1	150	150	(B)1
Oil mill	The following machineries are combined 1) Grain crasher 2) Oil press 3) Filter press 4) Diesel Engine 7-8 HP	2 sets	500	1,000	(B)2
Straw band making machine	Nanmoto Co. Ltd. made A-0 type B-0 type C-0 type D-0 type Diesel engine 3-4 HP including a set of standard accessary and spare parts	2 sets	650	1,300	(B)2
Grist mill	Efficiency 200 kg/hr, Diesel Engine 5-6 HP A set of standard accessary and spare parts	2	200	400	(B)2
Truck	5 ton load capacity	2	700	1,400	(B)2
Total				4,650	

Table 3.7-3 Machineries for Demonstration

Machinery	Specifications	Quantity	Unit Price	Amount	Remarks
Audio-visual machinery					
Cine projector	16 mm	1	100	100	(A)1
Film for projector		20	30	600	(A)10 (B)10
Printing machinery					
Duplicator	including copy paper, 1,000 sheets of B4 size and 1,000 sheets of B5 size	1	100	100	(A)1
A set of mimeograph	including 500 sheets of stencil paper	1	50	50	(A)1
A set of developing and enlarging machine	including printing papers and chemicals	1	100	100	(A)1
Conveying machinery					
Jeep		5	700	3,500	(A)3 (B)2
Micro-bus	20-passenger bus	1	1,000	1,000	(A)1
Truck	20 ton load capacity	1	700	700	(A)1
Total				6,150	

Table 3.7-4 Year-wised Machineries and Equipments for P.V.

Price: 1,000 yen

Machinery	1st Year		2nd Year		Remarks
	Quantity	Amount	Quantity	Amount	
Tiller			35	6,300	
Engine powered duster with mist sprayer			50	750	
Power thresher			10	400	
Corn sheller			5	150	
Mannual seed drill for rice and wheat	100	200			
Wheel barrow	100	1,000			
A set of implements for maintenance			2 sets	1,000	
Total		1,200		8,600	

Table 3.7-5 Year-wised Industrial Machineries in Agricultural Districts

Price:1,000 yen

Machinery	1st Year		2nd Year		Remarks
	Quantity	Amount	Quantity	Amount	
Rice shelling and pearling machine			2	400	
Peanut husher			1	150	
Oil mill			2 sets	1,000	
Straw band making machine			2 sets	1,300	
Grist mill			2	400	
Truck			2	1,400	
Total				4,650	

Table 3.7-6 · Year-wised Machineries for Demonstration

Price: 1,000 Yen

Machineries	1st Year		2nd Year		Remarks
	Quantity	Amount	Quantity	Amount	
Projector	1	100			
Film for projector	10	300	10	300	
Duplicator	1 set	100			
A set of mimeograph	1	50			
A set of developing and enlarging machine	1	100			
Jeep	3	2,100	2	1,400	
Micro-bus	1	1,000			
Truck	1	700			
Total		4,450		1,700	

Table 3.7-7 Implements for Maintenance and Consolidation

Implements	Standard	Quantity	Unit Price	Remarks
Tool caddie	Two stage type	1	15,000	
Socket wrench set	A set of 28 pieces	1	18,000	Box wrench
Double offset wrench set	for mm, a set of 6 pieces	1	2,500	Offset wrench
Double offset wrench set	for in, a set of 6 pieces	1	2,500	
Adjustable angle wrench	Length 200 mm	1	600	
Adjustable angle wrench	Length 300 mm	1	900	
Adjustable angle wrench	Length 375 mm	1	2,500	
Double ended wrench	for mm, a set of 6 pieces	2	1,000	
Double ended wrench	for in, a set of 6 pieces	1	1,000	
Ignition spanner	for mm	1	600	Ignition wrench set
Scissors	Length 200 mm	1	700	
Hollow wrench set	A set of 7 pieces	1	700	Hexagon wrench
Side cutting plier	Length 200 mm	1	700	Cutting plier
Combination plier	Length 200 mm	1	400	
Thin straight plier	Length 200 mm	1	500	
Single-handed hammer	Weight 450 g	1	250	
Single-handed hammer	Weight 670 g	1	300	
Plastic hammer	Weight 450 g	1	400	
Copper hammer	Weight 670 g	1	1,500	
Pitch gauge	for mm	1	150	
Pitch gauge	for in	1	150	

(cont'd)

Implements	Standard	Quantity	Unit Price	Remarks
Screw driver	Length 170 mm	1	150	
Screw driver	Length 250 mm	1	200	
Screw driver	Length 300 mm	1	250	
Cross point screw driver	Pit No.1	1	150	Philips driver
Cross point screw driver	Pit No.2	1	200	
Cross point screw driver	Pit No.3	1	200	
Cross point screw driver	Pit No.4	1	250	
Snap-ring plier	A set of 4 pieces	1	2,500	
Parts caddie	with 3 stage hinged door	1	15,000	
Parts plate	400 x 250 x 100	2	500	
Thickness gauge		1	250	
External micrometer	A set of 6 pieces 0 - 150 mm	1	35,000	
Cylinder gauge	50 - 150 mm (carl-mahr)	1	9,000	
Vernier Caliper	with depth 200 mm	1	3,000	
Torque wrench	Standard type 0 - 18 kg-m	1	6,000	
Tap and die set	Tap die 6 - 18 mm with 3 handles	1	9,000	
Adjustable reamer	A set of 11 pieces	1	24,000	
Fender tool set	Hammer 3, spoon 3, iron plate 4	1	7,000	
Silicone rectifier	Small sized high auto	1	15,000	
Compression gauge	For Diesel	1	14,000	
Nozzle tester		1	15,000	
Rigid rack	3,000 kg	1	1,400	

(cont'd)

Implements	Standard	Quantity	Unit Price	Remarks
Rigid rack	5,000 kg	1	2,500	
Oil hydraulic auto crane	1,000 kg	1	160,000	
Oil hydraulic press	1,500 kg	1	78,000	
Washing apparatus for each parts	Large size	1	70,000	
Cylinder gauge	50 - 150 mm (carl-mahr)	1	9,100	
External micrometer	0 - 25 mm	1	2,000	
External micrometer	25 - 50 mm	1	3,000	
External micrometer	50 - 75 mm	1	4,000	
External micrometer	75 - 100 mm	1	4,500	
External micrometer	100 - 125 mm	1	4,700	
External micrometer	125 - 150 mm	1	5,000	
Shock socket wrench	for mm	1	4,500	
Shock socket wrench	for in	1	5,500	
Timing light	Neon tube type	1	1,800	
Telescoping gauge	A set of 6 pieces	1	9,000	

Chapter 4. Land Improvement Plan

Chapter 4. Land Improvement Scheme

4.1. General Description

Although the existing developed areas have main irrigation facilities such as the Pakhanjore Tank and main irrigation canals, of which capabilities and elements were described in previous Chapter 2.7, these facilities do not function under the present conditions. Namely, the stored water in Pakhanjore tank during the rainy season only used for the irrigation of homestead during the dry season, and almost all these stored water is wasted without no irrigation of the existing fields, which are mainly utilized for paddy fields during the dry season by relying on the rain-fed irrigation.

The scheme of this project aims to raise the high utilization of the stored water, to promote the rational water management, to introduce the mechanical farming, and to promote the agricultural productions, by improving and constructing the following subjects.

a. The areas of 510 acres (206.4 ha) in Low Land located in the right bank of the main irrigation canal, and the area of 128 acres (51.8 ha) in Up Land located in the left bank of that, totaling 638 acres (258.2 ha), are selected as the project area, and irrigation and drainage scheme is to be established according to the projected plan.

b. Main irrigation canal of approximately 10 km extending from the Pakhanjore Tank to P.V. 43, and its related structures, such as siphons, bridge, outlet, spillway and as forth, will be improved, and some facilities will be provided, if required.

c. Rational and reasonable water distribution systems of the main irrigation canal will be established.

d. To increase the available storage capacities of the Pakhanjore tank, the existing spillway will be improved.

e. Land consolidation works, such as land readjustment works, land leveling works and improvement or construction of farm roads, irrigation and drainage canals, and terminal facilities, will be carried out over the whole project area.

f. For the irrigation of Up Land area of 128 acres (51.8 ha), pumping facilities will be installed near the site of the main irrigation canal.

4.2. Improving Plan of Main Irrigation Canal

4.2.1. Principles of Improving the Main Irrigation Canal

Improvement of the main irrigation canal will be conducted on the basis of following principles.

(a) To make gravity irrigation possible for the Low Land area located at the right side of the Main irrigation canal, while the Up Land area is planned to be irrigated by pumps, the design water level at distribution point of water is devided, considering the elevation of field.

(b) To determine the cross sectional area of the main irrigation canal enough to convey the flood discharge which is bigger than the volume of maximum required irrigation water because this canal has a role of the irrigation canal as well as the drainage canal. In improving the canal, existing longitudinal section shall be kept to reduce the construction cost required.

(c) To make the most use of the existing siphons, culverts and aqueduct by

providing the transitional canal at the both sides of upstream and downstream of them, except the some one under no good condition.

(d) To construct diversion works with a gate, because the existing ones are defective in material, form and size.

(e) To construct spillways at the site upstream of siphon to discharge the flood from the watershed of main irrigation canal during the rainy season.

(f) To protect the canal with wet masonry from scouring and errosion at the both sides of upstream and downstream of structures provided, and the canal section shall be improved for sliding owing to much excavation for toe of slope, if required.

(g) To line the canal with wet masonry to lower the loss water, especially for the alignment of canal around R.D. 27 to R.D. 28.

(h) To install the measuring gauge and check gate for the purpose of rational water management.

4.2.2. Estimation of Design discharge for Main Irrigation Canal

As stated in previous paragraph, main irrigation canal has two roles, main irrigation canal and drainage canal during the rainy season, therefore, the examinations of design required cross sectional area of the canal shall be made in the two cases, by applying the maximum irrigation water requirement and the maximum flood discharge in the rainy season.

Estimation of Maximum Irrigation Requirement

Based upon the proposed cropping pattern by villages and the required irrigation water by crops, maximum irrigation water requirement is computed as shown in Table 4.2.2-2 and Table 4.2.2-1 summarizes these computations. In this computations, effective rainfalls are not taken into

account, since no rainfall consequtive day more than 10 days can be seen in spite of the rainy season.

From Table 4.2.2-1, the maximum water requirement is estimated to be 0.360 cu.m/sec for the project area of 638 acreas, assuming that operation hours of pumps are 24 hours per day for the irrigation of Up Land areas. However, the operation hour of pumps of 24 hours is not desirable for operation and maintenance of pump. Consequently, operation hours of pumps are decided at 12 hours in a day. In this case, the maximum irrigation water requirement is estimated to be 0.407 cu.m/sec, as shown in Fig. 4.4.1-1.

Maximum Flood Discharge

The area located in the left side of the main irrigation canal being utilized for upland crops by rainfed irrigation during the rainy season, unit drainage discharge for upland field of 0.0306 cu.m/sec/ha is used for estimation of the maximum flood discharge.

Fig. 4.2.2-2 indicates the catchment and the maximum flood discharge.

4.2.3. Design of Main Irrigation Canal and Collateral Structures

Improving Cross Section of Main Irrigation Canal

In consideration at utilizing the existing structures as stated in 4.2.1, longitudinal slope is decides as follows;

Station No.			Slope
RD.0	-	RD.10 + 56.50 m	1 to 3,500
RD.10 + 56.50 m	-	RD.25 + 265.80 m	1 to 3,000
RD.25 + 265.80 m	-	RD.28 + 1,053 m	1 to 2,000

As for the cross sectional area, bottom width is designed to be 1.00 m

Table 4.2.2-1 Maximum Irrigation Water Requirement Without Effective Rainfall

(Unit: 10^3 cu.m)

Villages	4	5	6	7	8	9	10	11	12	1	2	3	Total
Tribal	23.2	-	89.3	213.0	214.3	184.1	40.4	77.2	135.9	121.5	41.3	37.2	1,177.4
P.V. 42	56.6	-	23.2	10.8	61.2	51.9	-	-	29.6	33.4	45.5	57.0	419.2
P.V. 13	45.2	-	77.7	202.6	204.0	173.1	16.9	55.4	110.8	103.8	40.0	49.6	1,079.1
P.V. 14	45.0	-	80.6	210.4	241.4	218.1	52.7	72.0	152.8	135.1	65.4	63.0	1,336.5
P.V. 43	75.6	-	80.0	208.8	210.3	178.4	15.0	44.2	111.9	112.9	81.6	99.3	1,218.0
Sub-total	245.6	-	350.8	895.6	931.2	805.6	125.0	248.8	541.0	506.7	273.8	306.1	5,230.2
Periphery	109.7	90.5	86.2	86.2	86.7	76.6	76.4	71.6	98.4	94.4	50.0	94.6	1,021.3
Total	355.3	90.5	437.0	981.8	1,017.9	882.2	201.4	320.4	639.4	601.1	323.8	400.7	6,251.5

Note: Maximum irrigation water requirement can be estimated to be 0.360 cu.m/sec for the Pakhanjore project area of 638 acres.

as shown below;

$$Q = \frac{931.2 \times 10^3}{86,400 \times 30} = 0.359 \text{ cu.m/sec}$$

$$\fallingdotseq 0.360 \text{ cu.m/sec}$$

Table 4.2.2-2 Monthly Irrigation Water Requirement without Effective Rainfall

(Tribal)

Description		Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Remarks
Area to be Irrigated (acre)	Paddy	16		95	95	95	95			16	16	16	16	
	Upland			63	63	63	63	157	142	142	142	48	48	
Net Irrigation Requirement (mm/month)	Paddy	286.8		118.1	308.1	310.2	263.2			150.0	169.4	230.8	288.8	
	Upland			66.2	132.3	133.0	117.6	33.1	69.8	112.0	97.5	60.5	36.6	
Irrigation Water Requirement														
Farm Head Gate Req. (mm/month)	Paddy	286.8		118.1	308.1	310.2	263.2			150.0	169.4	230.8	288.8	
	Upland			101.8	203.5	204.6	180.9	50.9	107.4	172.3	150.0	93.0	56.3	
Diversion Requirement (mm/month)	Paddy	358.5		147.6	385.1	387.8	329.0			187.5	211.8	288.5	361.0	
	Upland			127.3	254.4	255.8	226.1	63.6	134.3	215.4	187.5	116.3	70.4	
Diversion Requirement (10^3 m^3/month)	Paddy	23.2		56.8	148.1	149.1	126.5			12.1	13.7	18.7	23.4	
	Upland			32.5	64.9	65.2	57.6	40.4	77.2	123.8	107.8	22.6	13.7	
Diversion Requirement (ℓ/sec)	Paddy	9.0		41.1	55.3	55.7	48.8			14.0	5.1	7.7	8.7	
	Upland			23.5	24.2	24.3	22.2	15.1	29.8	46.2	40.2	9.3	5.1	
Total (ℓ/sec)		9.0		64.6	79.5	80.0	71.0	15.1	29.8	60.2	45.3	17.0	13.8	

(P.V. 42)

Description		Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Remarks
Area to be Irrigated (acre)	Paddy	39		39	39	39	39			39	39	39	39	
	Upland													
Net Irrigation Requirement (mm/month)	Paddy	286.8		118.1	308.1	310.2	263.2			150.0	169.4	230.8	288.8	
	Upland													
Irrigation Water Requirement														
Farm Head Gate Req. (mm/month)	Paddy	286.8		118.1	308.1	310.2	263.2			150.0	169.4	230.8	288.8	
	Upland													
Diversion Requirement (mm/month)	Paddy	358.5		147.6	385.1	387.8	329.0			187.5	211.8	288.5	361.0	
	Upland													
Diversion Requirement (10^3 m^3/month)	Paddy	56.6		23.3	60.8	61.2	51.9			29.6	33.4	45.5	57.0	
	Upland													
Diversion Requirement (ℓ/sec)	Paddy	21.8		16.9	22.6	22.8	20.0			34.3	12.5	18.8	21.3	
	Upland													
Total (ℓ/sec)		21.8		16.9	22.6	22.8	20.0			34.3	12.5	18.8	21.3	

(P.V. 13)

Description		Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Remarks
Area to be Irrigated (acre)	Paddy	23		130	130	130	130			23	23	23	23	
	Upland	16						45	107	107	107	62	62	
Net Irrigation Requirement (mm/month)	Paddy	286.8		118.1	308.1	310.2	263.2			150.0	169.4	230.8	288.8	
	Upland	94.5						48.2	66.6	112.0	101.0	60.5	75.0	
Irrigation Water Requirement														
Farm Head Gate Req. (mm/month)	Paddy	286.8		118.1	308.1	310.2	263.2			150.0	169.4	230.8	288.8	
	Upland	145.3						74.1	102.4	172.3	155.3	93.0	115.4	
Diversion Requirement (mm/month)	Paddy	358.5		147.6	385.1	387.8	329.0			187.5	211.8	288.5	361.0	
	Upland	181.6						92.6	128.0	215.4	194.1	116.2	144.3	
Diversion Requirement (10^3 m^3/month)	Paddy	33.4		77.7	202.6	204.0	173.1			17.5	19.7	10.8	13.4	
	Upland	11.8						16.9	55.4	93.3	84.1	29.2	36.2	
Diversion Requirement (ℓ/sec)	Paddy	12.9		56.2	75.6	76.2	66.8			20.3	7.4	4.5	5.0	
	Upland	6.8						8.2	21.4	34.8	31.4	12.1	13.5	
Total (ℓ/sec)		19.7		56.2	75.6	76.2	66.8	8.2	21.4	55.1	39.1	16.6	18.5	

(P.V. 14)

Description		Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Remarks
Area to be Irrigated (acre)	Paddy	31		135	135	135	135			31	31	31	31	
	Upland					42	42	126	146	146	146	62	62	
Net Irrigation Requirement (mm/month)	Paddy	286.8		118.1	308.1	310.2	263.2			150.0	169.4	230.8	288.8	
	Upland					90.1	117.6	53.8	63.3	112.0	95.5	60.5	36.6	
Irrigation Water Requirement														
Farm Head Gate Req. (mm/month)	Paddy	286.8		118.1	308.1	310.2	263.2			150.0	169.4	230.8	288.8	
	Upland					138.6	180.9	82.7	97.4	172.3	146.9	93.0	56.3	
Diversion Requirement (mm/month)	Paddy	358.5		147.6	385.1	387.8	329.0			187.5	211.8	288.5	361.0	
	Upland					173.3	226.1	103.4	121.8	215.4	183.6	116.3	70.4	
Diversion Requirement (10^3 m^3/month)	Paddy	45.0		80.6	210.4	211.9	179.7			23.5	26.6	36.2	45.3	
	Upland					29.5	38.4	52.7	72.0	129.3	108.5	29.2	17.7	
Diversion Requirement (ℓ/sec)	Paddy	17.4		58.3	78.6	79.1	69.3			27.2	9.9	15.0	16.9	
	Upland					16.3	14.8	19.7	27.8	48.3	40.5	12.1	20.5	
Total (ℓ/sec)		17.4		58.3	78.6	95.4	84.1	19.7	27.8	85.5	50.4	27.1	37.4	

(P.V. 43)

Description		Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Remarks
Area to be Irrigated (acre)	Paddy	44		134	134	134	134			44	44	44	44	
	Upland	16						40	90	90	90	83	60	
Net Irrigation Requirement (mm/month)	Paddy	286.8		118.1	308.1	310.2	263.2			150.0	169.4	230.8	288.8	
	Upland	94.5						48.2	63.1	112.0	107.4	46.7	75.0	
Irrigation Water Requirement														
Farm Head Gate Req. (mm/month)	Paddy	286.8		118.1	308.1	310.2	263.2			150.0	169.4	230.8	288.8	
	Upland	145.3						74.1	97.0	172.3	165.2	71.8	115.4	
Diversion Requirement (mm/month)	Paddy	358.5		147.6	385.1	387.8	329.0			187.5	211.8	288.5	361.0	
	Upland	181.6						92.6	121.3	215.4	206.5	89.8	144.3	
Diversion Requirement (10^3 m^3/month)	Paddy	63.8		80.0	208.8	210.3	178.4			33.4	37.7	51.4	64.3	
	Upland	11.8						15.0	44.2	78.5	75.2	30.2	35.0	
Diversion Requirement (ℓ/sec)	Paddy	24.6		57.9	78.0	78.5	68.8			38.7	14.1	21.2	24.0	
	Upland	6.8						7.2	17.1	29.3	28.1	12.5	13.1	
Total (ℓ/sec)		33.4		57.9	78.0	78.5	68.8	7.2	17.1	68.0	42.2	33.7	37.1	

(Periphery)

Description		Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Remarks
Area to be Irrigated (acre)	Paddy													
	Upland	114	89	89	89	89	89	95	120	120	120	114	114	
Net Irrigation Requirement (mm/month)	Paddy													
	Upland	131.3	138.9	132.3	132.3	133.0	117.6	109.8	81.5	112.0	107.4	60.5	113.3	
Irrigation Water Requirement														Irrigation Efficiency: 0.65
Farm Head Gate Req. (mm/month)	Paddy													Conveyance Loss: 15%
	Upland	202.0	213.7	203.5	203.4	204.6	180.9	168.9	125.4	172.3	165.2	93.1	174.3	
Diversion Requirement (mm/month)	Paddy													
	Upland	237.7	251.4	239.4	239.4	240.7	212.8	198.7	147.5	202.7	194.4	109.5	205.1	
Diversion Requirement (10^3 m^3/month)	Paddy													
	Upland	109.7	90.5	86.2	86.2	86.7	76.6	76.4	71.6	98.4	94.4	50.5	94.6	
Diversion Requirement (ℓ/sec)	Paddy													
	Upland	94.6	67.6	66.5	64.3	64.7	59.1	57.0	55.2	73.5	70.5	41.7	70.6	
Total (ℓ/sec)		94.6	67.6	66.5	64.3	64.7	59.1	57.0	55.2	73.5	70.5	41.7	70.6	

to 3.00 m adopted to the existing canal, and also limited height of embankment and side slopes are designed at 5.0 m and 1 to 1.5 respectively, considering the stability analysis as illustrated in Fig. 4.2.4-1.

Fig.4.2.3-1 indicates the standard cross section of the canal, and from this figure velocity of flow will range from 0.44 m/sec at max. to 0.14 m/sec at min., which are within a permissible velocity for earth canal.

Siphon, Culvert and Aqueduct

From the result of hydraulic calculation based on the previous longitudinal section and cross section of these structures, since the existing these facilities have an enough ability to make flow the maximum flood discharge, these facilities will be utilized in this project without the improvement. But, to protect the canal, revetment works will be performed with the wet mansonary.

Diversion Works

All diversion works will install a gate for rational water management, and to cross the service road and embankment of canal pipes will be buried.

Spillway

The weir height of spillway is decided so that only the excess water over the irrigation water level flow out, and the surface of service road adjacent the spillway will be paved with wet masonaries.

Inlet Works

The inlet works for flood discharge are lined with the wet masonaries against the danger of breaks due to erosion.

Check Gate

To control the water level, wooden check gates will be required in case of water level drawdown.

Measuring Gauge

At the immediate downstream of Pakhanjore Tank, pershall flume type measuring gauge made of reinforced concrete will be installed for rational water management. Fig. 4.2.3-2 indicates the water depth and discharge curve of this measuring gauge.

Service Road

The service road having the width of 4.0 m will be constructed on the right bank of the main canal for operation of Pakhanjore dam, diversion gates, check gates and rational water management could be expected.

Details of previous structures described shall be refered to drawings, and the construction shall be undertaken on the basis of "the Specification for the Works, Volume 1, II" published by the Central Public Works Department.

4.2.4. Calculation of Seepage Water and Examination of Stability Analysis of Main Canal

Quantity of seepage water from trapezoid proposed canal as shown in Fig. 4.2.4-1 is given in following formula by Werdernikov.

$q = k (B + 2H)$ in case of deep impervious stratum

$q = k (B - 2H)$ in case of shallow impervious stratum

where

q: unit quantity of seepage water

k: coefficient of permeability 2×10^{-7} m/sec

B: width of water surface 4.32 m

H: Water depth 0.44 m

$q = 2 \times 10^{7} (4.32 \pm 0.88) = 10.4 - 6.9 \times 10^{-7}$ cu.m/sec

Total seepage along the 9,500 m canal is

$q = q.\ell = 10.4 \times 10^{-7} \times 9{,}500 = 9.9 \times 10^{-3}$ cu.m/sec

Total amount of seepage water from the main canal is less than 3% of the discharge 0.4 cum/sec from the Pakhanjore dam and can be allowable.

However, the result of permeability tests in site have revealed that coefficient of permeability is extremely large in a part along the down stream where the canal should be lined.

° Stability analysis of the canal slope among many proposed methods for analysis of slope stability, slip circle method will be the best for this case.

Factor of safty is given as follows

$$F.S = \frac{\Sigma(N - P) \times \tan\phi + C \cdot L}{\Sigma T}$$

where

N: Normal force to slip circle

T: Tangential force to slip circle

P: Pore water pressure

ϕ: Angle of friction

C: Cohesion

L: Length of slip circle

The result calculated for designed typical section is shown in Fig. 4.2.4-1.

Factor at safety is 2.4 and sufficient.

