TJIHEA TANI MAKMUR PILOT PROJECT

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DESIGN REPORT

APRIL 1971

OVERSEAS TECHNICAL COOPERATION AGENCY

JAPAN

国際協力事業団
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PREFACE

The Government of the Republic of Indonesia has been carrying out energetically a project for the increase of rice production with the aim of attaining self-sufficiency in food supply and eliminating imports or rice. The basis of the project is the so-called "BIMAS Project" which envisages a large increase in rice production through intensive agricultural extension services, supplement of fertilizer and agricultural chemicals and required funds.

In implementing such a project on a full scale the Government of Indonesia requested the Government of Japan in 1966 to extend consulting services for agricultural development.

In response to the request, the Government of Japan provided required field surveys and made a careful review of the findings. Upon consultation with the Government of Indonesia an agreement for consulting services in agricultural field in Indonesia was signed on May 29, 1968 and the services under the agreement are in progress at present.

Of the above services, cooperation for the Tjihae Farm in Tjiandjur Province is equivalent to the so-called project cooperation. To substantiate this cooperation and make it more effective, it was considered necessary to reaffirm the need for the readjustment of earnable land, establishment and diffusion of farming techniques and promotion of systematic activities of farmers. The recent despatch of a detailed design survey team was realized against such a background.

The survey team headed by Mr. Heijiro Yoshiwara, a member of the Board of Directors, Overseas Technical Cooperation Agency, consists of 10 members made a field survey in Indonesia for a period of 60 days from Oct. 28, 1970 and obtained necessary data for the implementation of the project.

It is hoped that the contents of the report which summarizes the above data are well understood by the parties concerned including officials of the Government of Indonesia, staffs of the Japanese Embassy in Indoneisa and the Japanese experts to be assigned to the site and further guidance and advices are provided by these people.

In conclusion, I wish to take this opportunity to thank officials of the Government of Indonesia for their unlimited cooperation and support in the course of the survey.

1971

Tadashi Sakamoto
Director, Agricultural Cooperation Department
Overseas Technical Cooperation Agency

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O.T.C.A. = Overseas Technical Co-operation Agency

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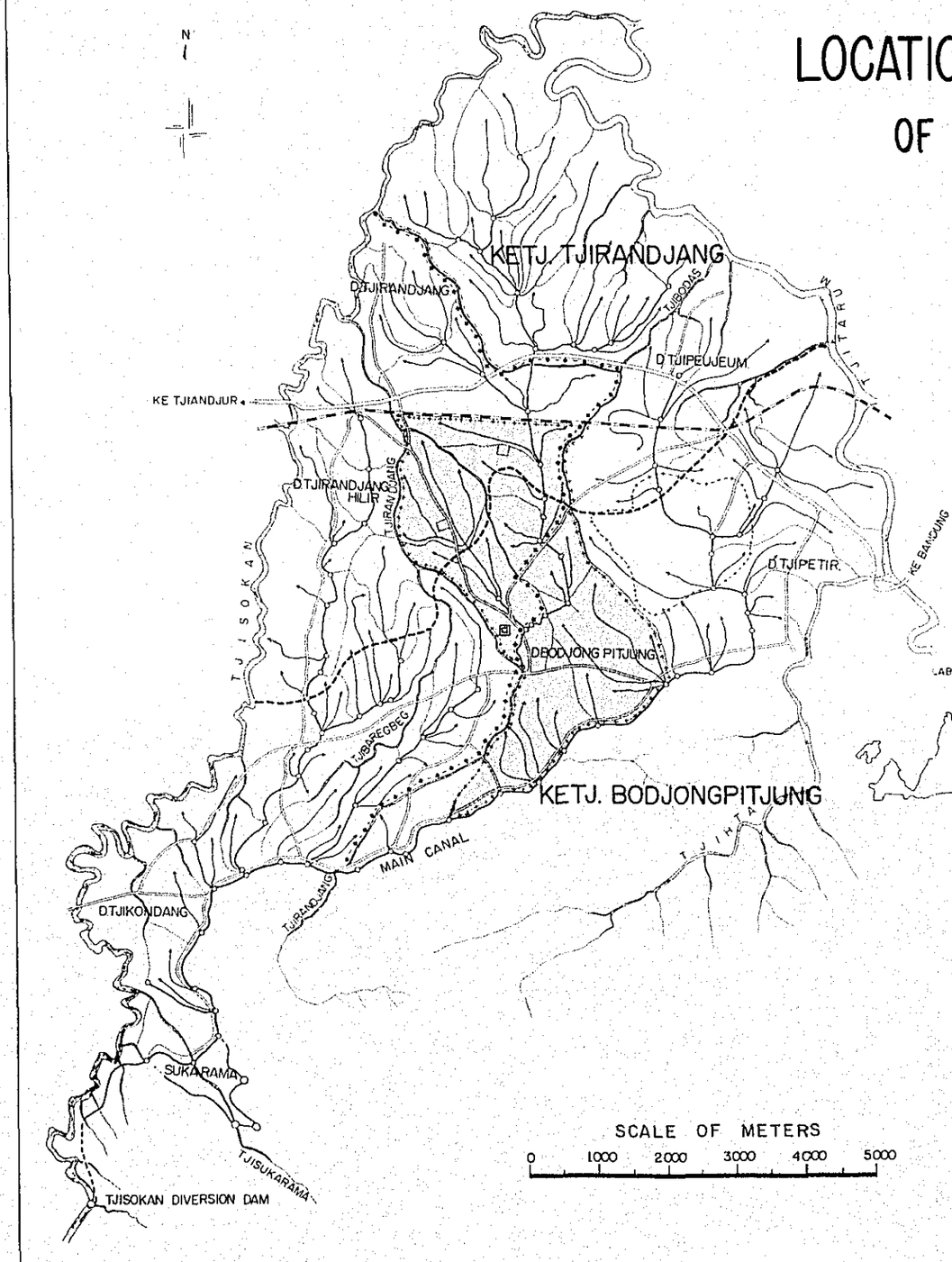
CHAPTER 1 INTRODUCTION