Fig. 4.2.2-2 DIAGRAM OF DRAINAGE SYSTEM, CATCHMENT AREA AND DESIGN FLOOD DISCHARGE

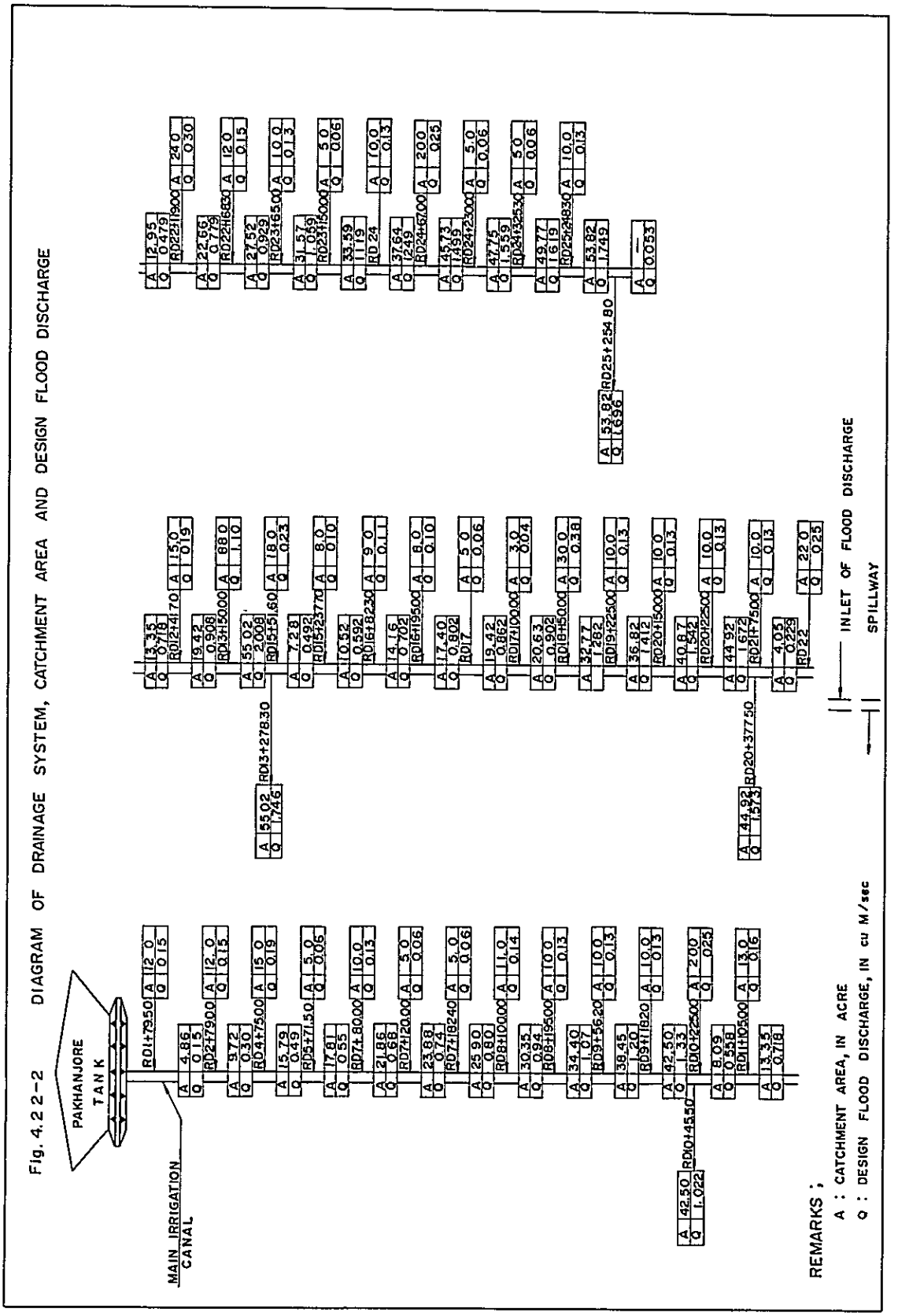
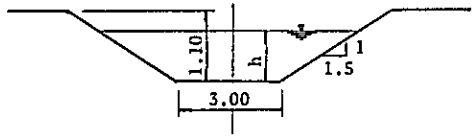


Fig. 4.2.3-1 Standard Cross Section of Main Irrigation Canal

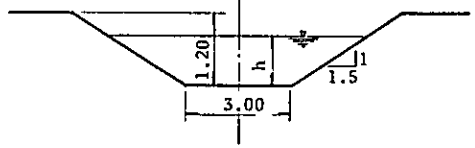
1. TYPE - A (RD 0 - RD 10 + 56.50)



Item		Drain-age	Irriga-tion
Capacity of water:	Q	1.33	0.407
Water depth (m):	h	0.853	0.438
Cross sectional area(sq.m):	A	3.650	1.602
Wetted Perimeter (m):	P	6.076	4.579
Hydraulic radius (m):	R	0.601	0.350
Velocity of flow (m/sec):	V	0.365	0.255
Friction loss head (m):	hv	0.007	0.003

I = 1/3500 Fb = 0.05h + hv + 0.10
n = 0.033 = 0.150
Fb = 0.247

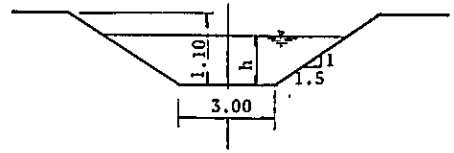
2. TYPE - B (RD 10 + 101.70 - RD 13 + 289.30)



Item		Drain-age	Irriga-tion
Capacity of water:	Q	2.008	0.308
Water depth (m):	h	1.020	0.358
Cross sectional area(sq.m):	A	4.621	1.266
Wetted Perimeter (m):	P	6.678	4.291
Hydraulic radius (m):	R	0.692	0.295
Velocity of flow (m/sec):	V	0.436	0.245
Friction loss head (m):	hv	0.010	0.003

I = 1/3000 Fb = 0.05h + hv + 0.10
n = 0.033 = 0.161
Fb = 0.180

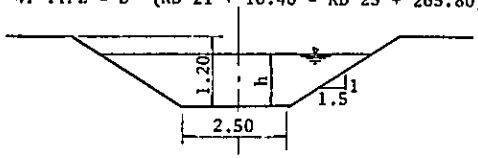
3. TYPE - C (RD 14 + 28.50 - RD 20 + 388.50)



Item		Drain-age	Irriga-tion
Capacity of water:	Q	1.672	0.262
Water depth (m):	h	0.921	0.324
Cross sectional area(sq.m):	A	4.035	1.129
Wetted Perimeter (m):	P	6.321	4.168
Hydraulic radius (m):	R	0.638	0.271
Velocity of flow (m/sec):	V	0.409	0.232
Friction loss head (m):	h	0.009	0.003

I = 1/3000 Fb = 0.05h + hv + 0.10
n = 0.033 = 0.155
Fb = 0.179

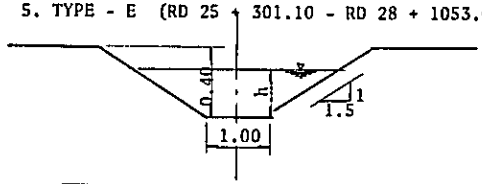
4. TYPE - D (RD 21 + 10.40 - RD 25 + 265.80)



Item		Drain-age	Irriga-tion
Capacity of Water:	Q	1.749	0.099
Water depth (m):	h	1.025	0.203
Cross sectional area(sq.m):	A	4.138	0.569
Wetted Perimeter (m):	P	6.196	3.232
Hydraulic radius (m):	R	0.668	0.176
Velocity of flow (m/sec):	V	0.423	0.174
Friction loss head (m):	hv	0.009	0.002

I = 1/3000 Fb = 0.05h + hv + 0.10
n = 0.033 = 0.160
Fb = 0.175

5. TYPE - E (RD 25 + 301.10 - RD 28 + 1053.00)



Item		Irriga-tion
Capacity of Water:	Q	0.053
Water depth (m):	h	0.207
Cross sectional area(sq.m):	A	0.271
Wetted Perimeter (m):	P	1.746
Hydraulic radius (m):	R	0.155
Velocity of flow (m/sec):	V	0.196
Friction loss head (m):	hv	0.002

I = 1/2000 Fb = 0.05h + hv + 0.10
n = 0.033 = 0.112
Fb = 0.193

Fig. 4.2.3-2 DISCHARGE CURVE OF MEASURING GAGE

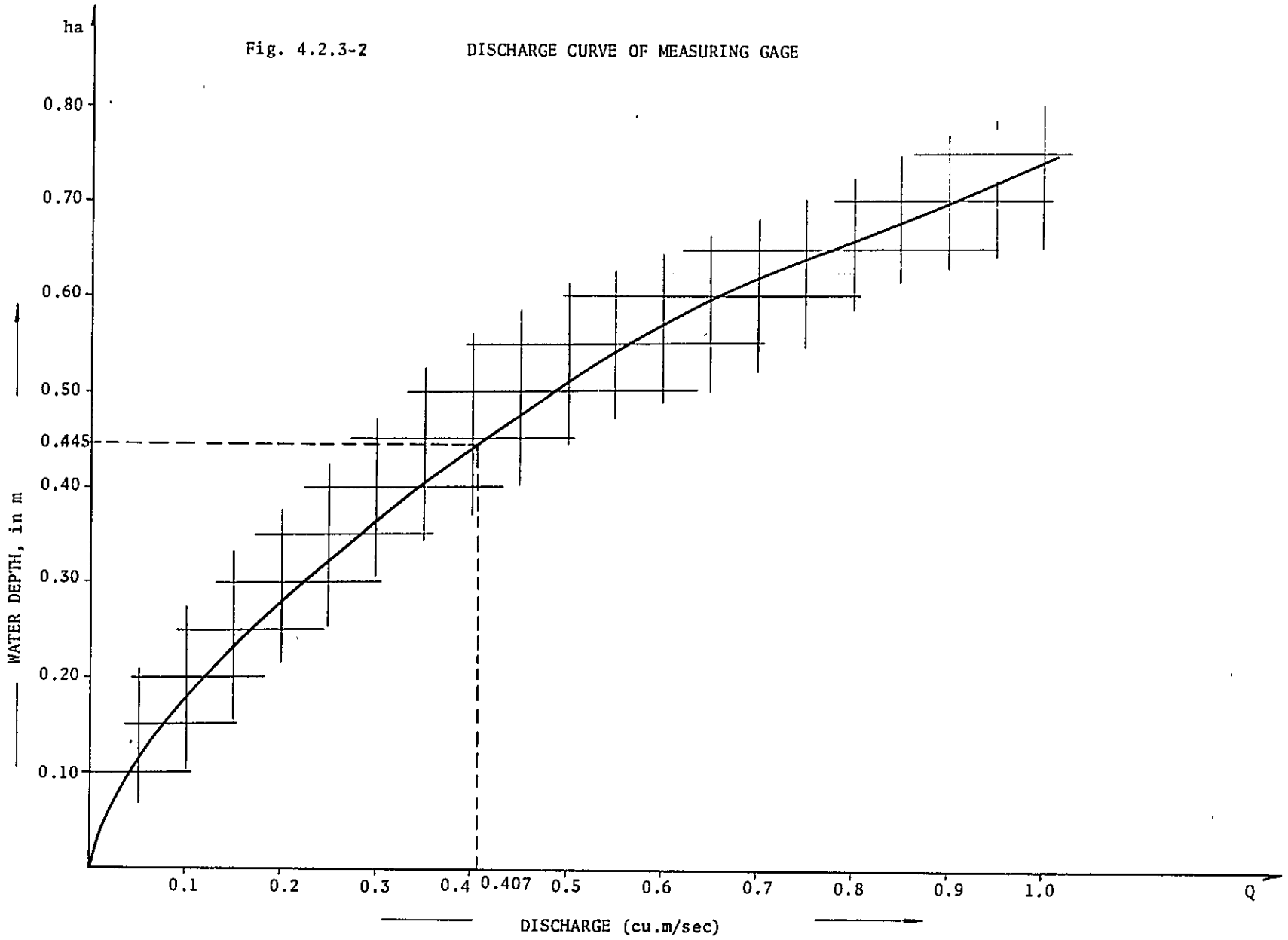
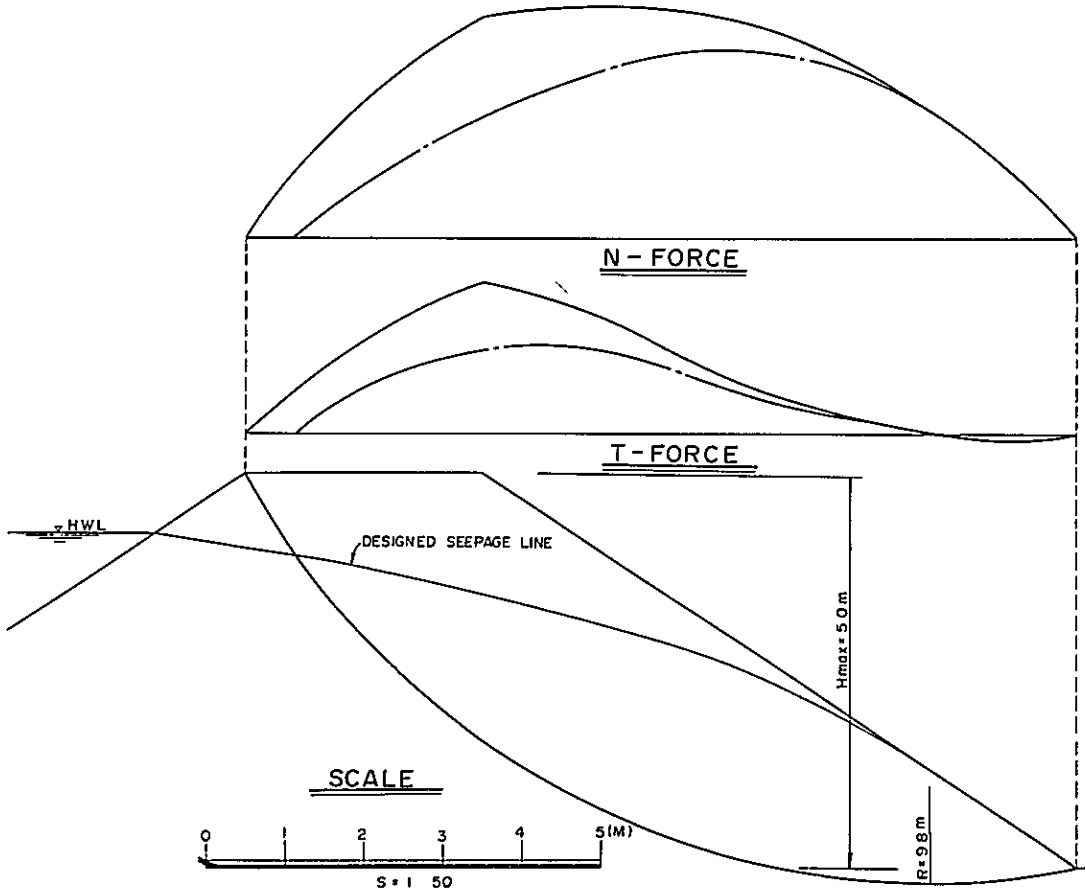


Fig. 4 2 4-1 STABILITY ANALYSIS OF MAIN CANAL SLOPE



SPECIFIC GRAVITY	2 67
DRY DENSITY	1 43 t/cm
WET DENSITY	1 68 t/cm
SATURATED DENSITY	1 89 t/cm
WATER CONTENT	1 78 %
COHESION	1.2 t/sm
ANGLE OF FRICTION	22° 30'
COEFFICIENT OF PERMEABILITY	2×10^{-7} m/s

MATERIAL	AREA	UNIT WEIGT	TOTAL WEIGT	Σ N tan φ	C L	Σ N tan φ + C L
WET	5 8	1 68	23 6	9.7	1 4 4	24 3
SUBMERGED	15 6	0 89				

MATERIAL	AREA	UNIT WEIGT	TOTAL WEIGT
WET	3.2	1 69	9 9
SUBMERGED	5.1	0.89	

FS = 2 4

4-15

4.3. Determination of Design Modulus for Irrigation and Drainage Scheme

4.3.1. Irrigation Scheme

(a) Determination of the Project Area

Out of the total cultivated area in 5 villages situated in Pakhanjore district, that is, Tribal, P.V. 42, P.V. 13, P.V. 14, and P.V. 43, the area of 638 acres (258.2 ha) are selected as the project area depending upon the water resources for the Pakhanjore tank.

The project area of 638 acres (258.2 ha) can be divided largely into two land categories, Low Land and Up Land, owing to the geographical conditions. The former is located in the right bank of the main irrigation canal, and utilized for paddy fields during the rainy season by rainfed irrigation, but some areas are non-cultivated area.

On the other hand, the latter is located in the left bank, and utilized for paddy fields during the rainy season as same as the former. Table 4.3.1-1 indicates the breakdown of project area by the village.

Table 4.3.1-1 Breakdown of the Project Area

(Unit: Acre)

Villages	Low Land		Up Land		Total
	Cultivated area	Non-cultivated area	Cultivated area	Non-cultivated area	
Tribal	66	34	58		158
P.V. 42	28		4	7	39
P.V. 13	71		41	18	130
P.V. 14	177				177
P.V. 43	134				134
	476	34	103	25	638

(b) Estimation of Irrigation Water Requirement

Proposed Cropping Pattern

As shown in Tables 4.3.1-5 to 4.3.1-10, 6 cropping patterns are designed for the each village respectively. Periphery district indicated in Table 4.3.2-10 is situated around the Pakhanjore tank, and the lands in this district are utilized for Up Land fields by lifting irrigation from the Pakhanjore tank through year.

Consumptive Use of Water

Estimation of consumptive use of water by crops are made by applying Blanney-Criddle formula, based upon the meteorological data because of no available data concerning to the consumptive use of water for crops, as same as in Mixed Farm. Blanney-Criddle formula used for the estimation of consumptive use is expressed in the following formula;

$$U = K \cdot F = K \cdot \frac{P.t}{100}$$

Where; U : Monthly consumptive use, in inch
K : Monthly coefficient
F : Monthly consumptive use coefficient (t x p)/100
P : Percentage of day-time hours occuring in the month
t : Mean temperature, in Fahrenheit

The results of calculation for estimating the consumptive use for Low Land crops (paddy) and Up Land crops are given in Tables 4.3.1-2 to 4.3.1-3 depending upon the proposed cropping pattern described previously and Blanney-Criddle formula.

In this calculation, following assumptions are made.

Percolation: According to the percolation test in the existing paddy fields, the rate of percolation is decided to be 2.0 mm

Table 4.3.1-2 Calculation of Monthly Consumptive Use for Low Land Crops (Paddy)

Item	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Representative cropping pattern for the calculation of water requirement		Paddy Rice			30	15		Paddy Rice	30		21		
Temperature, T (°C)	20.2	22.8	24.4	30.7	33.3	31.7	26.9	25.5	26.9	25.8	23.4	18.9	
Temperature, T (°F)	68.3	73.0	75.9	87.3	91.9	89.1	80.5	77.9	80.4	78.4	71.9	67.8	
Consumptive Use Factor, F	5.29	5.29	6.38	7.44	-	8.02	7.45	6.98	6.67	-	-	-	
Consumptive Use Coefficient, K	0.80	1.30	1.40	1.20	-	0.80	1.30	1.40	1.20	-	-	-	
Consumptive Use U_1 (in/month)	4.23	6.88	8.93	8.93	-	6.42	9.69	9.77	8.00	-	-	-	62.85
Consumptive Use U_2 (mm/month)	107.4	174.8	226.8	226.8	-	163.1	246.1	248.2	203.2	-	-	-	1,596.4
Percolation P (mm/month)	62.0	56.0	62.0	60.0	-	60.0	62.0	62.0	60.0	-	-	-	484.0
Puddling Water Req. Pa (mm)	-											150.0	150.0
Irrigation Requirement (U_2+P+Pa) (mm)	169.4	230.8	288.8	286.8	-	223.1	308.1	310.2	263.2	-	97.0	150.0	2,230.4

Table 4.3.1-3 Calculation of Monthly Consumptive Use for Up Land Crops

Item	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Representative cropping pattern for the calculation of water requirement	31	15	3month upland crops		15	15	4month upland crops		31	8	4month upland crops		
Temperature, T (°C)	20.2	22.8	24.4	30.7	33.3	31.7	26.9	25.5	26.9	25.8	23.4	18.9	
Temperature, T (°F)	68.3	73.0	75.9	87.3	91.9	89.1	80.5	77.9	80.4	78.4	71.9	67.8	
Consumptive Use Factor, F	5.29	5.29	6.38	7.44	8.41	8.02	7.45	6.98	6.61	6.41	5.45	5.19	
Consumptive Use Coefficient, K	0.80	0.45	0.70	0.75	0.65	0.65	0.70	0.75	0.70	0.40	0.65	0.85	
Consumptive Use, U (in/month)	4.23	2.38	4.46	5.58	5.47	5.21	5.21	5.24	4.63	2.56	3.54	4.41	52.92
Consumptive Use, (mm/month)	107.4	60.5	113.3	141.7	138.9	132.3	132.3	133.0	117.6	65.0	89.9	112.0	1,343.9
Irrigation Requirement (mm/month)	107.4	60.5	113.3	141.7	138.9	132.3	132.3	133.0	117.6	65.0	89.9	112.0	1,343.9

per day. The soil texture of loamy clay covers almost all project area, the rate of percolation is considered to be relatively small.

Puddling Water Requirement:

Rainy season paddy will be sown together with the coming of monsoon season, hence no puddling water requirement is necessary. However, dry season paddy will be sown together with the coming of monsoon season by transplanting cultivation. The puddling water requirement for nursery bed is decided to be 150 mm as follows;

Thickness of top soil for cultivation	:	150 mm
Porosity of soil	:	40 %
Submergence depth after puddling	:	50 mm
Puddling water requirement (250mm x 0.4) + 50mm	=	150 mm

Net Irrigation Requirement

Net irrigation requirement can be estimated by subtracting the effective rainfall from the irrigation requirement obtained by adding the percolation rates and puddling water requirement to the consumptive use.

In determining the design effective rainfall, 9 years rainfall records observed at Mixed Farm are available. From these rainfall records, an approximately 10-year probable rainfall, which corresponds to 1,421.5 mm in 1966, is determined as the design rainfall by using Hazen paper. However, as is seen in the records, a large fluctuation of rainfall during the dry season (October to March) can be found out. Consequently, the averaged rainfall is decided to be the design rainfall concerning the dry season.

From these selected monthly rainfalls, 75 percent of monthly rainfall is determined to be effective rainfall by making the reference to the report of Paralkote dam. Table 4.3.1-4 shows the effective rainfall for the project.

Table 4.3.1-4 Effective Rainfall, in mm

Month	10-year Probable Rainfall	Corrected Rainfall	Effective Rainfall
1	56.0	10.2	7.7
2	-	11.1	8.3
3	5.1	28.3	21.2
4	24.3	24.3	18.2
5	24.2	24.2	18.2
6	85.5	85.5	64.1
7	420.2	420.2	315.2
8	345.9	345.9	259.4
9	293.4	293.4	220.1
10	61.0	42.9	32.2
11	9.0	5.3	4.0
12	96.9	17.6	13.2
Total	1,421.5	1,308.9	981.8

Irrigation Water Requirement

Irrigation water requirement can be computed by divided the net irrigation requirement (irrigation requirement-effective rainfall) by irrigation efficiency and conveyance loss, as expressed in following expression;

$$I.W.R = \frac{N.I.R}{E(1-L)}$$

Where; I.W.R : Irrigation water requirement (mm)
N.I.R : Net irrigation requirement (mm)
Irrigation requirement-Effective rainfall
E : Irrigation efficiency, assumed to be 0.65
L : Conveyance loss, assumed to be 0.20

The results of estimation for irrigation water requirement are shown in Tables 4.3.1-5 to 4.3.1-10.

Table 4.3.1-5 Proposed Cropping Pattern and Estimation of Irrigation Water Requirement

(Tribal)

Description		Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Remarks
Proposed Crops														Total Area to be Irrigated: 158 Acre
Paddy		30 / 286.8		15 / 118.1	95 Acre / 308.1	310.2	263.2	30		21 / 150	16 Acre / 169.4	230.8	288.8	
Wheat									15 / 49.7	112.0	48 Acre / 107.4	60.5	10 / 36.6	
Mustard								8 94 Acre / 48.2	89.9	112.0	25 / 86.7			
Ragi				15 / 66.2	32 Acre / 132.3	133.0	117.6	5 / 10.5						
Hy. Maize				15 / 66.2	10 Acre / 132.3	133.0	117.6	5 / 10.5						
Alaha				15 / 66.2	15 Acre / 132.3	133.0	117.6	5 / 10.5						
Area to be Irrigated (acre)	Paddy	16		95	95	95	95			16	16	16	16	
	Upland			63	63	63	63	157	142	142	142	48	48	
Irrigation Requirement (mm/month)	Paddy	286.8		118.1	308.1	310.2	263.2			150	169.4	230.8	288.8	
	Upland			66.2	132.3	133.0	117.6	33.1	69.8	112.0	97.5	60.5	36.6	
Effective Rainfall (mm/month)	Paddy	18.2		34.2	315.2	259.4	220.1			4.7	7.7	8.3	21.2	
	Upland			34.2	315.2	259.4	220.1	32.2	4.0	13.2	7.7	8.3	6.8	
Net Irrigation Requirement (mm/month)	Paddy	268.6		83.9		50.8	43.1			145.3	161.7	222.5	267.6	
	Upland			32.0				0.9	65.8	98.8	89.8	62.2	29.8	
Irrigation Water Requirement														Irrigation Efficiency: 0.65
Farm Head Gate Req. (mm/month)	Paddy	268.6		83.8		50.8	43.1			145.3	161.7	222.5	267.6	Conveyance Loss: 20%
	Upland			49.2				1.4	101.3	152.1	138.2	95.7	45.9	$\Sigma Q = 163.82 \times 10^3\ m^3$
Diversion Requirement (mm/month)	Paddy	335.8		104.9		63.5	53.9			181.6	202.1	278.1	334.5	$\Sigma Q = 332.49 \times 10^3\ m^3$
	Upland			61.5				1.8	126.6	190.1	172.9	119.6	57.4	
Diversion Requirement ($10^3\ m^3$/month)	Paddy	21.74		54.17		24.41	20.72			11.76	13.09	18.01	21.66	
	Upland			15.68				1.14	72.75	109.24	99.30	23.23	11.15	
Total ($10^3\ m^3$/month)		21.74		69.85		24.41	20.72	1.14	72.75	121.0	112.39	41.24	32.81	$\Sigma Q = 518.05 \times 10^3\ m^3$

Table 4.3.1-6 Proposed Cropping Pattern and Estimation of Irrigation Water Requirement

(P.V. 42)

Description		Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Remarks
Proposed Crops		30		15	39 Acre		30			21	39 Acre		31	Total Area to be Irrigated: 39 Acre
Paddy		286.8		118.1	308.1	310.2	263.2			150.0	169.4	230.8	288.8	
Area to be Irrigated (acre)	Paddy	39		39	39	39	39			39	39	39	39	
	Upland													
Irrigation Requirement (mm/month)	Paddy	286.8		118.1	308.1	310.2	263.2			150.0	169.4	230.8	288.8	
	Upland													
Effective Rainfall (mm/month)	Paddy	18.2		34.2	315.2	259.4	220.1			4.7	7.7	8.3	21.2	
	Upland													
Net Irrigation Requirement (mm/month)	Paddy	268.6		83.9		50.8	43.1			145.3	161.7	222.5	267.6	
	Upland													
Irrigation Water Requirement														
Farm Head Gate Req. (mm/month)	Paddy	268.6		83.9		50.8	43.1			145.3	161.7	222.5	267.6	Irrigation Efficiency: 0.65
	Upland													Conveyance Loss: 20%
Diversion Requirement (mm/month)	Paddy	335.8		104.9		63.5	53.9			181.6	202.1	278.1	334.5	
	Upland													
Diversion Requirement (10^3 m^3/month)	Paddy	53.00		16.56		10.02	8.51			28.66	31.90	43.89	52.79	$\Sigma Q = 245.33 \times 10^3$ m^3
	Upland													
Total (10^3 m^3/month)		53.00		16.56		10.02	8.51			28.66	31.90	43.89	52.79	$\Sigma Q = 245.33 \times 10^3$ m^3

Table 4.3.1-7 Proposed Cropping Pattern and Estimation of Irrigation Water Requirement

(P.V. 13)

Description		Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Remarks
Proposed Crops														
Paddy		30 286.8		15 130 Acre 118.1	308.1	310.2	30 263.2			21 150.0	23 Acre 169.4	230.8	288.8	Total Area to be Irrigated: 130 Acre
Wheat									15 49.7	46 Acre 112.0	107.4	60.5	10 36.6	
Mustard								8 48.2	89.9	33 Acre 112.0	25 86.7			
Potato								8 48.2	89.9	12 Acre 112.0	107.4	31		
Vegetable		20 94.5							15 49.7	16 Acre 112.0	107.4	60.5	113.3	
Area to be Irrigated (acre)	Paddy	23		130	130	130	130			23	23	23	23	
	Upland	16						45	107	107	107	62	62	
Irrigation Requirement (mm/month)	Paddy	286.8		118.1	308.1	310.2	263.2			150.0	169.4	230.8	288.8	
	Upland	94.5						48.2	66.6	112.0	101.0	60.5	75.0	
Effective Rainfall (mm/month)	Paddy	18.2		34.2	315.2	259.4	220.1			4.7	7.7	8.3	21.2	
	Upland	12.1						23.9	4.0	13.2	7.7	8.3	21.2	
Net Irrigation Requirement (mm/month)	Paddy	268.6		83.9		50.8	43.1			145.3	161.7	222.5	267.6	
	Upland	82.4						24.3	62.6	98.8	93.3	52.2	53.8	
Irrigation Water Requirement														Irrigation Efficiency: 0.65
														Conveyance loss: 20%
Farm Head Gate Req. (mm/month)	Paddy	268.6		83.9		50.8	43.1			145.3	161.7	225.5	267.6	
	Upland	126.8						37.4	96.3	152.0	143.6	80.3	82.8	
Diversion Requirement (mm/month)	Paddy	335.8		104.9		63.5	53.1			181.6	202.1	278.1	334.5	
	Upland	158.5						43.4	120.4	190.1	179.5	100.4	103.5	
Diversion Requirement (10^3 m^3/month)	Paddy	31.26		44.14		26.73	22.67			16.90	18.81	25.89	31.13	$EQ = 217.53 \times 10^3$ m^3
	Upland	10.26						7.90	52.14	82.32	77.73	25.19	25.97	$EQ = 281.51 \times 10^3$ m^3
Total (10^3 m^3/month)		41.52		44.14		26.73	22.67	7.90	52.14	99.22	96.54	51.08	57.10	$EQ = 499.04 \times 10^3$ m^3

Table 4.3.1-8 Proposed Cropping Pattern and Estimation of Irrigation Water Requirement

(P.V. 14)

Description		Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Remarks
Proposed Crops														Total Area to be Irrigated: 177 Acre
Paddy		30 286.8		15 118.1	135 Acre 308.1	310.2	30 263.2			21 150.0	31 Acre 169.4	230.8	288.8	
Wheat									15 49.7	62 Acre 112.0	107.4	60.5	10 36.6	
Mustard								8 48.2	62 Acre 89.9	112.0	25 86.7			
Potato								8 48.2	22 Acre 89.9	112.0	25 86.7			
Til						10 90.1	42 Acre 117.6	65.0	10 30.0					
Area to be Irrigated (acre)	Paddy	31		135	135	135	135			31	31	31	31	
	Upland					42	42	126	146	146	146	62	62	
Irrigation Requirement (mm/month)	Paddy	286.8		118.1	308.1	310.2	263.2			150.0	169.4	230.8	288.8	
	Upland					90.1	117.6	53.8	63.3	112.0	95.5	60.5	36.6	
Effective Rainfall (mm/month)	Paddy	18.2		34.2	315.2	259.4	220.1			4.7	7.7	8.3	21.2	
	Upland					175.7	220.1	32.2	4.0	13.2	7.7	8.3	6.8	
Net Irrigation Requirement (mm/month)	Paddy	268.6		83.9		50.8	43.1			145.3	161.7	222.5	267.6	
	Upland							21.6	59.3	98.8	87.8	52.2	29.8	
Irrigation Water Requirement														Irrigation Efficiency: 0.65
Farm Head Gate Req. (mm/month)	Paddy	268.6		83.9		50.8	43.1			145.3	161.7	222.5	267.6	Conveyance Loss: 20%
	Upland							33.2	91.3	152.1	135.1	80.3	45.9	
Diversion Requirement (mm/month)	Paddy	335.8		104.9		63.5	53.9			181.6	202.1	278.1	334.5	
	Upland							41.5	114.1	190.1	168.9	100.4	57.4	
Diversion Requirement (10^3 m^3/month)	Paddy	42.13		57.31		34.69	29.45			22.78	25.35	34.89	41.96	$\Sigma Q = 288.56 \times 10^3$ m^3
	Upland							21.16	67.42	112.30	99.80	25.19	14.40	$\Sigma Q = 340.27 \times 10^3$ m^3
Total (10^3 m^3/month)		42.13		57.31		34.69	29.45	21.16	67.42	135.08	125.15	60.08	56.36	$\Sigma Q = 628.83 \times 10^3$ m^3

Table 4.3.1-9 Proposed Cropping Pattern and Estimation of Irrigation Water Requirement

(P.V. 43)

Description		Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Remarks
Proposed Crops														Total Area to be Irrigated: 134 Acre
Paddy		30		15	134 Acre		30			21	44 Acre			
		286.8		118.1	308.1	310.2	263.2			150.0	169.4	230.8	288.8	
Wheat									15	44 Acre			10	
									49.7	112.0	107.4	60.5	36.6	
Hy. Maize								8	23 Acre			5		
								48.2	89.9	112.0	107.4	10.8		
Potato								8	7 Acre		3			
								48.2	89.9	112.0	107.4			
Vegetable		20							15	16 Acre				
		94.5							49.7	112.0	107.4	60.5	113.3	
Are to be Irrigated (acre)	Paddy	44		134	134	134	134			44	44	44	44	
	Upland	16						40	90	90	90	83	60	
Irrigation Requirement (mm/month)	Paddy	286.8		118.1	308.1	310.2	263.2	17.2		150.0	169.4	230.8	288.8	
	Upland	94.5						48.2	63.1	112.0	107.4	46.7	75.0	
Effective Rainfall (mm/month)	Paddy	18.2		34.2	315.2	259.4	220.1			4.7	7.7	8.3	21.2	
	Upland	12.1						23.9	4.0	13.2	7.7	8.3	21.2	
Net Irrigation Requirement (mm/month)	Paddy	268.6		83.9		50.8	43.1			145.3	161.7	222.5	267.6	
	Upland	82.4						24.3	59.1	98.8	99.7	38.4	53.8	
Irrigation Water Requirement														Irrigation Efficiency: 0.65
Farm Head Gate Req. (mm/month)	Paddy	268.6		83.9		50.8	43.1			145.3	161.7	222.5	267.6	Conveyance Loss: 20%
	Upland	126.8						37.4	91.0	152.1	153.4	59.1	82.8	
Diversion Requirement (mm.month)	Paddy	335.8		104.9		63.5	53.1			181.6	202.1	278.1	334.5	
	Upland	158.5						46.8	113.8	190.1	191.8	73.9	103.5	
Diversion Requirement (10^3 m^3/month)	Paddy	59.79		56.89		34.44	28.80			32.34	35.99	49.52	59.56	$\Sigma Q = 357.33 \times 10^3$ m^3
	Upland	10.26						7.58	41.45	69.24	69.86	24.82	25.13	$\Sigma Q = 248.34 \times 10^3$ m^3
Total (10^3 m^3/month)		70.05		56.89		34.44	28.80	7.58	41.45	101.58	105.85	74.34	84.69	$\Sigma Q = 605.67 \times 10^3$ m^3

Table 4.3.1-10 Proposed Cropping Pattern and Estimation of Irrigation Water Requirement

(Periphery)

Description		Apr.	May.	Jun.	Jul.	Agu.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Remarks
Proposed Crops														Total Area to be Irrigated: 120 Acre
Plantain							89 Acre							
Betel Vine Orchard		141.7	138.9	132.3	132.3	133.0	117.6	114.0	89.9	112.0	107.4	60.5	113.3	
Vegetable		20 94.5							15 49.7	112.0	25 Acre 107.4	60.5	113.3	
Potato								8 48.2	6 Acre 89.9	112.0	31 107.4			
Area to be Irrigated (acre)	Paddy													
	Upland	114	89	89	89	89	89	95	120	120	120	114	114	
Irrigation Requirement (mm/month)	Paddy													
	Upland	131.3	138.9	132.3	132.3	133.0	117.6	109.8	81.5	112.0	107.4	60.5	113.3	
Effective Rainfall (mm/month)	Paddy													
	Upland	18.2	18.2	64.1	315.2	259.4	220.1	24.9	4.0	13.2	7.7	8.3	21.2	
Net Irrigation Requirement (mm/month)	Paddy													
	Upland	113.1	120.7	68.2				84.9	77.5	98.5	99.7	52.2	92.1	
Irrigation Water Requirement														Irrigation Efficiency: 0.65
Farm Head Gate Req. (mm.month)	Paddy													Conveyance Loss: 15%
	Upland	173.9	185.6	104.9				130.6	119.2	151.5	153.3	80.3	141.6	
Diversion Requirement (mm/month)	Paddy													
	Upland	204.5	218.3	123.4				153.6	140.2	178.2	180.3	94.4	166.5	
Diversion Requirement (10^3 m^3/month)	Paddy													
	Upland	94.35	78.63	44.45				59.05	68.09	86.54	87.56	43.55	76.82	$\Sigma Q = 639.04 \times 10^3$ m^3
Total (10^3 m^3/month)		94.35	78.63	44.45				59.05	68.09	86.54	87.56	43.55	76.82	

(c) Frequency of Irrigation

Available Moisture

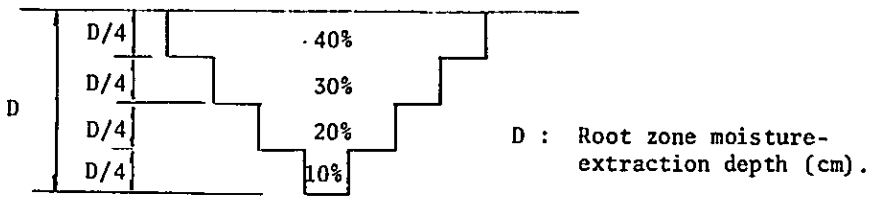
The results of analysis on an available moisture of the soil sampled from the existing paddy fields in both areas, Low Land and Up Land, has been already shown in Chapter 2, "Soil".

From the results of analysis, an available moisture of soil is determined to be 22 percent for Low Land, and 17 percent for Up Land respectively, as the representative value of soil moisture for whole project area.

Average Moisture-Extraction Pattern and Effective Root Zone Depth

Moisture-extraction pattern is different from crops, but following average pattern indicated in Fig. 4.3.1-2 is decided to be the design moisture-extraction pattern.

Fig. 4.3.1-2 Average Moisture-Extraction Pattern



Design effective root zone is classified into two types of moisture-extraction depth such as 1.20 m and 0.6 m according to the experimental report, Method for Scheduling and Determining Depth of Irrigation Employing Consumptive Use by Dr. S.E. Roy[1/].

1/ Derived from the Report of "Fifth Near East-South Asia Irrigation Practice Seminar".

Table 4.3.1-11 indicates the effective root zone depth for representative crops.

Table 4.3.1-11 Effective Root Zone Depth of Representative Crops

Crops	Depth of Rooting
Maize	120 cm
Wheat	120
Groundnut	120
Up Land paddy	120
Low Land paddy	60

Total Readily Available Moisture (T.R.A.M) and Net Amount of Water to be Replaced at Each Irrigation

The calculations of total readily available moisture (T.R.A.M) and net amount of water to be replaced at each irrigation are made on the two cases of the effective root zone of 1.20 m and 0.60 m by Low Land and Up Land fields. Table 4.3.1-12 gives the results of calculation and Tables 4.3.1-13 to 14 give the procedures of calculation.

Table 4.3.1-12 Net Amount of Water to be Replaced, in mm

Crops	Net Amount of Water to be Replaced	
	Low Land	Up Land
Low Land crops	120	90
Up Land crops	60	45

Frequency of Irrigation

Maximum safe interval of application for irrigation is ascertained by dividing the total readily available moisture computed previously by the peak consumptive use per day, provided that there is no rainfall.

Namely, estimation of maximum interval of irrigation is expressed in the following formula;

$$= \frac{\text{Net amount of water to be replaced}}{\text{Peak rate of consumptive use per day}}$$

Maximum interval of irrigation for Low Land;

Up Land crops : $\frac{125}{141.7/30} \fallingdotseq 25$ days

Low Land crops : $\frac{60.0}{310.2/31} \fallingdotseq 6$ days

Maximum interval of irrigation for Up Land;

Up Land crops : $\frac{90.0}{141.7/30} \fallingdotseq 19$ days

Low Land crops : $\frac{45.0}{310.2/31} \fallingdotseq 5$ days

From the result of calculation (Tables 4.3.1-13 to 14), though the maximum irrigation intervals for irrigation fluctuate widely by locations and crops, these calculated figures indicate an ideal irrigation intervals. According to the verbal information and experimental data at Mixed Farm, about 10 days irrigation intervals have been adopted for Up Land crops.

Based on these experimental data and the calculated figures, the irrigation intervals in the project are determined to be 10 days for Up Land crops and 7 days for Low Land crops respectively.

Table 4.3.1-13 Net Amount of Water to be Replaced for Low Land

Class-1. Design Moisture-Extraction Depth: 1.20 m

(1) Depth (cm)	(2) A.M (mm)	(3) Ratio of moisture-extraction	(4) (2)/(3) (mm)	(5) Restricting layer of moisture	(6) T.R.A.M. (mm)	(7) Net amount of water to be replaced (mm)	Remarks
0 - 30	66.0	0.4	165.0	*	165.0	115.5	$30^{cm} \times 22\% = 66^{mm}$
30 - 60	66.0	0.3	220.0			≒ 120.0	
60 - 90	66.0	0.2	330.0				
90 - 120	66.0	0.1	660.0				
Total	264.0						

Class-2. Design Moisture-Extraction Depth: 0.60 m

(1) Depth (cm)	(2) A.M (mm)	(3) Ratio of moisture-extraction	(4) (2)/(3) (mm)	(5) Restricting layer of moisture	(6) T.R.A.M. (mm)	(7) Net amount of water to be replaced (mm)	Remarks
0 - 15	33.0	0.4	82.5	*	82.5	57.8	$15^{cm} \times 15\% = 33^{mm}$
15 - 30	33.0	0.3	110.0			≒ 60.0	
30 - 45	33.0	0.2	165.0				
45 - 60	33.0	0.1	330.0				
Total	132.0						

Note: Net amount of water to be replaced = T.R.A.M. x 0.7

Table 4.3.1-14 Net Amount of Water to be Replaced for Up Land

Class-1. Design Moisture-Extraction Depth: 1.20 m

(1) Depth (cm)	(2) A.M. (mm)	(3) Ratio of mois-ture-extraction	(4) (2)/(3) (mm)	(5) Restricting layer of moisture	(6) T.R.A.M. (mm)	(7) Net amount of water to be replaced (mm)	Remarks
0 - 30	51.0	0.4	128.5	*	128.5	89.9	$30^{cm} \times 17\% = 51.0^{mm}$
30 - 60	51.0	0.3	170.0			≒ 90.0	
60 - 90	51.0	0.2	255.0				
90 - 120	51.0	0.1	510.0				
Total							

Class-2. Design Moisture-Extraction Depth: 0.60 m

(1) Depth (cm)	(2) A.M (mm)	(3) Ratio of mois-ture-extraction	(4) (2)/(3) (mm)	(5) Restricting layer of moisture	(6) T.R.A.M. (mm)	(7) Net amount of water to be replaced (mm)	Remarks
0 - 15	25.5	0.4	63.8	*	63.8	44.7	$15^{cm} \times 17\% = 25.5^{mm}$
15 - 30	25.5	0.3	85.0			≒ 45.0	
30 - 45	25.5	0.2	127.5				
45 - 60	25.5	0.1					
Total							

Note: Net amount of water to be replaced = T.R.A.M. x 0.7

4.3.2. Drainage Scheme

(a) Design Basic Rainfall

Daily rainfall records of 9 years from 1961 to 1966, observed at Mixed Farm, are available for study on the drainage scheme. Out of these available rainfall records, maximum daily rainfall is selected and design basic rainfall for the drainage scheme is determined to be 191 mm, which corresponds to the return period of 10-years probable daily rainfall, by using Hazen paper.

(b) Calculation of Unit Drainage Discharge

Paddy Fields

Unit surface drainage discharge for paddy fields is computed depending upon the assumption that the flood produced by the design rainfall, 191 mm corresponding to 10-years probable daily rainfall, is to be drained in 24 hours. Therefore, unit surface drainage discharge for paddy fields is calculated as follows;

$$Q = \frac{C.A.R.}{86,400}$$

Where; Q : Unit discharge for paddy fields per ha, in cu.m
C : Run-off coefficient
A : Unit area, in ha
R : Design daily rainfall, in mm

$$= \frac{1.0 \times 1.0^{ha} \times 10^{4} \times 191^{mm} \times 10^{-3}}{86,400}$$

$$= 0.0231 \text{ cu.m/sec/ha}$$

Up Land Fields

Procedure of determining the unit surface drainage discharge for Up Land fields is the same to that of paddy fields except the following assumptions.

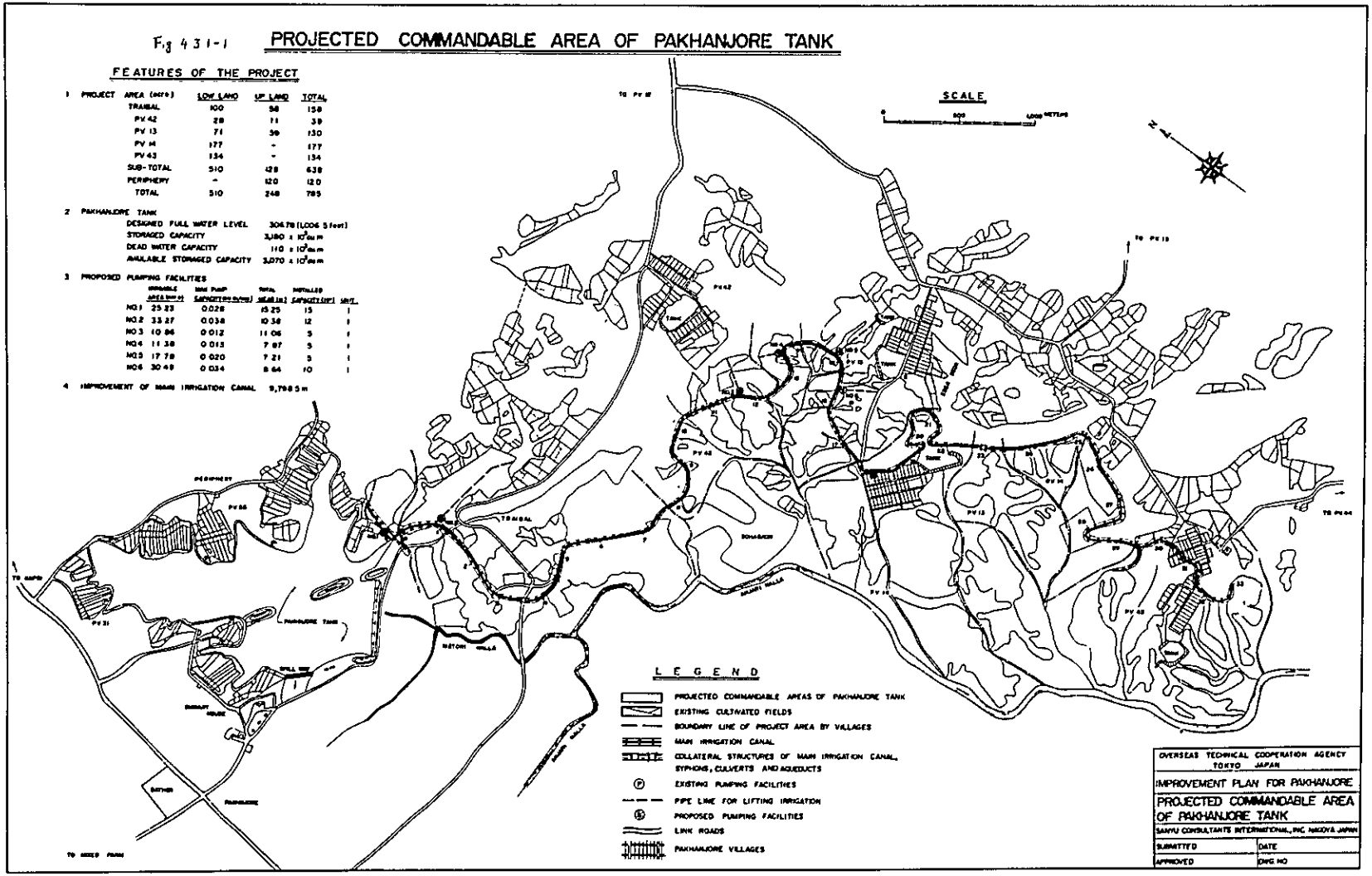


Fig 4.3.1-1 PROJECTED COMMANDABLE AREA OF PAKHANJORE TANK
FEATURES OF THE PROJECT
1 PROJECT AREA (acre)
LOW LAND UP LAND TOTAL
TRAMBAL 100 58 158
PV 42 28 11 39
PV 13 71 59 130
PV 44 177 - 177
PV 43 134 - 134
SUB-TOTAL 510 128 638
PERIPHERY - 120 120
TOTAL 510 248 785
2 PAKHANJORE TANK
DESIGNED FULL WATER LEVEL 306.78 (1006.5 feet)
STORAGED CAPACITY 3,180 x 10³ cu m
DEAD WATER CAPACITY 110 x 10³ cu m
AVAILABLE STORAGED CAPACITY 3,070 x 10³ cu m
3 PROPOSED PUMPING FACILITIES
NO.1 25.23 0.028 15.25 15 1
NO.2 33.27 0.038 10.38 12 1
NO.3 10.86 0.012 11.06 5 1
NO.4 11.38 0.013 7.87 5 1
NO.5 17.78 0.020 7.21 5 1
NO.6 30.49 0.034 8.64 10 1
4 IMPROVEMENT OF MAIN IRRIGATION CANAL 9,798.5 m
SCALE
0 500 1000 METERS
N
TO PV III
TO PV 13
TO PV 44
TO AMPA
TO MIXED FARM
TRAMBAL
PAKHANJORE TANK
LEGEND
PROJECTED COMMANDABLE AREAS OF PAKHANJORE TANK
EXISTING CULTIVATED FIELDS
BOUNDARY LINE OF PROJECT AREA BY VILLAGES
MAIN IRRIGATION CANAL
COLLATERAL STRUCTURES OF MAIN IRRIGATION CANAL, SYPHONS, CULVERTS AND AQUEDUCTS
EXISTING PUMPING FACILITIES
PIPE LINE FOR LIFTING IRRIGATION
PROPOSED PUMPING FACILITIES
LINK ROADS
PAKHANJORE VILLAGES
OVERSEAS TECHNICAL COOPERATION AGENCY TOKYO JAPAN
IMPROVEMENT PLAN FOR PAKHANJORE
PROJECTED COMMANDABLE AREA OF PAKHANJORE TANK
SANYU CONSULTANTS INTERNATIONAL, INC NAGOYA JAPAN
SUBMITTED
DATE
APPROVED
DWG NO

Run-off coefficient (c) is assumed to be 70 percent; and the flood is to be drained in 12 hours owing to the difference of topographic conditions in comparison with that of paddy fields. Subsequently, unit surface drainage discharge for Up Land fields is calculated to be 0.0306 cu.m/sec/ha.