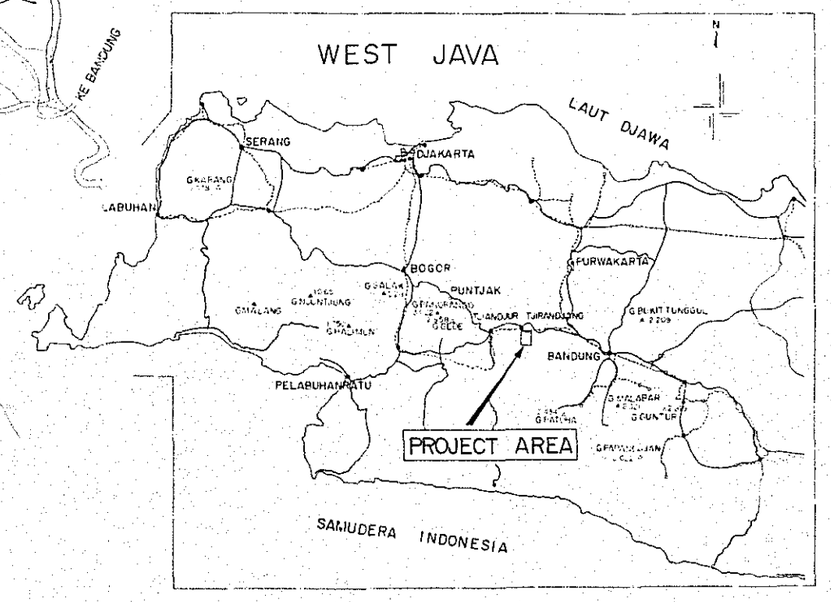
LOCATION OF TJIHEA PILOT PROJECT



LEGEND

- : BOUNDARY of TJIHEA PROJECT AREA, 1.086 ha
- : BOUNDARY of BLOCK I & II
- : IRRIGATION CANAL
- : BLOCK I, 2,723 ha
- : BLOCK II, 2,686 ha
- : P.P. Tjihea

KEY MAP



SCALE OF METERS

0 1000 2000 3000 4000 5000

INDONESIA	
THE TJIHEA TANI MAKMUR PILOT PROJECT	
LOCATION	
DRAWN :	SUBMITTED :
CHECKED :	APPROVED :
OVERSEAS TECHNICAL COOPERATION AGENCY TOKYO. DATE : MAR., 1971	PLAN : NO.