4.4. Irrigation and Drainage Scheme

4.4.1. Irrigation Scheme

Irrigation System

Irrigation water will be distributed from the main irrigation canal connecting with Pakhanjore tank, which is the only water resources for the project area. Namely, Low Land areas, located in the right bank of the main irrigation canal, will be irrigated directly from the main irrigation canal by management of gates to be installed, and Up Land areas, located in the left bank of the main irrigation canal, will be irrigated by lift irrigation of pumps installed near the site of main irrigation canal.

Fig. 4.4.1-1 indicates the diagram of water supply systems for the project area.

Irrigation Method

Irrigation methods will be varied with the crops introduced by the project, Table 4.4.1-1 gives the irrigation method for the representative crops.

Table 4.4.1-1 Irrigation Methods for Representative Crops

Crops	Irrigation Method
Paddy	Intermitted Irrigation
Hy. Maize	Flood Irrigation (after sowing, 45 periods of day)
	Furrow Irrigation (after flood irrigation, 60 periods of day)
Wheat	- ditto -
	- ditto -

Irrigation Water Requirement

Based upon the proposed cropping pattern established for each village, the monthly irrigation water requirement taking into account of no effective rainfall is computed to be 360 ℓ/sec/ha.

From the results of calculation, maximum irrigation water requirement for whole project areas of 638 acres is amounted to be 0.407 cu.m/sec as shown in Fig. 4.2.1-1, by assuming that the irrigation periods of time per day is 24 hours for paddy fields and 12 hours for Up Land fields respectively.

Each maximum irrigation water requirement at distribution point for each block is illustrated in Fig. 4.4.1-1.

Proposed Facilities

Irrigation Canals:

Irrigation canals in the fields are classified into two types, sub-main and lateral canals, according to the required capacities of water and location. These sub-main and lateral irrigation canals are to be constructed by using the concrete U-type flume, which will be fabrication in the site by the metal frame transported from Japan, in order to reduce the cross sectional area of canal and to lower the conveyance loss of water.

Pumping Facilities:

As described in previously, Up Land areas selected as the one portion of the project area has to be irrigated by pumps because of no available of gravity irrigation from the main canal due to high elevation on the topography.

Table 4.4.1-2 shows the required pumping station and its project areas, and also Table 4.4.1-3 indicates the dimentions of pumps required.

Table 4.4.1-3 Dimensions of Required Pumps for Up Land

No.of Pumps	Distance (m)	Accumulative Distance (m)	Suction Level (m)	Delivery Level (m)	Actual Head 1/ (m)	Length of Pipe Line (m)	Pump Capacity cu.m/sec	Pump Capacity cu.m/min	Suction Bore (mm)	Delivery Bore (mm)	Pipe Line Loss Head (‰)	Loss Head (m)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)=(7)x(12)
1	RD.0		300.228-306.324	313.89	13.66	394.0	0.028	1.68	150 - 125	250	1.5	0.59
2	RD.0+191.0	191.0	299.92	307.15	7.23	700.0	0.038	2.28	150 - 125	250	3.0	2.10
3	RD.11+139.0	3,436.0	298.68	307.85	9.17	269.0	0.012	0.72	100 - 80	150	3.3	0.89
4	RD.13+134.5	4,042.0	298.48	304.70	6.22	171.0	0.013	0.78	100 - 80	150	3.8	0.65
5	RD.14+301.5	4,511.1	298.28	303.60	5.32	388.0	0.020	1.20	125 - 100	200	2.3	0.89
6	RD.15+172.0	4,698.6	298.19	305.05	6.86	373.0	0.034	2.04	150 - 125	250	2.1	0.78

Total Head (m) (14)= (6)+(13)+1.0m	Efficiency (%)	Water Horse Power 2/ (HP)	Shaft Horse Power 3/ (HP)	Installed Capacity 4/ (HP)	Unit
	(15)	(16)	(17)	(18)	(19)
15.25	70	8.13	10.56	13	1
10.33	73	7.16	9.31	12	1
11.06	63	2.81	3.65	5	1
7.87	64	2.13	2.77	5	1
7.21	68	2.82	3.67	5	1
8.64	72	5.43	7.07	10	1

Note: 1/ Total Head = Actual Head + Loss Head + Pump Loss(1.00m)

2/ Water Horse Power = $0.222 \times \frac{Q.H}{\eta p}$ (HP)

where Q : Capacity (cu.m/min)

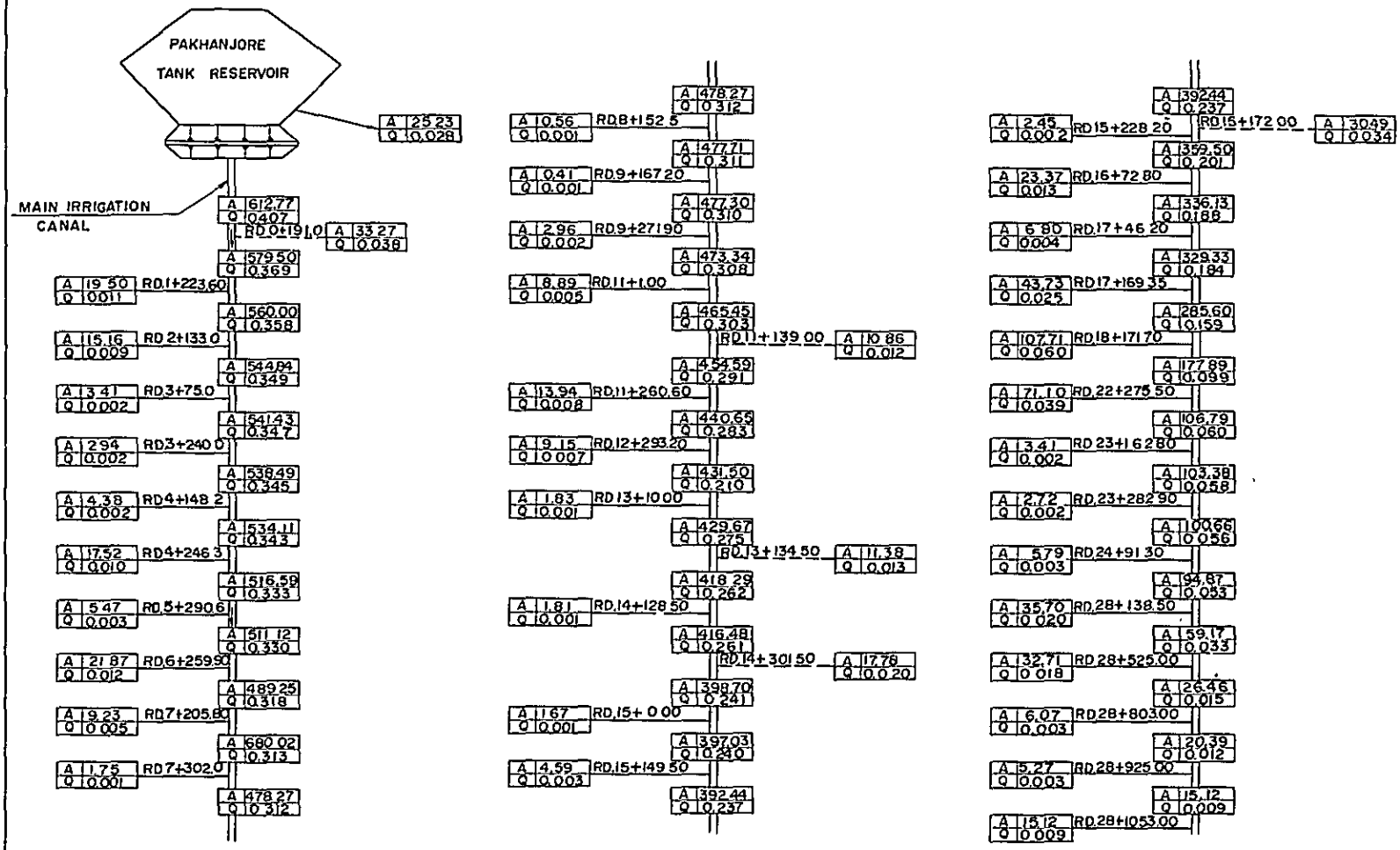
H : Total Head (m)

ηp: Efficiency (%)

3/ Shaft Horse power = Water Horse power x 1.3 (HP)

4/ Installed Capacity = Shaft Horse power x 1.2 (HP)

Fig. 4.4.1-1 DIAGRAM OF WATER SUPPLY SYSTEM, NET IRRIGABLE AREA AND DESIGN DISCHARGE



REGEND

A : NET IRRIGABLE AREA, IN ACRE
Q : DESIGN DISCHARGE, IN cu M/SEC

——|| : OUT-LET (GRAVITY IRR.)
---|| : OUT-LET (LIFTING IRR.)

Table 4.4.1-2 Required Pumping Station

Pumping Station	Location	Area acre	Pump Capacity 1/ ℓ/sec
No. 1	Tribal	25.23	28.0
No. 2	P.V. 42	33.27	38.0
No. 3	P.V. 42	10.86	12.0
No. 4	P.V. 13	11.38	13.0
No. 5	P.V. 13	17.78	20.0
No. 6	P.V. 13	30.49	34.0

Note: 1/ 2 x 360 ℓ/sec/ha x Area

4.4.2. Drainage Scheme

Prior to design of the drainage facilities, drainage systems in fields shall be established, depending upon the land consolidation plan. After establishment of drainage systems, the design flood drainage discharge can be calculated by multiplying the commandable area of drainage by the unit drainage discharge. As for the unit drainage discharge, since the project area is mainly utilized for paddy fields, unit drainage discharge for paddy fields of 0.0231 cu.m/sec can be adaptable for the computation of the flood discharge.

To drain the flood drainage discharge earth drainage canals, having the side slopes of 1:1 and design hydraulic gradient of 1/500 will be constructed. Therefore, drop works will be provided according to land fluctuation, if required.

4.5. Examination of Water Resources

4.5.1. Examination of Water Balance for Pakhanjore Tank

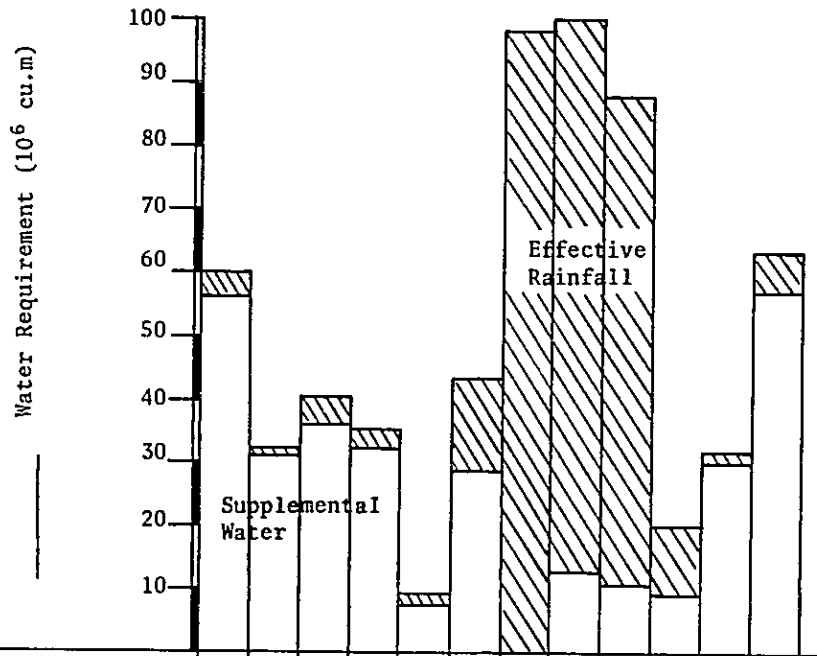
(a) Discharge from Pakhanjore Tank

Supplemental Water for Irrigation

From the results of analysis for irrigation water requirement on the design year, it was obviously found out that the supplemental irrigation will be required during the rainy season, because of occurrence of consecutive droughty day more than 10-days in spite of the duration of the rainy season.

Annual required supplemental irrigation water for the areas (Tribal, P.V. 42, P.V. 13, P.V. 14, P.V. 43 and Periphery), which rely upon the water resources of irrigation for the Pakhanjore tank, is of approximately 3,135 x 10^3 cu.m, and its monthly fluctuation can be illustrated, as shown in Fig. 4.5.1-1.

Fig. 4.5.1-1 Monthly Supplemental Water



Water Requirement	601	324	401	355	91	437	982	1018	882	201	320	639	6251 x 10^6
Effective Rainfall	42	10	41	32	12	148	982	888	772	104	18	67	3116 x 10^6
Supplemental Water	559	314	360	323	79	289	-	130	110	97	302	572	3135 x 10^6
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Evaporation from Pakhanjore Tank

References to the report of Pakhanjore Tank are made, so as to determine the evaporation rate from water surface, and monthly evaporation rates are dicided as following table.

Table 4.5.1-2 Evaporation Rate from Water Surface

Month	Evaporation Rate (mm/month)
Jan.	90.4
Feb.	108.2
Mar.	198.1
Apr.	280.4
May	393.0
Jun.	191.0
Jul.	84.6
Aug.	77.7
Sep.	72.6
Oct.	86.6
Nov.	79.8
Dec.	74.4
Total	1,736.8

(b) Inflow to Pakhanjore Tank

The inflow to the Pakhanjore tank is of the run-off discharge produced by storm and base flow. Average run-off discharge is computed on the basis of 10-years probable rainfall by applying Alexander Binny's Percentage, which is adopted in Madhaya Pradesh (M.P) to estimate the run-off discharge for the lack of other relevant data available for the monsoon season, that is, from June to October. On the other hand, though rainfalls can be seen even in the dry season, these rainfalls are not taken into account for the studies of water resources.

For an estimation of the base flow from the catchment areas of Pakhanjore tank of 15.02 sq.km, the observation data of 0.804 ℓ/sec/sq.km, which was carried out at the Anjari Nalla in Mixed Farm by using the V-notch weir, are applied to the catchment areas of Pakhanjore tank.

Table 4.5.1-3 shows the calculated inflow water to the Pakhanjore tank according to the above descriptions.

Table 4.5.1-3 Runoff Statement for the Design Year (1966)

Month	Rainfall 1/ (mm)	Accumulated Rainfall (mm)	Total Runoff by Rainfall (mm)	Runoff during the month (mm) 2/	Base Flow 3/ (mm)	Total Runoff 4/ (mm)	Total Runoff 4/ (10^3 m^3)
1	10.2				2.1	2.1	31,542
2	11.1				1.9	1.9	28,538
3	28.3				2.1	2.1	31,542
4	24.3				2.1	2.1	31,542
5	24.2				2.1	2.1	31,542
6	85.5	85.5	0.4	0.4	2.1	2.5	37,550
7	420.2	505.7	82.0	81.6	2.1	83.7	1,257,173
8	345.9	851.6	261.0	179.0	2.1	181.1	2,720,122
9	293.4	1,145.0	473.0	212.0	2.1	214.1	3,215,782
10	42.9	1,187.9	504.0	31.0	2.1	33.1	497,162
11	5.3				2.1	2.1	31,542
12	17.6				2.1	2.1	31,542
Total	1,308.9			504.0	25.0	533.0	7,945,039

Note: 1/ See Table 4.3.1-4

2/ Estimated by applying Alexander Binny's Percentage curve (Fig. 4.5.2-1)

3/ q = 0.804 ℓ/sec/sq.km

= 0.804 ℓ/sec x 10^{-3} x 86,400 x 30/10^6

= 2.1 mm/month

4/ (Runoff discharge + Base flow) x catchment area of 15.02 sq.km

(c) Calculation of Water Balance for Pakhanjore Tank

As stated previously, dimensions of Pakhanjore tank are summarised as following descriptions;

Full water surface	:	306.32 m (1,005 feet)
Storage capacity	:	2,670 x 10^3 cu.m
Dead water capacity	:	110 x 10^3 cu.m
Available storage capacity	:	2,560 x 10^3 cu.m

The calculations of water balance for Pakhanjore tank having the above mentioned features are made as shown in Table 4.5.1-4 by considering the outflow from and inflow to Pakhanjore tank. As is seen in Table 4.5.1-4, shortage water of 816 x 10^3 cu.m, equivalent to 32 percent of existing available storage capacity of 2,560 x 10^3 cu.m, can be seen in the design year, and it lasts for four months from April to June prior to monsoon season.

So as to solve the shortage water of Pakhanjore tank, following two methods can be considered. One method is such that the shortage water has to be supplied by the discharge from Paralkote dam under construction supervised by Indian Government, and the other way is of raising the full water level by improving the spillway of Pakhanjore tank, hence some portions of shortage water will be solved.

In the former case, it is impossible to expect the discharge from Paralkote dam in the early stage since some periods of year will be required to complete the construction of Paralkote dam. Therefore, though the shortage water will be supplied by the discharge from Paralkote dam after the implementation of dam in the future, as a first stage, the shortage water will be covered partially by raising the full water level owing to improvement of spillway of Pakhanjore tank.

According to the investigation of the vicinity of Pakhanjore tank,

Table 4.5.1-4 Working Table for the Pakhanjore Tank (Existing) (Catchment Area : 15.02 sq.km)

Month	Initial Reservoir Level, in m	Water Surface Area, in sq.m	Inflow, in cu.m/month	Draw-off, in cu.m/month	Evaporation		Net Deduction or Addition, in cu.m/month	Final Reservoir Capacity, in cu.m/month	Over Flow, in cu.m/month	Shortages, in cu.m/month
					mm/month	cu.m/month				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
10								2,670,000		
11	306.32	2,380,000	31,542	301,850	79.8	189,924	- 460,232	2,209,768		
12	305.80	2,000,000	31,542	572,080	74.4	154.800	- 695,338	1,514,430		
1	304.87	1,410,000	31,542	559,390	90.4	127,464	- 655,312	859,118		
2	303.65	910,000	28,538	314,180	108.2	98,462	- 384,104	475,014		
3	302.40	580,000	31,542	360,570	198.1	114,898	- 443,926	110,000		(-) 78,912
4	306.50	170,000	31,542	322,790	280.4	47,668	- 338,916	110,000		(-) 338,916
5	300.50	170,000	31,542	78,630	393.0	66,810	- 113,898	110,000		(-) 113,898
6	300.50	170,000	37,550	289,200	191.0	32,470	- 284,120	110,000		(-) 284,120
7	300.50	170,000	1,257,173	-	84.6	14,382	+ 1,242,791	1,242,791		
8	304.45	1,200,000	2,720,122	130,290	77.7	93,240	+ 2,496,592	2,670,000	1,069,383	
9	306.32	2,380,000	3,215,782	110,150	72.6	172,788	+ 2,932,844	2,670,000	2,932,844	
10	306.32	2,380,000	497,162	96,830	86.6	206,108	+ 194,224	2,670,000	194,224	
Total			7,945,039	3,135,196	1,736.8	1,319,014			4,196,451	815,846

Note: (6) ; Reference to Pakhanjore Dam Report prepared by Indian Government was made.

(9) ; As shown in Fig. 4.5.1-2, the existing full water level of Pakhanjore Tank is 306.32 m (1,005 feet), and its storage capacity is 2,670 x 10^3 cu.m. Dead water level is 300.5 m (1,001 feet) and its dead water capacity is 110x10^3 cu.m.

Table 4.5.1-5 Working Table for the Pakhanjore Tank (Plan) (Catchment Area : 15.02 sq.km)

Month	Initial Reservoir Level, in m	Water Surface Area, in sq.m	Inflow, in cu.m/month	Draw-off, in cu.m/month	Evaporation		Net Deduction or Addition, in cu.m/month	Final Reservoir Capacity, in cu.m/month	Over Flow, in cu.m/month	Shortages, in cu.m/month
					mm/month	cu.m/month				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
10								3,180,000		
11	306.80	2,820,000	31,542	301,850	79.8	225,036	- 495,344	2,684,656		
12	306.31	2,380,000	31,542	572,080	74.4	177,072	- 717,610	1,967,046		
1	305.50	1,800,000	31,542	559,390	90.4	162,720	- 690,568	1,276,478		
2	304.52	1,230,000	28,538	314,180	108.2	133,086	- 418,728	857,750		
3	303.65	910,000	31,542	360,570	198.1	180,271	- 510,299	347,451		
4	301.80	430,000	31,542	322,790	280.4	120,572	- 411,820	110,000		(-) 174,369
5	300.50	170,000	31,542	78,630	393.0	66,810	- 113,898	110,000		(-) 113,898
6	300.50	170,000	37,550	289,200	191.0	32,470	- 284,120	110,000		(-) 284,120
7	300.50	170,000	1,257,173	-	84.6	14,382	+ 1,242,791	1,352,791		
8	304.65	1,290,000	2,720,122	130,290	77.7	100,233	+ 2,489,599	3,180,000	662,390	
9	306.80	2,820,000	3,215,782	110,150	72.6	204,732	+ 2,900,900	3,180,000	2,900,900	
10	306.80	2,820,000	497,162	96,830	86.6	244,212	+ 156,120	3,180,000	156,120	
Total			7,945,039	3,135,196	1,736.8	1,661,596			3,719,410	572,387

Note: (6) ; Reference to Pakhanjore Dam Report prepared by Indian Government was made.

(9) ; Design full water level is decided to be 306.78 m (1,006.5 feet), including the raise of water level of 45 cm (1.5 feet), and the storage capacity of Pakhanjore Tank of 3,180 x 10^3 cu.m can be expected.

raising the water level of about 45 cm (1.5 feet), from full water level of 306.32 m (1,005 feet) to 306.78 m (1,006.5 feet), will not bring the damage to not only cultivated land located in the vicinity of the tank, but also main and collateral structures.

After the implementation of improvement of spillway, approximately 510 x 10^3 cu.m of increased storage capacity can be expected, and full water level of 306.78 m.

Even in this case, raising the water level of about 45 cm, approximately 572 x 10^3 cu.m equivalent to 19 percent of the available storage capacity of 3,070 x 10^3 cu.m shall be shortage, while present shortage of 815 x 10^3 cu.m corresponding to 32 percent of the available storage capacity, as shown in Table 4.5.1-5.

4.5.2. Design of Spillway of Pakhanjore Tank

Existing Pakhanjore spillway is located at 1,200 meter west of the main irrigation canal, and its overflow length is approximately 100 m. No facilities is provided except the boulder stones of 70-80 cm in diameter placed on the apron imediate downstream of crest, in order to reduce the velocity of flood discharge.

In improving this spillway to expect the much more an available storage capacity, following data are referred;

(a) The report of Agricultural Investigation in Dandakaranya Project[1/]

(b) Report of Pakhanjore Hydrology [2/]

1/ Prepared by Japanese teams dispatched from Overseas Technical Co-operation Agency.

2/ Derived from Indian Government.

Determination of Flood Discharge

According to the above data, the design flood discharge for Pakhanjore tank has been computed to be 133.1 cu.m/sec based upon the rainfall intensity of 215.9 mm/24 hours (8.5"/24 hours) corresponding to the duration of 24 hours in the 40 years return period. On the other hand, depending upon the overflow discharge of Pakhanjore spillway indicated in the report of Pakhanjore Hydrology, the probable overflow discharge is estimated as follows, by applying Gumbel-Chow formula;

Return Periods	Overflow Discharge, in cu.m/sec
100	128.5
50	112.1
40	104.2
20	91.4
10	75.7

From this calculation, the overflow discharge in the 40 years return period is 104.1 cu.m/sec. Difference between the flood discharge of 133.1 cu.m/sec and overflow discharge of 104.1 cu.m/sec will come from the loss such as absorption and initial storage loss of tank. The design overflow discharge of the spillway is decided to be 133.1 cu.m/sec.

Design of Overflow Spillway

Scale of overflow spillway is designed as follows;

Distance of pier	:	2.00 m
Width of pier	:	0.40 m
Number of overflow section	:	42
Total overflow length	:	84.0 m

Consequently, the overflow discharge per one section can be calculated at 3.169 cu.m/sec, and required overflow depth can be obtained by solving

the following equation;

$$Q = C \cdot L \cdot He^{3/2}$$

Where; Q : Overflow discharge, in cu.m/sec/section
C : Overflow coefficient 2.0
L : Actural overflow length, in m
$L = L' - 2Ka \cdot He$
L': Distance of pier 2.0m
Ka : Coefficient of contraction 0.035
He : Overflow depth, in m

Fig. 4.5.2-1 indicates the relation between the overflow discharge (Q) and the overflow depth (H), above mentioned.

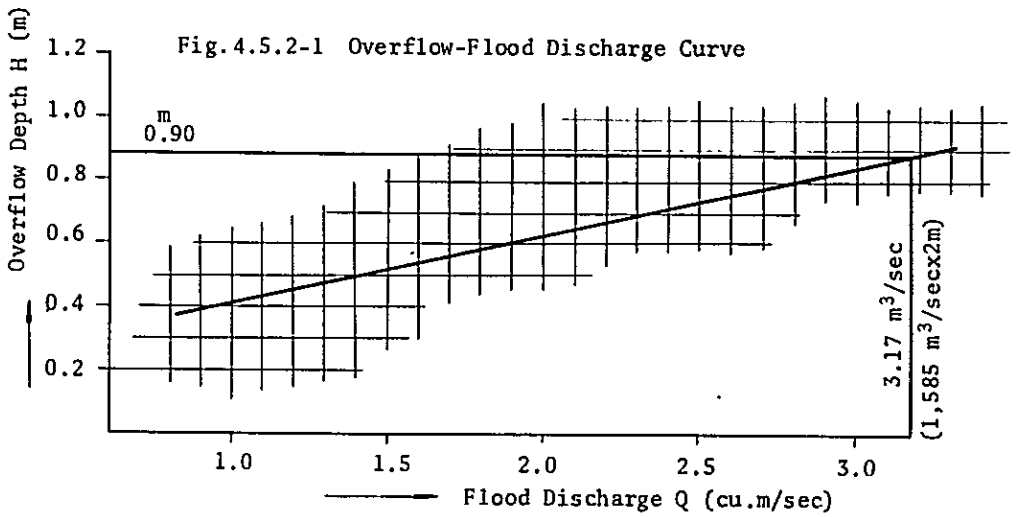


Fig.4.5.2-1 Overflow-Flood Discharge Curve

Fig. 4.5.1-2 AREA AND CAPACITY CURVE FOR PAKHANJORE TANK

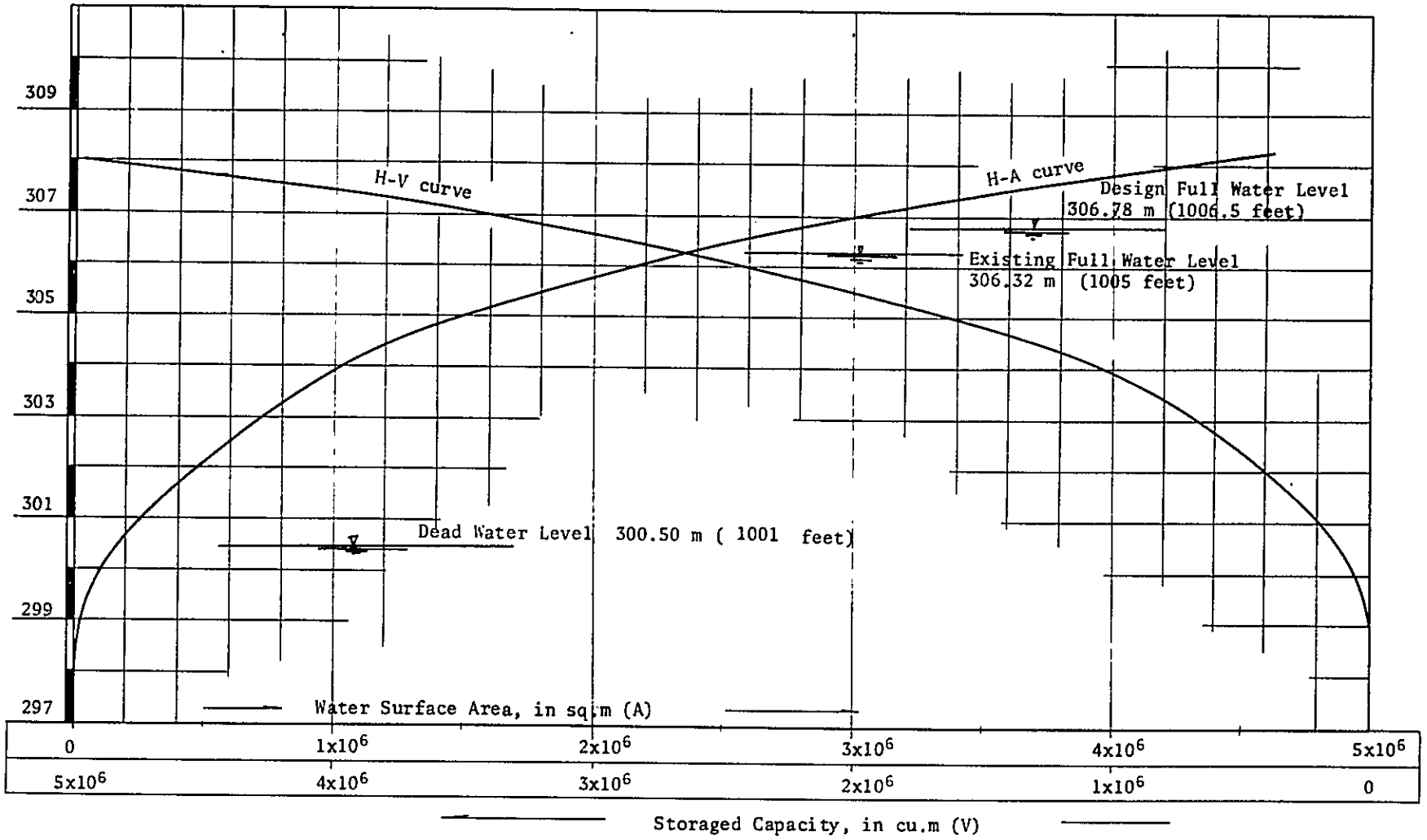
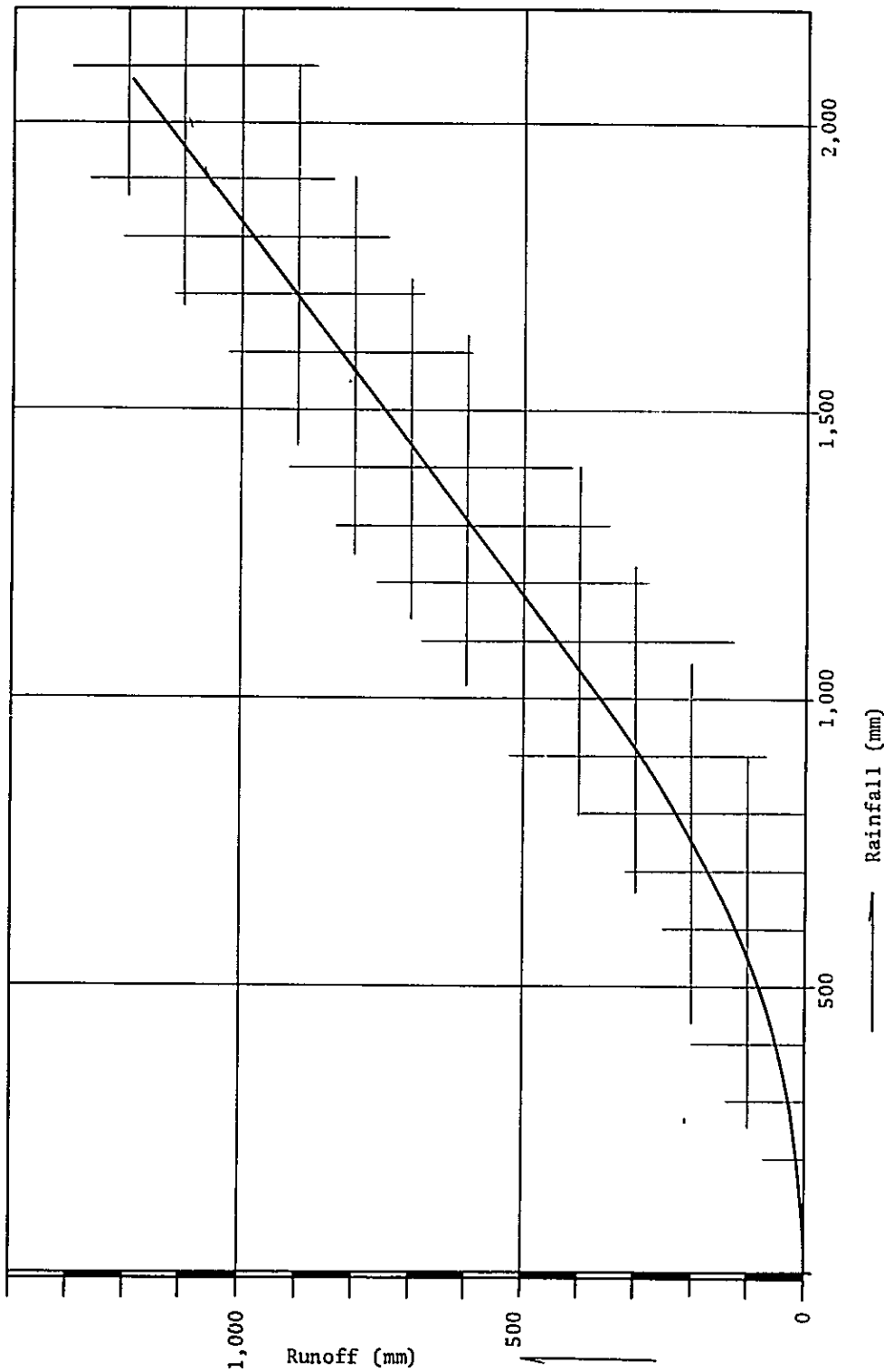
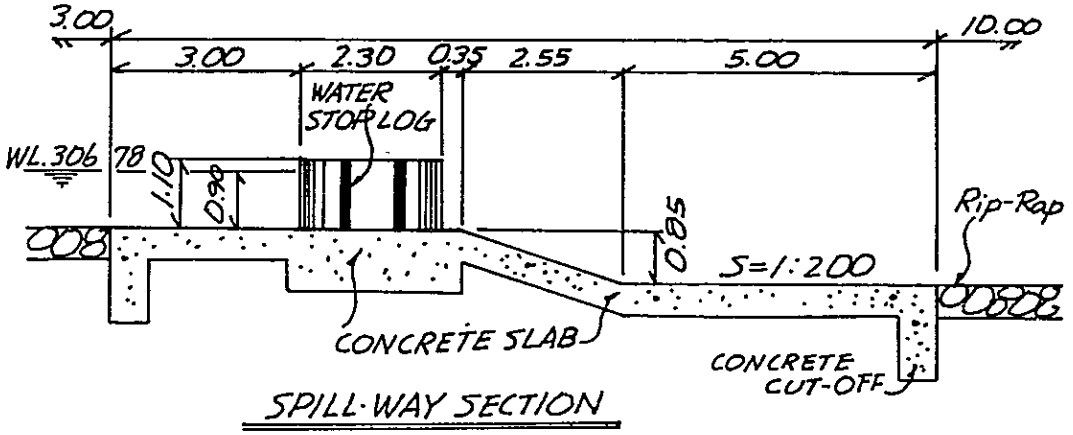


Fig. 4.5.1-3 ALEXANDER BINNY'S CURVE



From this graph, the required overflow depth can be obtained to be 0.90 m. The height of pier is designed at 1.10 m taking into account the freeboard of 0.20 m, as shown in Fig. 4.5.2-2.

Fig. 4.5.2-2. Section of Design Spillway

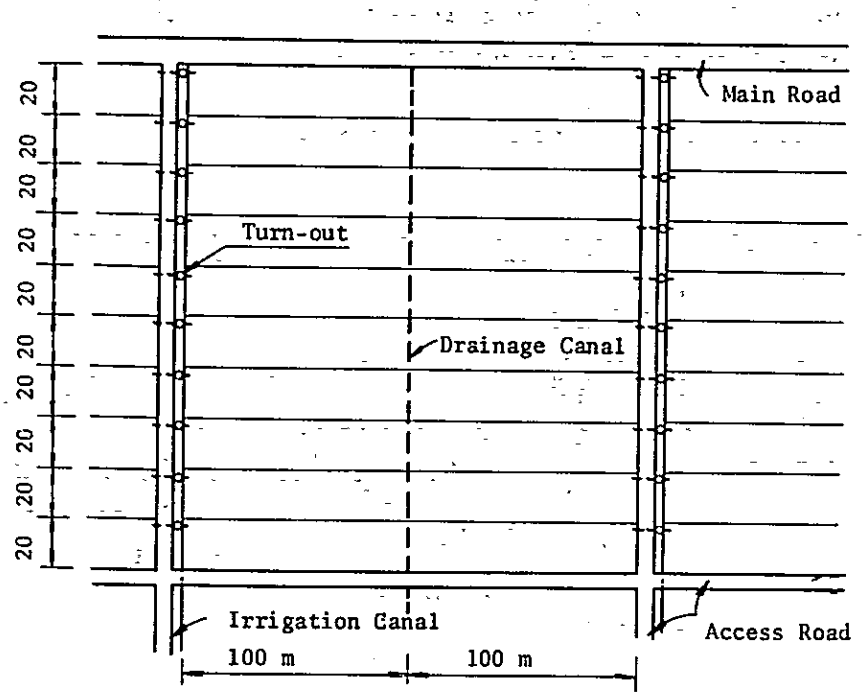


4.6. Land Improvement Plan

Land improvement works, including the land readjustment, arrangement of roads, irrigation and drainage systems, and leveling works, will be carried out all over the project area, in order to introduce the mechanized agriculture, to raise the operation efficiency of agricultural equipments, and to promote the agricultural productions and the productivity of labour.

Considering the topographic restriction, economic earth moving, convenient of water management, haulage of farming materials, harvest and so forth, the size of one standard farm land block is designed to be 100 m x 20 m with the long side along the contour lateral as shown in Fig. 4.6-1.

Fig.4.6-1 Standard Farm Land Block



As is seen from Fig. 4.6-1, irrigation and drainage systems in this area are established to construct irrigation and drainage canals along the short side of plot.

The leveling works against the fluctuation of land will be carried out within one farm land plot to reduce the earth moving volume. For estimating the earth moving volume (V) and haul distance (D), the convenient method developed by Agricultural Land Development Machinery Public Corpo-

ration will be used. The explanation of this method is described hereinafter.

If the coefficient of swell factor (f) used for calculating the capacity of construction equipment is assumed to be 1.0, boundary line of excavation and embankment will pass the center of figure in the plot, running parallel with contour line. Depending upon the variation of the intersection angle of θ which is made by crossing the boundary line of excavation and embankment and the line which will pass the center of figure in parallel with long side of the plot, the required earth moving volume and mean haul distance can be estimated by applying the equations indicated in Table 4.6-1.

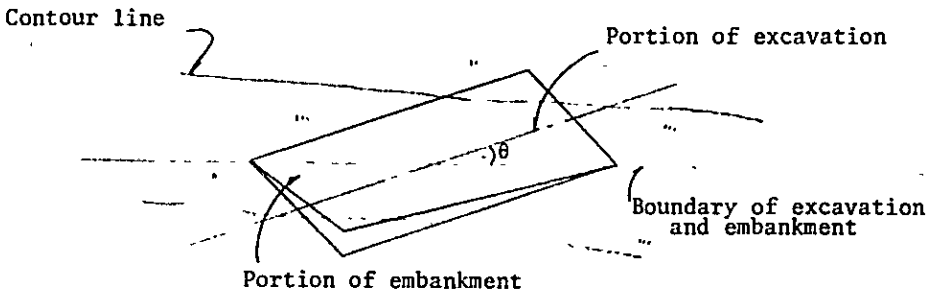
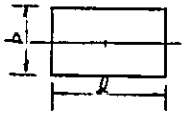
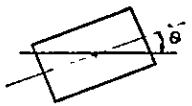
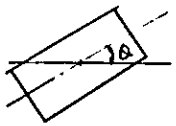
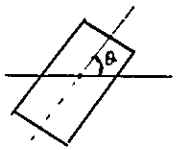
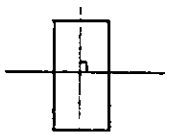


Table 4.6-1 Equation for Estimating the Required Earth Moving Volume (V), Mean Haul Distance (D) and Output of Machine (V)x(D)

Class	Description: Figure	Description: Range of θ	Equations: V (cu.m/sq.m)	Equations: D (m)	Equations: V. D
I		$\theta = 0$	$\frac{h.\ell.b}{4}$	$\frac{2}{3}b$	$\frac{h.\ell.b^2}{6}$
II		$\tan\theta < \frac{1}{K}$ $(0 \leqq \theta < \tan^{-1}\frac{1}{K})$	$\frac{IKb^3(K^2\sin^2\theta+3\cos^2\theta)}{24\cos\theta}$	$\frac{2b\cos\theta\sqrt{K^4\sin^2\theta+\cos^2\theta}}{K^2\sin^2\theta+3\cos^2\theta}$	$\frac{IKb^4\sqrt{K^4\sin^2\theta+\cos^2\theta}}{12}$
III		$\tan\theta = \frac{1}{K}$ $(\theta = \tan^{-1}\frac{1}{K})$	$\frac{h.\ell.b}{6}$	$\frac{1}{2}\sqrt{\ell^2+b^2}$	$\frac{IK^2b^4}{12}$
IV		$\tan\theta > \frac{1}{K}$ $(90° \geqq \theta > \tan^{-1}\frac{1}{K})$	$\frac{Ib^3(3K^2\sin^2\theta+\cos^2\theta)}{24\sin\theta}$	$\frac{2Kb\sin\theta\sqrt{K^4\sin^2\theta+\cos^2\theta}}{3K^2\sin^2\theta+\cos^2\theta}$	$\frac{IKb^4\sqrt{K^4\sin^2\theta+\cos^2\theta}}{12}$
V		$\theta = 90°$	$\frac{h.\ell.b}{4}$	$\frac{2}{3}\ell$	$\frac{h.\ell^2.b}{6}$

Remarks; $K = \frac{\ell}{b}$, $I = \tan i = \frac{2h}{b\cos\theta + \ell\sin\theta}$, i = Land slope, h = Maximum depth of excavation

4.7. Road Plan

In this project area, main roads which is linking the principal cities and access roads which is linking the each village are maintained by Construction Department. The width of road is designed to be 6.00 m for main roads and 3.00 m for access roads. These roads are paved by moorum and its thickness is 15 cm for main roads and 7 cm for access road respectively.

The farm roads in the field are not sufficient under present condition. In the land improvement plan, farm roads will be provided along the short side of field. As for the standard section, drawing shall be referred.

4.8. Quantities for Major Construction Works in Command Area by Pakhanjore Tank

The quantities for major construction works in the Pakhanjore area are summarized as indicated in Table 4.8-1.

Table 4.8-1 Quantities for Major Construction Works in the Pakhanjore Area

	Major Works	Unit	Quantities
A.	Improvement for spillway of Pakhanjore tank	Place	1
B.	Improvement for main canals	Place	9,798.5
C.	Improvement for collateral structures of main canals		
	Siphon	Place	6
	Aqueduct	"	1
	Culvert	"	6
	Bridge	"	2
	Measuring gauge	"	1
	Check gate	"	7
	Spillway	"	4
	Diversion works	"	34
	Inlet works	"	36
D.	Irrigation pump	"	6
E.	Land improvement plan	Acre	638
F.	Farm roads	m	9,128

Note: As for the detail of quantities, Chapter 13 shall be referred.

Chapter 5. Living Conditions Improvement Plan

Chapter 5 Living Conditions Improvement Plan

5.1 Basic Conception

As other aspects of rural life, there is much room for improvement in the aspect of living conditions. An attempt to change the old and traditional customs inevitably faces some resistance. But if there is a strong will to do so, it would not be very difficult to find some means of making life much more convenient and comfortable. In order to do this, it is essential to awaken the enthusiasm of people for taking steps forward to break away from the existing state of things.

On the other hand, however, it is also necessary that the fundamental conditions for everyday life are provided sufficiently. There are several such 'fundamental conditions' but here it would be appropriate to narrow our attention down to what is considered most urgently needed at the present moment and realistic enough not to be much deviated from the realities. So, it is probably most advisable to take up the question of drainage arrangements in the village. The efficient disposal of sewage not only in the rainy season but also in the dry season is undoubtedly a problem that cannot be neglected from the standpoint of public sanitation such as the prevention of various diseases. Consumption of water will increase in proportion to the rise in the living standard and the farmland irrigation system for the dry season will eventually be provided and then it will become a serious problem how to dispose of the sewage that is produced in the village. This is not a problem that can be solved by the individual farm households. Even if they tried to tackle the problem separately on their own, not much can be expected from such endeavors. So, it is necessary to plan and build a public drainage system for the whole villages.

Since the water supply required for the everyday life of people has already be secured, the time will come soon when the development of an adequate system of municipal water supply will be taken up for consideration as the next task for the people to tackle. The introduction of electricity is also one of the important fundamental living facilities and is earnestly desired by the settlers. Therefore it should be made a pro-

blem to be solved in the future in consideration of the financial standard of the farmers at the present time. But the power transmission lines must be set up first. The improvement of kitchen facilities in the farm households, more efficient execution of domestic work, more varied and well-balanced dietary intake, and the improvement of the way of nursing children are also important questions. It is considered that there is much room for improvement in these fields of domestic life if appropriate advices are given and the housewives themselves use their ingenuity and inventiveness.

The second conceivable plan for the improvement of living conditions is the development of the communication system of information such as wireless communication service. This will be great help to encourage the settlers in this isolated area from other districts to stir up their enthusiasm for improving their lives by keeping close contact with the wide outer world thereby receiving a wide variety of social, economic and cultural information. It can be said that the various improvements proposed in the aspect of farm management are ultimately for the uplift of the settlers living standard and this will become a mere desk plan unless underlined by their own will and enthusiasm for improving their lives. The contact with the outer world will be a great motivation for the settlers to have a desire to move forward from the present state of things.

5.2 Execution Plans

5.2.1 Plan for the development of drainage facilities

In order to provide good drainage in the residential area for the settlers, there will be provided the main drains and branch drains to remove rain-water from the ground of the individual houses, elementary school and other establishments to the main drains. Waste water produced in the everyday lives of the people also will be removed through these drains.

5.2.2 Plan for the development of information transmission facilities

A key station will be constructed in Pakhanjore, where the kind of information which are considered useful to the settlers and which they love

to hear will be selected and broadcast by radio. Some programs of Radio India will be relayed by the station to reach the settlers. It also will be possible to use this broadcasting system to communicate the information which public agencies and other organizations desire to deliver to the settlers. In this way the communication system will make it possible to disseminate information simultaneously and quickly over a wide range to serve the convenience of the settlers and help improve the administrative efficiency. The broadcasting will take place during the fixed periods of time every day so that the listeners may pay their attention to their speakers when the time has come. If the urgent necessity arises for sending a communication to someone who is otherwise difficult to contact immediately, anyone can ask the key station to broadcast the massage. Such emergency broadcast will be preceded by a fixed call sign so that the listeners may know an emergency broadcast is forthcoming.

The receivers will be made available at the rate of one for several households so that the settlers may receive the information service at the regular times of broadcasting in the morning, noon recess and evening. In addition to the broadcasting of information, such entertaining broadcasts as music and dramas will be transmitted from time to time. The settlers will be able to enjoy the broadcasting service only by occassionally replacing the dry batteries for their receivers. It will be possible to control the sound volume and to turn off the receiver if there is no need to listen.

This communication system helps keep the settlers informed about things which are happening in the outer world, and thus shortening the distance between them and the outer world.

A total sum of rupees of 1.2 lakh will be appropriated for this plan including the construction of the key station and for the receivers to be provided in the settlers' homes.

Chapter 6. Agriculture Cooperative Society Plan

Chapter 6 Agricultural Cooperative Society Plan

6.1 Basic Conception

a) Establishment of cooperative organization in the phase of production

In view of the actual agricultural and other conditions in this area at the present time, the highest priority should be given to the problems on how to enhance agricultural productivity and what means and methods should be used to achieve this object. It is needless to say that co-operation in the marketing of farm products and in the purchasing of goods the farmers will be necessary. But what should be done first is to establish co-operative relations among the farmers to increase their production. Not much can be expected from the endeavors of the individual farmers if they work separately where the available means of production are so poor that they have to work almost bare-handed under the very severe natural conditions. Such being the case, it is imperative for the settlers to form a co-operative organization in the phase of production if their agricultural economy is to be expanded speedily. This organization will be very closely related to the lives of the settlers and it will function mainly in the phase of agricultural production and its function will be extended further to co-operative activities in their everyday life. It will be still too primitive to deserve the name of "co-operative society" but certainly it will become a substructure on which an agricultual co-operative society will be formed in the near future.

b) The scale of the basic productive organization

In view of the nature of the cooperative organization in the phase of production, the smallest unit of organization will consist of about five households. The constituent members will be increased in case it is needed. Such fundamental organization will be constituted by blood-ties such as brothers and relatives or friends and in some cases by the people living in the same neighborhood. It is desirable that the organization is based on the cooperative relations arising spontaneously among the settlers.

c) Development of functional groups and the scope of activity and scale of the agricultural co-operative society

To nurture functional groups that have specific and definite purposes and have adequate functions to achieve their respective purposes to serve as an infrastructure of the agricultural co-operative society will be one of the effective methods for the establishment and expansion of the agricultural co-operative society. It will be a group of the operators of farming machinery or in some case a group for studying specific farming techniques. Such groups also will help promote the co-operative activity in the phase of production in the direction toward the definite purpose. These group activities will help stabilize the farm produce in variety and quality and secure an advantage for the settlers in the marketing of their products. The agricultural co-operative society, based on the activities of these functional groups, will tackle its many-sided task, such as the leasing of cultural chemicals, the advancement of both production and livelihood funds, and the marketing of farm products, and the supply of daily necessities.

Taking into consideration the scope of trading and social activities of the settlers, the most realistic and proper size of an agricultural co-operative society is the area with five to ten communities at most. This size is considered the most recommendable because if it is extended to cover too large an area it will not necessarily help increase the interest of the settlers in the co-operative society and strengthen their solidarity as the members of the society. It is very difficult for people to form really co-operative relations with total strangers. The scale of the agricultural co-operative society can be expanded as the scope of the economic activities and the sphere of action of the settlers are enlarged with the passage of time. The disadvantage arising in trading due to the smallness of scale of the society can be made up for by forcing the central co-operative association.

6.2 Execution Plan

6.2.1 Formation of mutual assistance squads

About five neighboring families will form a mutual assistance squad. The mutual assistance squads will be the basic units of organizations helping each other both in everyday life and agricultural productive activities.

Any problem to be solved by the co-operative efforts of the settlers will be discussed first within the squad. Such ceremonies as weddings and funerals will be performed co-operatively by the squad. Any work beyond the labor force of a household or the kind of work that can be done more effectively by the co-operative endeavors of several persons will be undertaken collectively by the squad. Apart from some types of work which require special talents or skills, there are probably many kinds of work which can be done more pleasantly and efficiently when many people work together. It also will be an effective method for increasing farming productivity to divide a series of tasks among many people, each specializing in a particular work. In transplanting of rice plants, for example, the farmers are divided into two groups and one group collect the seedlings from the nursery and the other plant them so that the work of transplanting may be finished quickly and the field is irrigated immediately after completion of the work so that the young rice plants can easily take root and grow well.

Apart from the above-mentioned neighborhood squad organization, there can be a voluntarily organized group of brothers and relatives to substitute or supplement the co-operative work.

6.2.2. Organization of mechanical work squads

When it is necessary to fallow hard soil or to do many works at the one time, the farm machines designed for such particular types of work ought to be employed. The operation of such a machine requires special knowledge

and skill. If there is only one person specially trained in the operation of the machine, the machine will be left idle when the operator cannot work due to illness or other reasons. Therefore, it is necessary that several persons skilled in the operation of farm machinery form a squad so that they co-operate with each other to carry out the work. This squad will be formed with several young farmers quick to absorb mechanical knowledge and physically fitted for such machine operation. Such persons will be selected from among the young people of all communities and given training on a mixed farm. Any type of work such as weeding which require many assisting workers will be carried out efficiently through the co-operative operation by the mutual assistance squad and the machine operators squad.

There can be several squads specializing in the operation of specific machines or the same squad can handle several different kinds of machinery. What is important is to make it clear who is responsible for the operation of the machines and who is responsible for the maintenance and storage of them and how to share the repair cost when the machines are damaged. Normally, the farmer will pay a sum in proportion to the amount of work that has been done for him. The machines that have been supplied by the Government can be owned collectively by the squad but it is considered more advisable that such machines are owned by the agricultural co-operative society and the machine operators squad pay the rent to use the machine. The farm machinery to be supplied for this plan most likely comprise 35 power tillers, 50 power weeders, 10 power threshers and 5 corn shellers. In introducing the farm machinery it will be necessary to give due consideration to the use of the cattle for farming that have been kept. Such draught animals are so useful and economical that they ought to be used for some types of work such as puddling or stamping. It is not a wise policy to replace the animals with machinery all at once.

6.2.3. The establishment of a small-scaled multi-purpose agricultural co-operative society

a) Functions

At the present stage of development, as previously mentioned, it is essential that the basic unit of the agricultural co-operative society is on a scale corresponding as close as possible to the size of the economic sphere surrounding the settlers and the radius of their everyday activities. The P.M.A. is already in existence, making reasonable activities expected from it. However, in order to promote further the community development, a plan is made for the formation of a small-scaled agricultural co-operative society whose sphere of activity covers mainly the four communities receiving water supply from the Pakhanjore Tank. The proposed society is now tentatively called the Pakhanjore Agricultural Multi-purpose Society (PAMS).

The PAMS will make extensive activities to meet the needs of the settlers in both farm management and everyday life. The society will be provided with various kinds of farm machinery to lease them out to the above-mentioned machine operators squads. It also will have a rice mill available for use by the settlers and so the farmers' wives are free from such drudgery as rice hulling and polishing. Its many-sided activities will include the supply of daily necessities, various farming materials, seeds and so forth to the settlers. As the farm production increase, the marketing of farm products will be one of its important tasks and it will become necessary for the society to act as a bank for the settlers so that the income from the sales of their products are kept in their saving accounts.

b) Scope of activity

If the PAMS is a fully perform its functions as mentioned above, it will become necessary for it to have some full-time staff members and its office and other facilities. In order that these things are made possible for the PAMS, a scope of its activity must be defined.

According to the farm management plan in the Pakhanjore Community Development Project, the gross agricultural output of the four communities combined is estimated to expand to approximately 19.7 lakhs of rupees in

five years or about three times as much as the present 6.6 lakhs of rupees. Even if the consumption of the farm crops by the settlers themselves is assumed to increase by 20 percent over the present level, the rest of them to be placed on the market will amount to somewhere around 14.9 lakhs of rupees in market value or about 4.4 times as much as the present 3.4 lakhs of rupees. (Refer to "Income and Expenditure of the Average Farm Household") The weekly bazaar which is a place of trading and also a place of society and recreation to the settlers is indispensable in their life. Such being the case, the existing bazaar will be continued in its present size and the marketing of the farm products which will increase beyond the capacity of the bazaar will be handled by the PAMS. Then the PAMS will be handling goods amounting to about 11.5 lakhs of rupees in value. If it undertakes other works such as the supply of agricultural productive materials and necessities of life, the management of farm machinery for collective use and also the banking business (a portion of sales of farm products not immediately needed will be deposited in the settlers' saving accounts and if possible the cooperative society will manage the government loans to the settlers on behalf of the Government), the total volume of business handled by the society will amount to about 28.3 lakhs of rupees as shown on Table 6.2.2. (some extra sum will be added to this figure if the use of collective facilities and the output of agricultural industry are taken into account). Assuming the marketing and purchasing commissions to be 3 percent and the banking business commissions to be 1 percent, the cooperative society will earn 68,000 rupees or more from these operations. If this magnitude of business can be ensured for the PAMS, it will be able to employ full-time staff members of five or so to manage the business affairs so that it can continue its activities as an agricultural cooperative society.

Table 6.2.3-1 The Regional Economy and the Agricultural Co-operative Activities

(Unit: rupee)

Classification	Present		Future	
	Total	For the agricultural co-operative society	Total	For the agricultural co-operative society
Sales of farm products	340.4	13.8	1,492.8	1,152.8
Purchases of productive materials	38.5	11.8	682.5	519.5
Purchases of necessities of life	300.6	-	745.0	320.0
(Breakdown of purchases of productive materials)				
Fertilizers	18.4	11.8	271.0	271.0
Agricultural chemicals	5.5	-	135.5	135.5
Farm applicances and machinery	6.8	-	113.0	113.0
Fuels	-	-	50.0	50.0
Others	8.7	-	113.0	50.0
(Breakdown of purchases of necessities of life)				
Seasonings and the like	200.2	-	350.0	100.0
Clothing	42.8	-	150.0	50.0
Articles of daily use	38.0	-	120.0	70.0
Others	19.7	-	125.0	100.0

Table 6.2.3-2 The Magnitude of Business of P.A.M.S.

(Pakhanjore Agricultural Multi-purpose Cooperative Society - Tentatively named)

		Business scale	Commission rate	Operational scale	Remarks
		rupees	%	rupees	
Output	Marketing	1,153,000	3.0	34,590	
	Purchasing	840,000	3.0	25,200	
	1) Agricultural productive materials	520,000	3.0	15,600	
	2) Necessities of life	320,000	3.0	9,600	
	Facilities for collective use	α		α	Income from leasing power tillers, weeding machines,etc.
	Agricultural village industry	α		α	Income from processing operations such as rice mill, oil mill, rope-making, etc.
	Banking business	836,000	1.0	8,360	
	1) Government funds	536,000	1.0	5,360	Commissions for the custody of government funds
	2) Funds from affiliates	300,000	1.0	3,000	
Total of output and input		2,829,000 + α	-	68,150 + α	
Input	Wage payment to employees	5 persons	500 rupees a month	30,000	
	Others	-	-	38,150	

c) Management and operation

What was discussed previously in a) and b) is a mere example to illustrate what the proposed agricultural multi-purpose cooperative society is. Now it has become pretty sure that even a group of four communities with about 230 households in total can organize and maintain its agricultural cooperative society. The next question is how to manage and operate such organization by the settlers themselves.

First, the agricultural cooperative society should be established close to the settlers so that they may be encouraged to have an enthusiasm to make full use of the society for the betterment of their farm management and everyday life. It will take a long time if you wait for such a situation to arise spontaneously. So, it will be necessary to educate the settlers on the merits of the agricultural cooperative society. For this purpose a favorable opportunity will be provided by the training of the farmers constituting the backbone of the settlers on Mixed Farm.

Next, the directors of the agricultural cooperative society must be elected by the settlers from among themselves. The elected directors of the society will make plans for the management and operation and carry them out with the approval obtained at the general meeting of the members of the society. All fundamentally important matters concerning the management and operation of the society must be decided after deliberation and voting at the general meeting. The next important matters will be decided at the meeting of directors. Not much important matters will be left to the discretion of the responsible staff members of the society.

The operational expenses of the society in its first years will be financed by the initial contribution of the members but from the second year it must depend on the commissions received by the society from the users of its services. The financial burden on the members should be restricted to the contributions they make at the time of admission into the society. It is needless to say that when the need has arisen for

expanding the scope of business of the society the members will be required to make additional contributions to raise the required fund. If any surplus is left after deducting all necessary expenses from the business income, it will be divided among the members in proportion to their use of the services of the society or be set aside as a fund for future expansion of the business of the society or for the education of the members.

In the beginning some difficulties will be experienced when the agricultural cooperative society is managed and operated by the settlers on their own. This being so, pertinent advices, guidances and assistance of the related organization will be very important for the successful operation of the society.

6.3. The farmers' Cooperative Society Consciousness at the Present Time

Speaking briefly, the farmers' cooperative society consciousness has not yet developed to a high degree. There are several reasons for this. First, the farm production is still on such a small scale and the farm household economy is on such a low level that there is presently little actual necessity for doing something by organizing an agricultural cooperative society. Another reason is that the merchandise economy has not yet advanced to such a degree that the evils such as the intermediate exploitation by wicked traders are felt keenly. However, the settlers seems to be growing increasingly aware of the necessity of their cooperative society. Their growing awareness of the necessity of an agricultural cooperative society is reflected in what they said. For instance, some settlers expressed their desire to have a cooperative society to given them a loan of money to cover their living expenses when they have no cash. Presently they have to buy on credit their daily necessities from the permanent shops at the bazaar and make payments (about 20 percent more than the prices at the time of purchase) in the autumnal season of harvet. Some people said they wanted to increase output of their farms

by collectively using farm machines with their brothers and friends. These opinions were the most typical of what we had heard from the settlers. We also heard an opinion that the farm products would be sold at much higher prices if they can be delivered to the large market (Raipur). We asked the settlers a question as to what they expected most from the agricultural cooperative organization and most of them answered unanimously they wanted to sell their products at proper market prices and purchase goods at reasonably low prices. Most of the settlers undoubtedly have a certain degree of awareness of the usefulness of an agricultural cooperative society. But they still do not seems to have reached the stage where they feel keenly the necessity of such organization. "The idea of the agricultural cooperative society is very good all right but we have so far managed to get along somehow without it and we are still doing so. But it would be better to have it in the future". This seemed to be the average opinion of the settlers. As their farm production actually increases considerably in the future, such a negative way of thinking will change to a very positive one and the time for such a change is likely to come soon.

6.4. Conceivable farm Village Industry

At present there is virtually no farm work during about two-third of the year and there is no opportunity to engage themselves in any side job except the work on the dam site. Women do not go out to work on the farm and stay at home to manage domestic affairs but there is not so much work as to keep them busy all day long. Even when irrigation water become available to make possible the cultivation of crops during the dry season in the near future, the settlers will have considerable time left after doing their farm work. If such surplus labor is used productively, the living conditions of the settlers will be improved more rapidly.

Presently, the farm crops produced in this area are delivered unprocessed to distant markets. If these farm products are processed to some degree by the settlers themselves and then delivered to the markets,

it will increase the market value of their products and make productive use of their surplus labor. This would really be killing two birds with one stone.

Farm village industry is well worth considering as good solution to the above two problems.

The following kinds of farm village industry are considered recommendable for this area.

1) Rice mill
2) Oil mill
3) Rope-making
4) Manufacture of jute bags
5) Manufacture of starch
6) Manufacture of canned fruits, green peas, etc.
7) Others

There is already erected a rice mill at Kapusi and a similar installation will be needed at Pakhanjore, too, as the production of rice increases in this area. The oil mill is a facility for extracting oils from the seeds of sesame and rape that are cultivated in this area. The production of sesame and rape seeds in this area will increase further owing to the introduction of new varieties of these plants. The oil mill will greatly help increase the market value of these products and moreover increase the supply of edible oils for the settlers to improve their diets. 3) and 4) are the manufacturing of products with increased commercial value out of Kenaf which is presently shipped out roughly bundled after being barked and dried. For the rope-making, it will be desirable to introduce a machine capable of making rope from rice straws. 4) is the manufacturing of jute bags that are generally used for packing grains. This will be greatly beneficial for the settlers who have to purchase jute bags for delivering their products to the market. 5) is the manufacturing of starch from the maize and potatoes which have been shipped out unprocessed. Starch can be sold at high and stabilized prices. 6) is the

canning of fruits and green peas peculiar to this district so that they may last long. 7) as for the others, there must be some work in which the nimble hands of women can be used effectively.

Whatever industry is adopted, it is necessary to make sufficient preparations in advance such as careful market research, technical studies and completion of efficient management arrangements because there is not much instances of such farm village industry in other districts. Since special skills are required, it will also be an important problem how to recruit and train such workers. For the introduction of the facilities except the rice mill, it is considered necessary to start full-scale operation after passing an experimental stage. We think that the types of industry described in 1), 2) and 3) can be introduced at the present moment. It is an important problem where these industrial facilities will be located and who will be in charge of the management and operation of them. For it is considered difficult to manage such industrial operations profitably without some management sense and marketing knowledge and ability. Such being the case, it is necessary that such industrial facilities are installed in Mixed Farm in the first several years in order to acquire necessary technical and management knowledge and skill.

They will be transferred to the agricultural cooperative society only after sufficient experiences have been gained and it has been ascertained that they will be profitably operated by the settlers. The farm village industry, closely related with the marketing activities of the agricultural cooperative society, is expected to grow steadily.

Planned Installation of Rice-polishing Machines, Oil Presses and Rope-Making machines

Taking into consideration the actual state of things in the farm villages and the progress of the development program, we have chosen the type of rice-polishing machine which is mainly aimed at saving the labor for polishing the rice for the settlers' own consumption and has a surplus

capacity for polishing rice for the villages in the vicinity.

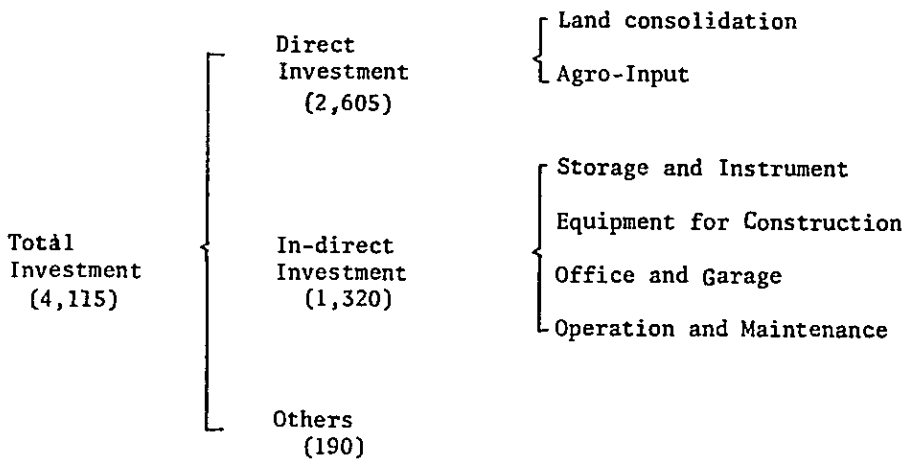
The oil press will be the type which combines the functions of seed crasher, oil press and oil filter and is capable of meeting the needs of the settlers' own and also of the neighboring villages.

As for the rope-making machine, the type that is capable of making ropes ranging from 1/16 in. to 1/4 in. in diameter from rice straws and jute.

Chapter 7. Cost Estimation

Chapter 7 Cost estimation

Cost-estimation of this project has been done in each category of investment as follows.



* Unit = 1,000 Rs.

The result of estimation is summarized as follows:

(Unit=1,000 Rs.)

Kind of Investment	Local-Currency Component	Foreign-Exchange Component	Total
Direct Investment	1,230	1,375	2,605
Indirect Investment	310	1,010	1,320
Other Investment	30	160	190
Total Investment	1,570	2,545	4,115

Remarks: Cost estimation is based on "SCHEDULE OF RATES DANDAKARANYA PROJECT IN FORCE FROM 15-11-1963 and Japanese specification is adoped for construction equipment.

Table 7-1 Cost Estimation

(unit = 1,000 Rs)

Item	Description	Total Cost	Currency Component		Remarks
			Foreign	Domestic	
Irrigation Works	Renovation of shape & gradient canal structures, Measuring facility, Reservoir (spillway) Irrigation facility for paddy and upland	930	310	620	See Table 7-2
Land Consolidation	Land Shaping, Field arrangement, Road, Bridge, Drainage, etc.	855	245	610	See Table 7-2
	Sub-Total	1,785	555	1,230	
Agro. Initial-Input	Agricultural Machinery & instrument:	430	430	-	
	Fertilizer:	270	270	-	
	Chemicals & Seeds	120	120	-	
	Sub-Total	820	820	-	
Better Living	Farm stead drainage:	10	-	10	
	Wireless information service	120	120	-	
Farmer Cooperative	Prefab storage, Oil mill, Rice mill, Rope making machine, Building:	210	160	50	
	Vehicles:	80	80	-	
Construction Equipment		650	650	-	
Operation	Runing expence, Maintenance	250	-	250	
	Sub-Total	1,320	1,010	310	
Miscellaneous	Inland transportation and Others	50	20	30	
	Ship transportation	140	140	-	
	Sub-Total	190	160	30	
	Total	4,115	2,545	1,570	

Table 7-2 Estimates of Direct Investment Cost

Item	Cost (Rs)	Currency Component (Rs)		Remarks
		Foreign	Domestic	
1. Renovation of Reservoir	122,690	1,880	120,810	(1,883) 120,807 x 100%
2. Irrigation Main Canals	269,230	44,500	224,730	(44,501) 224,727 x 100%
3. Irrigation Branch Canals	295,410	41,540	253,870	(16,146) 98,684 x 257.26% 1/
4. Pumps & Pipe Lines	244,490	221,790	22,700	(221,790) 22,696 x 100%
5. Drainage Canals	19,600	960	18,640	(372) 7,244 x 257.26%
6. Farm Roads	147,450	35,190	112,260	(13,678) 43,638 x 257.26%
7. Field Arrangement	687,050	206,630	480,420	(80,320) 186,744 x 257.26%
Total (Item 1 - 7)	1,785,920	552,490	1,233,430	

Note 1/ 257.26% = 100 x $\frac{\text{Benefited area by whole Pakhanjore Project ; 638 acre}}{\text{Low Land area in P.V. 13 \& P.V. 14 ; 284 acre}}$

Chapter 8. Economic Justification of the Project

Chapter 8. Economic Justification of the Project

8.1. Introduction

This project is a Pakhanjore community development programme which is including land consolidation for all over Pakhanjore area. The evaluation criteria of this project is based on Mixed Farm Improvement Plan.

8.2. Benefits from Direct Investment
(Benefits accruing to the immediate project-area)

The balance between the net-profit being raised from agricultural production on 638 acres of cultivated land which is dotted along the Paralkote district main road in Pakhanjore, so called P.V.13, P.V.14, P.V.42, PV43 and Traibal area, and the net-profit available therefrom upon completion of the project will stand as benefit attributable to the direct investment under this project Setion 2 see Chapter 3.

8.3. Economicality of the Project

Economicality of the direct-investment part of the project will be examined here on the basis of socio-economic survey conducted in the year proceeding to commencement of the project (that is 1973)

8.3.1. Annual Incremental Net Benefit

Improvement-effects of the project on the productivity-increase are supposed to work through annual incremental process until it reaches at specific turn-over at the end of the fifth year. Assuming the economic useful life as 30 years and annual interest-rute at 6%, an annual incremental net benefit will be calculated at Rs 598,290.

Year	Net Incremental Profit		Its Present Worth
1	Rupee	0	0
2	Rupees	181,000	161,090
3	"	313,000	262,795
4	"	542,000	429,318
5	"	716,834	
⋮		⋮	7,382,028
30		716,834	
	Total		8,235,231

Annual incremental profit = Rs 8,235,231 x 0.07265 = Rs 598,290
(0.07265 = Capital-recovery factor)

8.3.2. Annual Cost and Expenditure

The above-calculated profit is due to direct-investments meant for land consolidation and initial input for betterment of farm-management in the project-area. The investment for betterment of farm-management is being estimated in the annual production-cost when calculated annual incremental net-profit, hence the land consolidation investment alone stands as annual cost involved in our estimation.

At the assumed annual interest-rate of 6% the total of the annual costs for land consolidation works will come to Rs 129,993.

Year	Land Consolidation Works Cost (including the interest during construction period)	Its Present Worth
1	1,003,732	946,921
2	946,495	842,381
Total	1,950,227	1,789,302

Annual cost, Rs 1,789,302 x 0.07265 = 129,993
(0.07265 = capital-recovery factor)

8.3.3. Annual Operation Cost

For maintenance and operation cost of the structures newly built under the project, an incremental cost of Rs 52,888 will be required, in addition to Rs 2,833 as for depreciation or replacement-cost of pumps (supposing their economic useful life lasts for 15 years)

Replacement-cost of pumps	= Rs 99,130	
Present-worth of pumps	= Rs 39,018	(Rs 99,130 x 0.3936)
Annual-cost of pumps	= Rs 2,833	(Rs 39,018 x 0.07265)

8.3.4. Benefit-cost Ratio

(1)	Annual incremental benefit		Rs 598,290
(2)	Annual Cost,	Construction cost	Rs 129,993
		O & M cost	Rs 55,726
		Total	Rs 185,719

(3) Benefit-cost ratio

$$\frac{598,290}{185,719} = 3.22$$

VOLUME II. FINAL DESIGN FOR PAKHANJORE COMMUNITY

Chapter 9. Outline of the Project

Chapter 9. General Description of Final Design

9-1. Objective of the Project

The villagers in Pakhanjore region, after entering into the under reclaimed jungle, have conquered many difficulties with big efforts, which they were confronted with in their reclaiming works as settlers, and at last succeeded in attaining their first object to stabilize their livings as independent farmers.

However, it is further required to reform the fluctuation of their land and improve thier farming technique, if they expect more stabilized farm management passing out of the existing farming system, in which only single cropping is performed in the rainy season. Therefore, the village developing scheme including the land consolidation works will be performed at P.V. 13 and P.V. 14, through which the main irrigation canals run from Pakhanjore Tank.

In another words, the target of the project is to bring the villagers more stabilized farm management and higher level of living by training them to increase their agricultural products.

As to Up Land, lift irrigation will be introduced to the farmers, including the Traibal to improve their farming.

It is expected that the project will be successfully accomplished, and it will work as one of the demonstrations for new farming against many people who live in the vicinity of this project area.

9-2. Basic Conception of the Project

1) This village developing scheme will be carried out in the two villages,

PV.13 and PV. 14, which locate in the catchment area of the right ba k of the main irrigation canal from Pakhanjore Tank, and whose blocks of cultivable lands are relatively large.

2) Farm management planning taking into account the double cropping, including paddy rice, will be performed.

3) The existing main canal from Pakhanjore Tank and the others will be adjusted if required.

4) To increase the available storage capacities of Pakhanjore Tank, the spillway will be improved.

5) Land consolidation works, such as land readjustment, land leveling and improvement on construction of irrigation & drainage canals and farm roads will be carried out.

6) Training for leveling up the villagers' living will be conducted in P.V. 13 and P.V. 14.

9.3. Scales of the Project

Followings are determined as the scale of this project.

1) Village P.V. 13 P.V. 14

2) Area 248 acres in the right bank area of the main irrigation canal from Pakhanjore Tank, and 124 acres, 6 blocks in the left bank of the canal.

3) Construction Period The Government of Japan is ready to cooperate for five years about the followings; improvement of farm management, land consolidation works and leveling up of the villagers' living.

4) Project Cost

Total project cost:	$3,020 \times 10^3$ Rs
Domestic Currency:	$1,045 \times 10^3$ Rs
Foreign Currency:	$1,975 \times 10^3$ Rs

5) Major Land Consolidation Works

Farm Land Consolidation P.V. 13, 14:	248 acres
Improvement of Main Irrigation Canal:	9,798.5 m
Pumping Facilities:	6 places
Improvement of Pakhanjore Spillway:	1 place

Chapter 10. Farm Management Practical Plan

Chapter 10 Farm Management Practical Plan

Table 10-1 Cropping Plans and Estimated Benefits in P.V. 13

Kharif

Crops	Cropping Ratio	Cropping Area	Yield per Acre	Unit Price	Benefit per Acre	Total Yield	Total Benefit
Paddy	52.7 %	143 acres	50 maund	24 rupees	1,200 rupees	7,150 maund	171,600 rupees
Maize	8.8	23	40	20	800	920	18,400
Kenaf	17.5	47	14	30	420	658	19,740
Sesame (Til)	21.0	57	6	75	450	342	25,650
Total	100.0	270					235,390

Rabi

Crops	Cropping Ratio	Cropping Area	Yield per Acre	Unit Price	Benefit per Acre	Total Yield	Total Benefit
Paddy	18 %	23 acres	60 maund	24 rupees	1,440 rupees	1,380 maund	33,120 rupees
Wheat	35	46	40	40	1,660	1,840	73,600
Mustard	26	33	20	50	1,000	660	33,000
Potato	9	12	150	25	3,750	1,800	45,000
	12	16	10	30	300	160	4,800
Total	100	130					189,520

Table 10-2 Production Materials (Fertilizer, Agricultural Chemicals, Weedicide and Seed) in P.V. 1% for Kharif

Crops	Cropping Acreage	Fertilizer				Agricultural chemicals			Weedicide			Seed	
		Contents of Fertilizer	Article	Quantity per acre	Quantity per acreage	Article	Quantity per acre	Quantity per acreage	Article	Quantity per acre	Quantity per acreage		
	acre			kg	kg								
Paddy	143	N=45	Potassium Sulfate.583	100	14,300	Ruberon. Tablet form	20 tablet	2,860 tablet				Padma	950 kg
		P=30	P.C P Urea Compound	80	11,440	Buraesu Dust form	12 kg	1,716 kg				J-10	950 kg
		K=15	Urea	40	5,720	Benapon' Dust form	15 kg	2,145 kg				IR-8	950 kg
						E.P.N Dust form	12 kg	1,716 kg	-	-	-		
Hy Maize	23	N=45	Ammonium Sulfate	100	2,300	E P.V.. Dust form	12 kg	256 kg	Linuron	600 g	13,800 g	Hy. Gangalol	138 kg
		P=30	Supperphosphate	180	4,140								
		K=15	Urea	50	1,150								
			Potassium Chloride	25	575								
Kenaf	47	N=10	Ammonium Sulfate	50	2,350							AMU-1	94 kg
		P=15	Supperphosphate	100	4,700								
		K=10	Potassium Chloride	20	940								
Til	57	N=10	Ammonium Sulfate	50	2,850	Ekachin: Liquid form	150 cc	8,550 cc	-	-	-	T-128	114 kg
		P=10	Supperphosphate	70	3,990								

Table 10-3 Production Materials (Fertilizer, Agricultural Chemicals, Weedicide and Seed) in P.V. 13 for Kharif

Crops	Cropping Acreage	Fertilizer				Agricultural chemicals			Weedicide			Seed	
		Contents of Fertilizer	Article	Quantity per acre	Quantity per acreage	Article	Quantity per acre	Quanity per acreage	Article	Quantity per acre	Quantity per acreage		
	acre			kg	kg								
Paddy	23	N=45	Potassium Sulfate 585	100	2,300	Ruberon: Table form	20 tablet	460 tablet				Padma	230 kg
		P=30	P.C.P. Urea Compund	80	1,840	Buraesu. Dust form	12 kg	276 kg				J-10	230 kg
		K=15	Urea	40	920	Denapon: Dust form	15 kg	315 kg					
						E.P.N : Dust form	12 kg	276 kg					
Wheat	46	N=50	Potassium Sulfate 585	200	9,200	E.M.P.	20 tablet	920 tablet				S-308	276 kg
		P=30	Urea	50	2,300	(Ruberon)						S-227	276 kg
		K=15											
Mustard	33	N=10	Ammonium Sulfate	50	1,650	Ekachin' Liquid form	600 cc	19,800 cc				B-85	25 kg
		P=16	Supperphosphate	100	3,300							T-12	25 kg
		K=10	Potassium Chloride	20	660								
Potato	12	N=45	I. B. Compund 604	200	2,400	Daijiston Dust form	8 kg	96 kg				Kufrisandri	4,000 kg
		P=30	Urea	30	360	Erusun: Liquid form	600 cc	7,200 cc					
		K=15	Supperphosphate	70	840							Milatry	4,000 kg
Pulses	16	N=10	Ammonium Sulfate	50	800							Mung	160 kg
		P=20	Supperphosphate	125	2,000	-	-	-					

Table 10-4 Cropping Plans and Estimated Benefits in P.V. 14

Kharif

Crops	Cropping Ratio	Cropping Area	Yield per Acre	Unit Price	Benefit per Acre	Total Yield	Total Benefit
Paddy	53 %	135 acres	50 maund	24 rupees	1,200 rupees	6,750 maund	162,000 rupees
Sesame (Til)	18	47	6	75	450	282	21,150
Mustard	18	47	14	30	420	658	19,740
Maize	8	21	40	20	800	840	16,800
Pulses	3	8	10	30	300	80	2,400
Total		258					222,090

Rabi

Crops	Cropping Ratio	Cropping Area	Yield per Acre	Unit Price	Benefit per Acre	Total Yield	Total Benefit
Paddy	18 %	31 acres	60 maund	24 rupees	1,440 rupees	1,860 maund	44,640 rupees
Weat	35	62	40	40	1,600	2,480	99,200
Mustard	35	62	20	50	1,000	1,240	62,000
Potato	12	22	150	25	3,750	3,300	82,500
Total		177					288,340

Table 10-5 Production Materials (Fertilizer, Agricultural Chemicals, Weedicide and Seed) in PV 14 for Kharif

Crops	Cropping Acreage	Fertilizer				Agricultural chemicals			Weedicide			Seed	
		Contents of Fertilizer	Article	Quantity per acre	Quantity per acreage	Article	Quantity per acre	Quantity per acreage	Article	Quantity per acre	Quantity per acreage		
	acre			kg	kg								
Paddy	135	N=45	Potassium Sulfate 585	100	13,500	Ruberon: Tablet form	20tablet	2,700tablet				Padma	900 kg
		P=30	P.C.P. Urea Compound	80	10,800	Buraesu. Dust form	12 kg	1,620 kg				J-10	900 kg
		K=15	Urea	40	5,400	Denapon: Dust form	15 kg	2,000 kg				IR-8	900 kg
						E.P.N.: Dust form	12 kg	1,620 kg					
Til	47	N=10	Ammonium Sulfate	50	2,350	Ekachin: Liquid form	150 cc	7,000 cc				T-128	92 kg
		P=10	Superphosphate	70	3,290								
Mustard	47	N=10	Ammonium Sulfate	50	2,350							AHU-1	94 kg
		P=15	Superphosphate	100	4,700								
		K=10	Potassium Chloride	20	940								
Maize	21	N=45	Ammonium Sulfate	100	2,100	E.P N: Dust form	12 kg	252 kg	Linuron	600 g	12,600 g	Hy Gangalol	126 kg
		P=30	Superphosphate	180	3,780								
		K=15	Urea	50	1,050								
			Potassium Chloride	25	425								
Pulse	8	N=10	Ammonium Sulfate	50	400							Mung	80 kg
		P=20	Superphosphate	125	1,000								

Table 10-6 Production Materials (Fertilizer, Agricultural Chemicals, Weedicide and Seed) in PV 14 for Kharif

Crops	Cropping Acreage	Fertilizer				Agricultural chemicals			Weedicide			Seed	
		Contents of Fertilizer	Article	Quantity per acre	Quantity per acreage	Article	Quantity per acre	Quantity per acreage	Article	Quantity per acre	Quantity per acreage		
	acre			kg	kg								
Paddy	31	N=45	Potassium Sulfate 585	100	3,100	Ruberon: Tablet form	20 tablet	620 tablet				Padma	310 kg
		P=30	P C.P. Urea Compound	80	2,480	Buraesu Dust form	12 kg	372 kg				J-10	310 kg
		K=15	Urea	40	1,240	Denapon Dust form	15 kg	465 kg					
						E P N. Dust form	12 kg	372 kg					
Wheat	62	N=50	Potassium Sulfate	200	12,400	E.P.N.: Form	20tablet	1,240tablet				S-308	372 kg
		P=30	Urea	50	3,100	(Ruberon)						S-227	372 kg
		K=15											
Mustard	62	N=10	Ammonium Sulfate	50	3,100	Ekachin Liquid form	400 cc	24,800 cc				B-85	46 kg
		P=10	Superphosphate	100	6,200							T-12	46 kg
		K=10	Potassium Chloride	20	1,240								
Potato	22	N=50	I.B. Compound 604	200	4,400	Daijiston. Dust form	8 kg	176 kg				Kufrisanduri	7,900 kg
		P=30	Urea	30	660	Erusan. Liquid form	600 cc	13,200 cc				Milatry	7,900 kg
		K=15	Superphosphate	70	1,540								

Chapter 11. Final Design of Land Consolidation

Chapter 11. Final Design of Land Consolidation

Land Consolidation

Land consolidation works, such as land readjustment, land leveling, improvement or construction of farm roads, irrigation and drainage canals will be carried out in the cultivable land of 248 acreas in P.V. 13 and P.V. 14.

The standard scale of one plot is 0.2 ha (100 m x 20 m) whose long sides go along the contours, and short sides along the irrigation and drainage canals.

The irrigation canals are to be constructed with the U type flume made of concrete. The total length of them is 7,688 m as shown in Table 11-1.

Table 11-1 Length of Irrigation Canal

Type	Width of Flume	Length (m)
A	350	1,943.5
B	250	5,744.5
Total		7,688.0

The drainage canals have the side slope of 1 : 1, and drop works will be provided to them if required. Total length of the drainage canals is 1,691 m.

Two types of farm roads, namely, the main roads of 6.0 m width and the access roads of 3.0 m width will be constructed. Total length of those roads are shown in Table 11-2.

Table 11-2 Length of Farm Road

Farm Road	Length (m)
Main Road	3,177
Access Road	5,951

Improvement of Main Irrigation Canal

Improvement of the main irrigation canals will carried out as following Table 11-3 depending upon the basic objective described in Chapter 4.2.

Table 11-3 Outline of Improvement of Main Irrigation Canals

Major Works	Unit	Quantities
Improvement of cross section	m	9,798.5
Siphon transition	Place	12
Culvert		
Constructed	ditto	1
Improved	ditto	5
Aqueduct	ditto	2
Measuring gauge	ditto	1
Check gate	ditto	7
Inlet works	ditto	12
Spillway	ditto	4
Diversion works	ditto	34
Bridges	ditto	2
Canal lining	m	1,245.6
Service road	m	9,792.0

Pumping Facilities

Irrigation water will be pumped up from the main irrigation canals to the six blocks which consist of Up Land. Table 11-4 shows the required feature of the pumps.

Table 11-4 The Required Feature of Pumps

Stations	Area (acrea)	Pump Capacity (cu.m/sec)	Total Head
No.1	25.23	0.028	15.25
No.2	33.27	0.038	9.95
No.3	10.86	0.012	11.34
No.4	11.38	0.013	8.25
No.5	17.78	0.020	7.49
No.6	30.49	0.034	8.80

Improvement of Pakhanjore Spillway

The existing Pakhanjore Tank has available storage capacity of 2,560 x 10^3 cu.m at the designed maximum full water level of 306.32 m (1,005 feet) (Storage capacity of 2,670 x 10^3 at the designed full water level of 306.32 m - Dead water capacity of 110 x 10^3 cu.m at the dead water level of 300.5 m). But the shortage water of 816 x 10^3 cu.m equivalent to 32% of the existing available water is estimated in the calculation of water balance when introduction of the double cropping is taken into account. So the method of raising the full water level of this tank to the elevation of 306.78 m (1,006.5 feet) by improving the spillway will be carried out for solving the some portion of these water shortages.

In this case, the available storage capacity of 3,070 x 10^3 cu.m can be expected, but futher more shortage at 572 x 10^3 cu.m through the designed year equivalent to 19% of the available storage capacity is estimated.

This shortage water, in future, has to rely on the discharge from the Paralkote dam under construction.

Dimensions of improved spillway is given as follows;

Design full water level:	306.78 m (1,006.5 feet)
Dead water level:	300.50 m (1,001.0 feet)
Design maximum storage capacity:	3,180 x 10^3 cu.m
Dead water capacity:	110 x 10^3 cu.m
Available storage capacity:	3,070 x 10^3 cu.m
Overflow length per one section:	2.00 m
Width of pier:	0.40 m
Height of pier:	1.10 m
Number of Overflow section:	42.0
Total overflow length:	84.0 m

Chapter 12. Practical Plan for Improvement of Living Conditions and Consolidation of Cooperative Association.

Chapter 12. Practical Plan for Improvement of Living Conditions and Consolidation of Cooperative Association

12.1 Practical Plan for Improvement of Living Conditions

It is planned to dig a main waterway for draining the residential quarter and branch waterways reaching the settlers' houses for the draining thereof, both of which are especially necessary during the rainy season. For ensuring speeden communications and transfer to information is a telegraphic transmitting station built in the center of the area and each house is equipped with a receiver.

Table 12.1-1 Item Required for Improvement of Living Conditions

	Item	Unit Price (in thousand yen)	Quantity	Amount (in thousand yen)	Remarks
I.	Waterways of residential quater			500	
II.	Wireless Information Service				
	Receiver	5	100	500	
	Central Transmitting Station Equipment	5,200	one set	5,200	
	Total			6,200	

12.2 Practical Plan for Consolidation of Cooperative Association

Three prefabricated warehouses are to be built in order to keep the farm products until they sell at the highest price. Each building, which has a capacity of 323 cubic meters, is capable of storing 210 cubic meters of products assuming its effective storage capacity at 65% of the whole storage capacity. If a half of the rice plants grown each year are threshed soon after being cut and a half of the rice thus produced is stored for sale in the rainy season of the year after five years, an effective storage capacity of 1,250 cubic meters is required. The total effective capacity of the three existing warehouses is only 630 cubic meters or about half of the capacity required. It is necessary that the farmers themselves make up the deficiency.

A building having an approximate area of 50 square meters is to be built adjacent to the Association's office. This building will serve as a workshop and also as a shed housing the farming implements and vehicles for the common use of the farmers. The office building covers an area of about 40 square meters, and is equipped with printing and calculating machines as necessary for the execution of clerical work.

The Association also requires two small trucks for delivering the farm products to nearby markets and also for providing the members of the Association with various kinds of service, a large truck for transporting the products to the markets in distant places, a mobile shop car at which people can buy daily necessities on those days when the bazaar is closed, and a jeep to be used for various kinds of communications.

The facilities and equipment as mentioned above will gradually be introduced in accordance with the establishment and development of management system of the Association and the increase in quantity of the farm products as below-mentioned in the table of the yearly plans.

Table 12.2-1 Facilities and Equipment required for Further Development of Farms

Item	Specification	Unit Price (in thousand yen)	Number Required	Amount (in thousand yen)	Remarks
Prefabricated Warehouse	7.2 m x 18 m lightweight steel framework roofed with type "M" tiles and colored steel plates, and walled with corrugated, colored steel plates	2,600	3	7,800	7.2x18x2.5 =323 m^3
Combined Workshop and Housing Shed	3 k x 5 k reinforced building roofed with #31 colored steel plates and walled with 2.7 mm thick plywood boards	1,050	1	1,050	
Office building	3 k x 4 k reinforced building roofed with #31 colored steel plates and walled with 2.7 mm thick plywood boards	1,000	1	1,000	
Printing Maghine with Materials	one set	50	1	50	
Calculating Machine		100	1	100	
Small Truck	2 t	700	2	1,400	
Large Truck	5 t	700	1	700	
Mobile shop car		800	1	800	
Jeep		700	1	700	
Total				13,600	

Table 12.2-2 Yearly Plans for Further Development of Farms

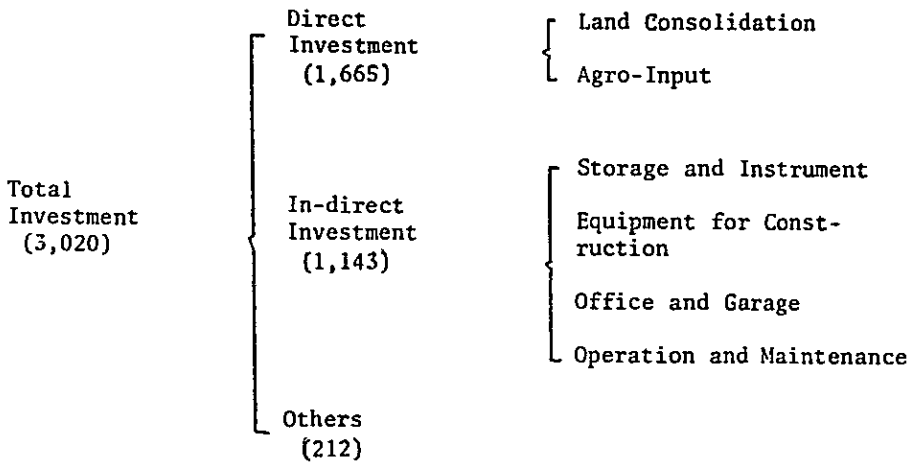
(in thousand yen)

	1st Year		2nd Year		3rd Year		4th Year		5th Year		Total
	No.	Amount	No.	Amount	No.	Amount	No.	Amount	No.	Amount	Amount
Prefabricated Mobile Warehouse					1	2,600	2	5,200			7,800
Combined Workshop and Housing Shed			1	1,050							1,050
Office Building			1	1,000							1,000
Printing Machine with materials			1	50							50
Calculating Machine			1	100							100
Small Truck			2	1,400							1,400
Large Truck					1	700					700
Mobile shop car					1	800					800
Jeep			1	700							700
Total				4,300		4,100		5,200			13,600

Chapter 13. Cost-Estimation

Chapter 13 Cost Estimation

Cost-estimation of this project has been done in each category of investment as follows.



* Unit = 1,000 Rs.

Direct-Investment is meant only for our immedicate project area (248 acres).

Estimation of cost is based on the following terms and conditions:

(1) This project will run for full five years, starting from September 1672 and ending in September 1977.

(2) Principal machinery, equipment and material such as construction machinery pumps, steel materials, wires etc. will be supplied from Japan (foreign exchange component) and local labour, fuel, cement, wooden materials, bricks etc., will be supplied by the Government of India (local currency component).

(3) Works meant for improvement of irrigation drainage facilities will be completed within the first two years.

The result of estimation is summarized as follows:

Kind of Investment	Local-Currency Component	Foregin-Exchange Component	Total
Direct Investment	706	959	1,665
Indirect Investment	298	845	1,143
Other Investment	41	171	212
Total Investment	1,045	1,975	3,020

Remarks: Cost estimation is based on "SCHEDULE OF RATES DANDAKARANYA PROJECT IN FORCE FROM 15-11-1963" and Japanese specification is adoped for construction equipment.

Table 13-1 Cost Estimation

(unit = 1,000 Rs.)

Item	Description	Total Cost	Currency Component		Remarks
			Foreign	Domestic	
Irrigation Works	Renovation of shape & gradient canal structures, Measuring facility, Reservoir (spillway) Irrigation facility for paddy and upland	752	284	468	see Table 13-2
Land Consolidation	Land shaping, Field arrangement, Road, Bridge, Drainage, etc.	332	94	238	see Table 13-2
	Sub-Total	1,084	378	706	
Agro. Initial-Input	Agricultural Machinery & Instrument:	429	429	-	
	Fertilizer:	105	105	-	
	Chemicals & Seeds	47	47	-	
	Sub-Total	581	581	-	
Better Living	Farm stead drainage:	10	-	10	
	Wireless Information service	120	120	-	
Farmer Cooperative	Prefab storage, Oil mill, Rice mill, Rope making machine, Building:	208	160	48	
	Vehicles:	75	75	-	
Construction Equipment		490	490	-	see Table 13-3
Operation	Runing expence, Maintenance	240	-	240	
	Sub-Total	1,143	845	298	
Miscellaneous	Inland Transportation and Others	72	31	41	
	Ship Transportation	140	140	-	
	Sub-Total	212	171	41	
	Total	3,020	1,975	1,045	

Table 13-2 Estimates of Direct Investment Cost

Item	Cost (Rs)	Currency Component (Rs)		Remarks
		Foreign	Domestic	
1. Renovation of Reservoir	64,870	1,000	63,870	(1,883) / 120,807 x 52.87% 1/
2. Irrigation Main Canals	152,140	25,150	126,990	(44,501) / 224,727 x 56.51 2/
3. Irrigation Branch Canals	114,830	16,150	98,680	(16,146) / 98,684 x 100%
4. Pumps & Pipe Lines	99,860	90,180	9,680	(90,184) / 9,676 x 100%
5. Drainage Canals	7,610	370	7,240	(372) / 7,244 x 100%
6. Farm Roads	57,320	13,680	43,640	(13,678) / 43,638 x 100%
7. Field Arrangement	267,060	80,320	186,740	(80,320) / 186,744 x 100%
Total (Item 1 - 7)	763,690	226,850	536,840	
In case that Item 1 & 2 take 100%	938,600	247,080	691,520	
and Item 4 takes 6 pumps & pipe lines	1,083,230	378,690	704,540	

Note ; 1/ 52.87% = 100 x Gross duty of water on P.V. 13 & P.V. 14 ; 0.230 m^3/sec / Gross duty of water on whole Pahkanjore ; 0.435 m^3/sec

2/ 56.51% = 100 x Gross duty of water on P.V. 13 & P.V. 14 ; 0.230 m^3/sec / Gross dury of water on Pakhanjore Main canal ; 0.407 m^3/sec

Table 13-2-1 Total Direct Investment Cost

	Item	Cost (Rs)	Currency Component (Rs)		Remarks
			Foreign	Domestic	
1.	Reservoir (Spillway)	122,690	1,883	120,807	Objected area 638 acre
2-1	Irrigation Main Canals	122,323	16,169	106,154	"
2-2	Syphons & Aqueduct	7,064	-	7,064	"
2-3	Culverts & Bridges	11,188	14	11,174	"
2-4	Measuring Facility	5,046	1,057	3,989	"
2-5	Checks & Spillways	13,050	-	13,050	"
2-6	Diversion Works	66,429	27,261	39,168	"
2-7	Flood Inlet	41,233	-	41,233	"
2-8	Inspection Roads	2,895	-	2,895	"
	Sub-total (2-1 - 8)	269,228	44,501	224,727	
3.	Irrigation Branch Canals	114,830	16,146	98,684	Objected area 248 acre
4-1	Pumps & Pipe Line No.1	51,709	47,607	4,102	Tribal
4-2	" No.2	72,110	65,746	6,364	"
4-3	" No.3	20,807	18,253	2,554	P.V. 42
4-4	" No.4	16,851	14,787	2,064	P.V. 13
4-5	" No.5	33,193	29,859	3,634	P.V. 13
4-6	" No.6	49,516	45,538	3,978	P.V. 13
	Sub-total (4-1 - 4-6)	244,486	221,790	22,696	
	Sub-total (4-4 - 4-6)	99,860	90,184	9,676	
5.	Drainage Canal	7,616	372	7,244	Objected area 248 acre
6.	Farm Roads	57,316	13,678	43,638	"
7.	Field Arrangement	267,064	80,320	186,744	"

Table 13-3 Bill of Quantities for Construction Works

Item	Description	Quantity	Unit	Unit Cost		Total Cost (Rs)	Currency Component		Remarks
				Foreign	Domestic		Foreign	Domestic	
1. Reservoir (Spillway)									
	Excavation	2,480	m^3	0.53	1.24	4,389	1,314	3,075	III-3, 60A-3
	Centering & Shuttering	1,138.3	m^2		6.46	7,353		7,353	V-4
	Cement Concrete 1:5:10	634.55	m^3	0.60	52.34	33,593	381	33,212	IV-1
	Cement Concrete 1:2:4	258.72	m^3	0.60	98.19	25,559	155	25,404	IV-4
	Reinforced Cement Concrete 1:2:4	40.33	m^3	0.60	102.08	4,141	24	4,117	V-1
	M.S. Reincorcement	22,902	kg		1.30	29,773		29,773	V-3
	Steel Works	1,915	kg		1.86	3,562		3,562	XI-2
	Steel Works (M.S. Bars)	648	kg		1.10	713		713	XI-3
	Wooden Stop Logs	11.33	m^3		386.69	4,381		4,381	VIII-4-(b)
	Earth Filling	25	m^3	0.36	1.12	37	9	28	III-1, BD-2 +III-9-(b)
	Ripraps	643.5	m^3		14.28	9,189		9,189	XVII-7
	Total					122,690	1,883	120,807	

Item	Description	Quantity	Unit	Unit Cost		Total Cost	Currency Component		Remarks
				Foreign	Domestic	(Rs)	Foreign	Domestic	
2. Irrigation Main Canals									
2-1 Open Canals									
	Excavation (Rock)	252	m^3	2.37	5.50	1,983	597	1,386	III-5-(a) AMR125, TY62
	Excavation (Earth)	12,520	m^3	0.46	1.08	19,281	5,759	13,522	III-3, BD2
	Earth Filling	27,257	m^3	0.36	1.12	40,341	9,813	30,528	III-1, BD2 +III-9-(b)
	Sodding (Water side)	35,500	m^2		0.21	7,455		7,455	III-29, +III-30x10
	Sodding (Air side)	20,800	m^2		0.21	4,368		4,368	III-29 +III-30x10
	Canal lining (Grouted stone patching)	1,170.3	m^3		41.78	48,895		48,895	XVII-4+ (I-B-9)x150%
	Total					122,323	16,169	106,154	
2-2 Syphons & Aqueduct									
a. Syphons	No.1 Syphon (Masonry)	23.43	m^3		41.79	979		979	VII-3
	No.2 "	26.29	m^3		41.79	1,099		1,099	"
	No.3 "	26.00	m^3		41.79	1,087		1,087	"
	No.4 "	24.30	m^3		41.79	1,015		1,015	"
	No.5 "	24.12	m^3		41.79	1,008		1,008	"
	No.6 "	18.62	m^3		41.79	778		778	"
	Sub-total					5,966		5,966	

Item	Description	Quantity	Unit	Unit Cost		Total Cost (Rs)	Currency Component		Remarks
				Foreign	Domestic		Foreign	Domestic	
b. Aqueduct	Aqueduct (Masonry)	26.28	m^3		41.79	1,098		1,098	VII-3
	Sub-total					1,098		1,098	
	Total					7,064		7,064	
2-3 Culverts & Bridges									
a. Culverts	No.1 Culvert (Masonry)	26.68	m^3		41.79	1,115		1,115	VII-3
	No.2 "	26.58	m^3		41.79	1,111		1,111	"
	No.3 "	26.20	m^3		41.79	1,095		1,095	"
	No.4 "	25.10	m^3		41.79	1,049		1,049	"
	No.5 "	27.18	m^3		41.79	1,136		1,136	"
	No.6 "	29.79	m^3		41.79	1,245		1,245	"
	Concrete pipe ϕ750m/m	5.40	m		38.00	205		205	
	Dismantling Masonry	11.6	m^3		3.62	42		42	XIV-3
	Sub-total					6,998		6,998	
b. No.1 Bridge	Reinforced Cement Concrete 1:2:4	12.24	m^3	0.60	102.08	1,256	7	1,249	V-1
	Centering and Shuttering	48.3	m^2		6.46	312		312	V-4
	M.S.Reinforcement	450	kg		1.30	585		585	V-3
	Sub-total					2,153	7	2,146	

Item	Description	Quantity	Unit	Unit Cost		Total Cost (Rs)	Currency Component		Remarks
				Foreign	Domestic		Foreign	Domestic	
b. No.2 Bridge	Reinforced Cement Concrete 1:2:4	11.52	m^3	0.60	102.08	1,183	7	1,176	V-1
	Centering and Shurttering	45.6	m^2		6.46	295		295	V-4
	M.S. Reinforcement	430	kg		1.30	559		559	V-3
	Sub-total					2,037	7	2,030	
	Total					11,288	14	11,174	
2-4 Measuring Facility									
	Laying Stone	13.93	m^3		41.78	582		582	XVII-4+ (I-B-9)x150%
	Cement Concrete 1:3:6	0.75	m^3	0.60	72.73	55	0	55	IV-3
	Centering and Shuttering	101.9	m^2		6.46	658		658	V-4
	Reinforced Cement Concrete 1:2:4	11.92	m^3	0.60	102.08	1,224	7	1,217	V-1
	M.S. Reinforcement	1,055	kg		1.30	1,372		1,372	V-3
	Measuring Facility	1	set	1,060	105	1,155	1,050	105	Japan Made
	Total					5,046	1,057	3,989	

Item	Description	Quantity	Unit	Unit Cost		Total Cost (Rs)	Currency Component		Remarks
				Foreign	Domestic		Foreign	Domestic	
2-5 Checks & Spillways									
a. Check gates (No.1-No.7)	Masonry	38.74	m^3		41.79	1,619		1,619	VII-3
	Laying Stone	21.45	m^3		41.78	896		896	XVII-4+ (I-B-9)x150%
	Wooden Stop Logs	6.73	m^3		386.69	2,602		2,602	VIII-4-(b)
	Sub-total					5,117		5,117	
b. Spillways (No.1-No.4)	Masonry	48.00	m^3		41.79	2,006		2,006	VII-3
	Laying Stone	141.86	m^3		41.78	5,927		5,927	XVII-4+ (I-B-9)x150%
	Sub-total					7,933		7,933	
	Total					13,050		13,050	
2-6 Diversion Works									
Diversion Works No.1 - No.34									
	Centering and Shuteering	865.6	m^2		6.46	5,592		5,592	V-4
	Reinforced Cement Concrete 1:2:4	62.42	m^3	0.60	102.08	6,409	37	6,372	V-1

Item	Description	Quantity	Unit	Unit Cost		Total Cost	Currency Component		Remarks
				Foreign	Domestic	(Rs)	Foreign	Domestic	
	M.S. Reinforcement	3,290	kg		1.30	4,277		4,277	V-3
	Cement Concrete 1:3:6	39.27	m^3	0.60	72.73	2,880	24	2,856	IV-3
	Cement Mortar 1:3	1.76	m^3		110.89	195		195	I-C-2
	Laying Stone	243.32	m^3		41.78	10,166		10,166	XVII-4+ (I-B-9)x150%
	ϕ250 Manual Sluice Gate	34	Nos	800	40	28,560	27,200	1,360	Japan Made
	ϕ250 Concrete pipe	193.70	m		6.60	1,278		1,278	
	Steel Works (Screen)	3,802	kg		1.86	7,072		7,072	XI-2
	Total					66,429	27,261	39,168	
2-7 Flood Inlet									
Flood Inlet No.1 - No.36									
	Laying Stone	986.9	m^3		41.78	41,233		41,233	XVII-4+ (I-B-9)x150%
	Total					41,233		41,233	
2-8 Inspection Road									
	Moorum	2,924	m^3		0.99	2,895		2,895	XVI-1.6

Item	Description	Quantity	Unit	Unit Cost		Total Cost (Rs)	Currency Component		Remarks
				Foreign	Domestic		Foreign	Domestic	
3. Irrigation Branch Canals									
a. Open Channels	Type A (Type 350)	1,943.5	m	2.36	6.34	16,909	4,587	12,322	
	" B (Type 250)	5,744.5	m	1.73	5.27	40,212	9,938	30,274	
	Sub-total					57,121	14,525	42,596	
b. Bending Works (Concrete Box Stand)									
	Type A	1	No	0.08	31.06	31	0	31	
	Type B	6	Nos	0.09	32.04	193	1	192	
	Sub-total					224	1	223	
c. Diversion Works									
	Type A	5	Nos	0.08	35.16	176	0	176	
	" B	7	"	0.08	35.12	247	1	246	
	" C	138	"	0.09	34.29	4,744	12	4,732	
	" D	57	"	0.08	61.22	3,495	5	3,490	
	" E	71	"	0.08	79.08	5,621	6	5,615	
	" F	19	"	0.08	88.00	1,674	2	1,672	
	Sub-total					15,957	26	15,931	

Item	Description	Quantity	Unit	Unit Cost		Total Cost (Rs)	Currency Component		Remarks
				Foreign	Domestic		Foreign	Domestic	
d. Conduit (Culvert Box)									
	Type A (250 m/m)	132	Nos	8.34	256.7	34,987	1,101	33,886	
	" B (250 m/m)	5	"	13.90	427.56	2,208	70	2,138	
	" C (350 m/m)	31	"	11.24	369.28	11,796	348	11,448	
	" D (350 m/m)	4	"	18.74	615.47	2,537	75	2,462	
	Sub-total					41,528	1,594	39,934	
	Total (a+b+c+d)					114,830	16,146	98,684	
4-1 Pump No.1									
a. Equipment	Pump 150 - 125	1	No	17,000		17,000	17,000		Japan made
	Diesel Engine 15p.s	1	No	3,850		3,850	3,850		"
	Attachment	1	set	3,250		3,250	3,250		"
	Cement Concrete 1:3:6	1.50	m^3	0.60	72.73	110	1	109	IV-3
	Roofing (G.I.Sheet)	4.0	m^2		11.24	45		45	IX-1
	Sub-total					24,255	24,101	154	
b. Suction Pit	Excavation	15	m^3	0.56	1.31	28	8	20	III-7, UH03
	Earth filling	7	m^3		0.49	3		3	III-10-(a)

Item	Description	Quantity	Unit	Unit Cost		Total Cost (Rs)	Currency Component		Remarks
				Foreign	Domestic		Foreign	Domestic	
	Masonry	4.6	m^3		59.47	274		274	VII-7
	Sub-total					305	8	297	
c. Pipe Line & Delivery									
	Excavation	343	m^3	0.56	1.31	641	192	449	III-7, UH03
	Centering and Shuttering	16.7	m^2		6.46	108		108	V-4
	Reinforced Cement Concrete 1:2:4	2.40	m^3	0.60	102.08	246	1	245	V-1
	M.S. Reinforcement	270	kg		1.30	351		351	V-3
	Cast iron-pipe ϕ250	395	m	59.00	5.90	25,636	23,305	2,331	Japan made
	Earth filling	340	m^3		0.49	167		167	III-10-(a)
	Sub-total					27,149	23,498	3,651	
	Total (a+b+c)					51,709	47,607	4,102	
4-2 Pump No.2									
a. Equipment	pump 150 - 125	1	No	17,000		17,000	17,000		
	Diesel Engine 13 p.s	1	No	3,850		3,850	3,850		
	Attachment	1	set	3,250		3,250	3,250		

Item	Description	Quantity	Unit	Unit Cost		Total Cost (Rs)	Currency Component		Remarks
				Foreign	Domestic		Foreign	Domestic	
	Cement Concrete 1:3:6	1.50	m^3	0.60	72.73	110	1	109	
	Roofing (G.I.Sheet)	4.0	m^2	11.24		45		45	
	Sub-total					24,255	24,101	154	
b. Suction pit	Excavation	15	m^3	0.56	1.31	28	8	20	
	Earth filling	7	m^3		0.49	3		3	
	Masonry	4.6	m^3	59.47		274		274	
	Sub-total					305	8	297	
c. Delivery	Excavation	600	m^3	0.56	1.31	1,122	336	786	
	Centering and Shuttering	16.7	m^2		6.46	108		108	
	Reinforced Cement Concrete 1:2:4	2.40	m^3	0.60	102.08	246	1	245	
	M.S. Reinforcement	270	kg		1.30	351		351	
	Cast iron pipe ϕ250	700	m	59.00	5.90	45,430	41,300	4,130	
	Earth filling	597	m^3		0.49	293		293	
	Sub-total					47,550	41,637	5,913	
	Total (a+b+c)					72,110	65,746	6,364	

Item	Description	Quantity	Unit	Unit Cost		Total Cost (Rs)	Currency Component		Remarks
				Foreign	Domestic		Foreign	Domestic	
4-3 Pump No.3									
a. Equipment	Pump 100 - 80	1	No	4,700		4,700	4,700		
	Diesel Engine 5 p.s	1	No	1,770		1,770	1,770		
	Attachment	1	set	1,920		1,920	1,920		
	Cement Concrete 1:3:6	1.50	m^3	0.60	72.73	110	1	109	
	Roofing (G.I.Sheet)	4.0	m^2		11.24	45		45	
	Sub-total					8,545	8,391	154	
b. Suction Pit	Excavation	15	m^3	0.56	1.31	28	8	20	
	Earth filling	7	m^3		0.49	3		3	
	Masonry	4.6	m^3		59.47	274		274	
	Sub-total					305	8	297	
c. Delivery	Excavation	238	m^3	0.56	1.31	445	133	312	
	Centering and Shuttering	16.7	m^2		6.46	108		108	
	Reinforced Cement Concrete 1:2:4	2.40	m^3	0.60	102.08	246	1	245	
	M.S. Reinforcement	270	kg		1.30	351		351	

Item	Description	Quantity	Unit	Unit Cost		Total Cost (Rs)	Currency Component		Remarks
				Foreign	Domestic		Foreign	Domestic	
	Cast iron pipe ϕ150	270	m	36.00	3.60	10,692	9,720	972	
	Earth filling	235	m^3		0.49	115		115	
	Sub-total					11,957	9,854	2,103	
	Total (a+b+c)					20,807	18,253	2,554	
4-4 Pump No.4									
a. Equipment	Pump 100 - 80	1	No	4,700		4,700	4,700		
	Diesel Engine 5 p.s	1	No	1,770		1,770	1,770		
	Attachment	1	set	1,920		1,920	1,920		
	Cement Concrete 1:3:6	1.50	m^3	0.60	72.73	110	1	109	
	Roofing (G.I.Sheet)	4.0	m^2		11.24	45		45	
	Sub-total					8,545	8,391	154	
b. Suction Pit	Excavation	15	m^3	0.56	1.31	28	8	20	
	Earth filling	7	m^3		0.49	3		3	
	Masonry	4.6	m^2		59.47	274		274	
	Sub-total					305	8	297	

Item	Description	Quantity	Unit	Unit Cost		Total Cost (Rs)	Currency Component		Remarks
				Foreign	Domestic		Foreign	Domestic	
c. Delivery	Excavation	156	m^3	0.56	1.31	291	87	204	
	Centering and Shuttering	16.7	m^2		6.46	108		108	
	Reinforced Cement Concrete 1:2:4	2.40	m^3	0.60	102.08	246	1	245	
	M.S. Reinforcement	270	kg		1.30	351		351	
	Cast iron pipe ϕ150	175	m	36.00	3.60	6,930	6,300	630	
	Earth filling	154	m^3		0.49	75		75	
	Sub-total					8,001	6,388	1,613	
	Total (a+b+c)					16,851	14,787	2,064	
4-5 Pump No.5									
a. Equipment	Pump 125 - 100	1	No	6,670		6,670	6,670		
	Diesel Engine 5 p.s	1	No	1,770		1,770	1,770		
	Attachment	1	set	2,500		2,500	2,500		
	Cement Concrete 1:3:6	1.50	m^3	0.60	72.73	110	1	109	
	Roofing (G.I.Sheet)	4.0	m^2		11.24	45		45	
	Sub-total					11,095	10,941	154	

Item	Description	Quantity	Unit	Unit Cost		Total Cost (Rs)	Currency Component		Remarks
				Foreign	Domestic		Foreign	Domestic	
b. Suction Pit	Excavation	15	m^3	0.56	1.31	28	8	20	
	Earth filling	7	m^3		0.49	3		3	
	Masonry	4.6	m^3		59.47	274		274	
	Sub-total					305	8	297	
c. Delivery	Excavation	338	m^3	0.56	1.31	632	189	443	
	Centering and Shuttering	16.7	m^2		6.46	108		108	
	Reinforced Cement Concrete 1:2:4	2.40	m^3	0.60	102.08	246	1	245	
	M.S. Reinforcement	270	kg		1.30	351		351	
	Cast iron pipe ϕ200	390	m	48.00	4.80	20,592	18,720	1,872	
	Earth filling	335	m^3		0.49	164		164	
	Sub-total					22,093	18,910	3,183	
	Total (a+b+c)					33,493	29,859	3,634	
4.6. Pump No.6									
a. Equipment	Pump 150 - 125	1	No	17,000		17,000	17,000		
	Diesel Engine 10 p.s	1	No	2,960		2,960	2,960		

Item	Description	Quantity	Unit	Unit Cost		Total Cost (Rs)	Currency Component		Remarks
				Foreign	Domestic		Foreign	Domestic	
	Attachment	1	set	3,250		3,250	3,250		
	Cement Concrete 1:3:6	1.50	m^3	0.60	72.73	110	1	109	
	Roofing (G.I.Sheet)	4.0	m^2	11.24		45		45	
	Sub-total					23,365	23,211	154	
b. Suction Pit	Excavation	15	m^3	0.56	1.31	28	8	20	
	Earth filling	7	m^3		0.49	3		3	
	Masonry	4.6	m^3		59.47	274		274	
	Sub-total					305	8	297	
c. Delivery	Excavation	345	m^3	0.56	1.31	645	193	452	
	Centering and Shuttering	16.7	m^2		6.46	108		108	
	Reinforced Cement Concrete 1:2:4	2.40	m^3	0.60	102.08	246	1	245	
	M.S.Reinforcement	270	kg		1.30	351		351	
	Cast iron pipe ϕ250	375	m	59.00	5.90	24,338	22,125	2,213	
	Earth filling	322	m^3		0.49	158		158	
	Sub-total					25,846	22,319	3,527	
	Total (a+b+c)					49,516	45,538	3,978	

Item	Description	Quantity	Unit	Unit Cost		Total Cost (Rs)	Currency Component		Remarks
				Foreign	Domestic		Foreign	Domestic	
5. Drainage Canal									
	Open Channel	1,691	m	0.22	0.70	1,556	372	1,184	
	Culvert Type A	1	No		388.42	388		388	
	" Type B	5	Nos		313.30	1,567		1,567	
	" Type C	1	No		238.18	238		238	
	Drop	31	Nos		124.75	3,867		3,867	
	Total					7,616	372	7,244	
6. Farm Roads	Main Roads	3,177	m	2.02	6.73	27,799	6,318	21,381	
	Access Roads	5,951	m	1.22	3.74	29,517	7,260	22,257	
	Total					57,316	13,678	43,638	
7. Field Arrangement									
	Earth Works	200,800	m^3	0.40	0.93	267,064	80,320	186,744	III-1, 60A.3
	Total					267,064	80,320	186,744	

(PAKHANJORE)

Table 13-3 Specification of Construction Equipments

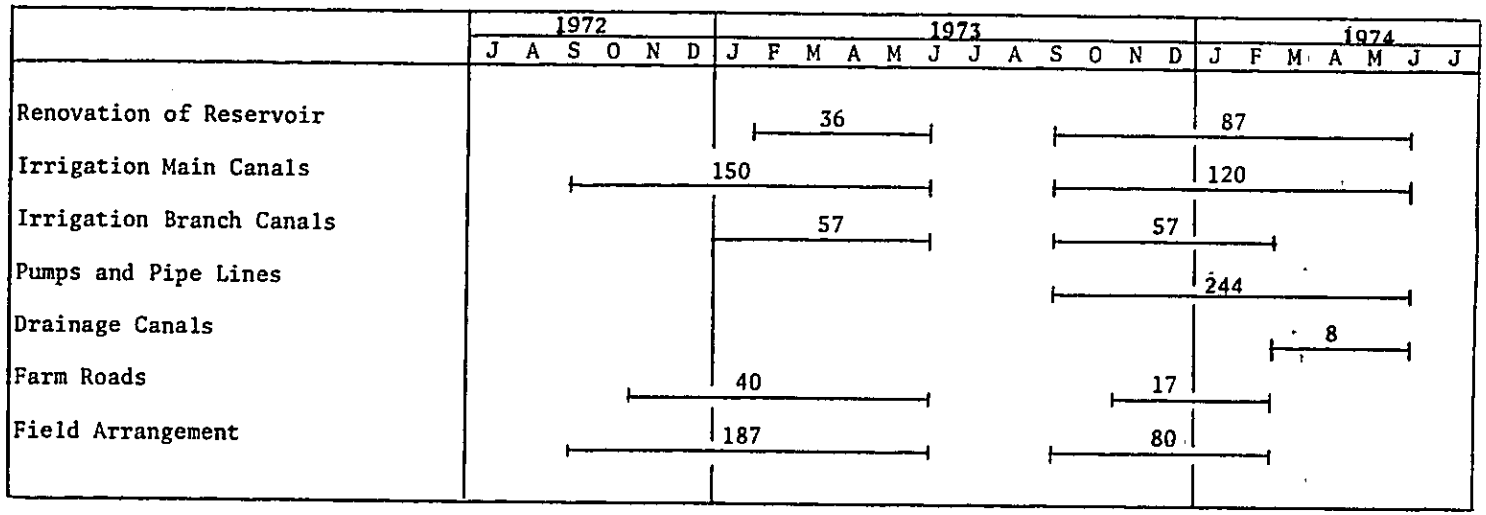
Equipment	Type	Weight	Price
Angle-Dozer No.1	D60A-3, with winch	15.50 t	¥ 6,150,000
Angle-Dozer No.2	D60A-3, with Ripper	16.20	6,400,000
Back-Hoe	UH03, with Clamshell	11.30	6,030,000
Tractor	BD2, 2t	2.80	2,100,000
Concrete Mixer No.1	TD8, Diezel Eng. 5 ps.	0.95	230,000
Concrete Mixer No.2	TD8, Diezel Eng. 5 ps.	0.95	230,000
Concrete Vibrator No.1	EFK327, Gas. Eng. 3 ps.	0.06	85,000
Concrete Vibrator No.2	EFK327, Gas. Eng. 3 ps.	0.06	85,000
Belt Conveyer No.1	KE5, 7 m, Gas. Eng. 3 ps.	0.15	40,000
Belt Conveyer No.2	KE5, 7 m, Gas. Eng. 3 ps.	0.15	40,000
Belt Conveyer No.3	KE5, 7 m, Gas. Eng. 3 ps.	0.15	40,000
Belt Conveyer No.4	KE5, 7 m, Gas. Eng. 3 ps.	0.15	40,000
Belt Conveyer No.5	KE5, 7 m, Gas. Eng. 3 ps.	0.15	40,000
Steel Forms Type 350	width 350 mm, 67 kg x 16 sets	1.07	239,000
Steel Forms Type 250	width 250 mm, 50 kg x 48 sets	2.04	538,000
Air Compressor	AMR125, D. Eng. 36 ps.	1.00	950,000
Pick Hammer No.1	CA7A, Air 0.9 m^3/min	-	15,000
Pick Hammer No.2	CA7A, Air 0.9 m^3/min	-	15,000
Pick Hammer No.3	CA7A, Air 0.9 m^3/min	-	15,000
Jack Hammer No.1	TY62, Air 1.9 m^3/min	-	44,000
Jack Hammer No.2	Ty62, Air 1.9 m^3/min	-	44,000
Miscellaneous		0.96	150,000
Total		54.00 t	¥ 23,520,000
			≒ Rs.490,000

Chapter 14. Annual Schedules for Implementation of the Project

Chapter 14 Annual Schedules for Implementation of the project

Tentative schedule for implemention of the project extending full two years is given in Fig. 14-1.

Fig. 14.1 Construction Schedule



Note: Number indicate the Cost of the Construction (Unit = 1,000 Rs.)

Table 14-1 Budgetary Schedule in Year

(Unit: 1,000 Rs)

Item	Cost	1970 - 71		1971-72		1972-73		1973-74		1974-75		Component	
		Foreign	Domestic	Foreign	Domestic	Foreign	Domestic	Foreign	Domestic	Foreign	Domestic	Foreign	Domestic
Pakhanjore community													
Main canal	392					25	160	21	186	-	-	46	346
IRR. facility for paddy	115					8	49	8	50	-	-	16	99
IRR. facility for upland	245					-	-	222	23	-	-	222	23
Land consolidation	332					66	162	28	76			94	238
Agro. initial input	581					118	-	463	-	-	-	581	-
Better living	130					120	10	-	-	-	-	120	10
Farmer cooperative	283					42	48	85	-	108	-	235	48
Construction equipment	490					490	-	-	-	-	-	490	-
Sub-total	2,568					869	429	827	335	108	-	1,804	764
Operation	240						80		80		80	-	240
Miscellaneous	212					60	15	60	15	51	11	171	41
Total	3,020					929	524	887	430	159	91	1,975	1,045

Chapter 15. Economic Justification of the Project

Chapter 15. Economic Justification of the Project

15.1. Introduction

The economic evaluation of the project for all over Pakhanjore community development programme is made on Part I (The Report of Improvement For Pakhanjore Community Development Programme) and the economic evaluation of final design for PV13, PV14 is stated on this part.

15.2. Benefits from Direct Investment
(Benefits accruing to the immediate project-area)

The balance between the net-profit being raised from agricultural production on 248 acres of PV13, PV14 area, and the net-profit available therefrom upon completion of the project will stand as benefit attributable to the direct investment under this project, (see Section 2, Chapter 3).

15.3. Economicality of the Project

Economicality of the direct-investment part of the project will be examined here on the basis of socio-economic survey conducted in the year proceeding to commencement of the project (that is 1973).

15.3.1. Annual Incremental Net Benefit

Improvement-effects of the project on the productivity-increase are supposed to work through annual incremental process until it reaches at a specific turn-over at the end of the fifth year. Assuming the economic useful life as 30 years and annual interest-rate at 6%, an annual incremental net benefit will be calculated at Rs 252,897.

Year	Net Incremental Profit		Its Present Worth
1	Rupee	0	0
2	Rupees	72,000	64,080
3	"	150,000	125,940
4	"	227,000	179,807
5	"	302,115	3,111,210
30		302,115	
	Total		3,481,037

Annual incremental profit = Rs 3,481,037 x 0.07265 = Rs 252,897
(0.07265 = Capital-recovery factor)

15.3.2. Annual Cost and Expenditure

The above-calculated profit is due to direct-investments meant for land consolidation and initial input for betterment of farm-management in the project-area. The investment for betterment of farm-management is being estimated in the annual production-cost when calculated annual incremental net-profit, hence the land consolidation investment alone stands as annual cost involved in our estimation.

At the assumed annual interest of 6% the total of the annual costs for land consolidation works will come to Rs 55,590.

Year	Land Consolidation Works Cost (including the interest during construction period)	Its Present Worth
1	429,660	405,341
2	404,316	359,841
Total	833,976	765,182

Annual cost, Rs 765,182 x 0.07265 = 55,590
(0.07265 = Capital-recovery factor)

15.3.3. Annual Operation Cost

For maintenance and operation cost of the structures newly built under the project, an incremental cost of Rs 39,628 will be required, in addition to Rs 1,216 as for depreciation or replacement-cost of pumps (supposing their economic useful life lasts for 15 years)

Replacement-cost of pumps	= Rs 42,540	
Present-worth of pumps	= Rs 16,744	(Rs 42,540 x 0.3936)
Annual-cost of pumps	= Rs 1,216	(Rs 16,744 x 0.0726)

15.3.4. Benefit-cost Ratio

(1) Annual incremental benefit — Rs 252,897

(2) Annual Cost

Construction Cost	Rs 55,590
O & M cost	Rs 40,844
Total	Rs 96,434

(3) Benefit-cost ratio

$$\frac{252,897}{96,434} = 2.62$$