CHAPTER 1. INTRODUCTION

1-1 Background of the Plan

The economic policy of the Government of Indonesia, ever since its independence, has been to place special emphasis on increasing rice production. The most ambitious program along this direction was BIMAS, or the Three-Year-Plan for Food-Production-Increase, initiated in 1965.

BIMAS called for the mobilization of all the available human resources, and of all possible institutional measures for the attainment of its target. More specifically, BIMAS covers an enormous expanse of land, spreading over 1.2 million ha. in 24 Propinsi (provinces) during the rainy season, and half-a-million ha. in 12 Propinsi, during the dry season. Under the plan, an agricultural extension officer was assigned to each village (desa) to give guidance in five basic agronomic areas: improved seeds, better irrigation, advanced cultivation techniques, adequate fertilizing, and prevention of harmful insects and diseases. Necessary materials for increased production were distributed to the farmers through credits provided by the State Bank.

The Indonesian Government, in the meanwhile, being eager to secure a guaranteed supply of rice for the consumers concentrated in Djakarta and its suburbs, took up, in May 1966, an intensive paddy production-increase program called "Dewi Sri Djaja Scheme", or West Java Emergency Paddy Production Increase Program, within the metropolitan enclave consisting of the capital and its seven Kabupatin. The Dewi Sri Djaja Scheme was meant to break, once for all, the transport bottlenecks between the producing area and the consumption centers and to solve the food price problems, through an approach similar to the emphasis on the five essential agronomic areas as in the case of BIMAS. However, did not materialize according to plans and was later absorbed into BIMAS.

Against this background of the critical need to implement a food production program, the Indonesian Government envisaged the implementation of the following seven items as indispensable steps for the success of BIMAS program, and approached the Japanese Government, in June 1966, with a request for agricultural development cooperation in both economic and technical aspects, particularly with respect to items (2), (3), (4), and (6):

Pre-requisites for Successful Implementation of Food-Production-Increase Program in Indonesia as envisaged by its Government

(1) Training of a team of junior officials in programming and administration of agricultural development policies.

(2) Qualitative improvement of agricultural extension officers.

(3) Training of seed-inspection specialists

(4) Strengthening of Agricultural Mechanization Center.

(5) Establishment of additional Agricultural High Schools.

(6) Strengthening of teaching personnel of such Agricultural High Schools and replenishment of their educational facilities and teaching materials.

(7) Establishment of District Development Centers and training of farmers.

In compliance with the above request, the Japanese Government sent two teams of experts to Indonesia: a preliminary survey team (for a period of three weeks) in October 1966 and an implementation survey team (for 35 days) in March 1967, which, after intensive field surveys and technical discussions with the people concerned, identified the types of co-operation, and the kinds and amount of material aids to be given for the purpose, while selecting several sites where such co-operation could profitably take place. The Minutes of Discussions exchanged between the Government of Indonesia and the leader of the latter survey team outlined the forth-coming Japanese techno-economic co-operation. Consequently, Japan's co-operation was formally committed to the Indonesian Food-Production-Increase Program through the signing of the Agreement between these two Governments, on May 29, 1968. This co-operation would be extended for three years starting on the date of the signing of the said Agreement.

Japan's co-operation towards Indonesian Food-Production-Increase Program

I: Training on Raising & Selection of Seed-Paddy

Pursuant to the conclusion arrived at between the authorities concerned of the Government of Indonesia and the Japanese experts' team that the most urgent and basic means for achieving increased paddy production would be to establish a proper system for raising improved seeds and to train qualified seed-selection specialists, the Central Agricultural Research Institute at Muara near Bogol was decided upon as the site for such training. Three Japanese experts, specializing, respectively, in seed-raising programming, seed inspection system development, and seed-raising technique, will train 30 Indonesians at a time for a period of three weeks, following which they should undergo another six-month field training of their own. Necessary machinery, tools, implements and materials for this purpose will be provided from Japan.

II: Training on Mechanized Farming

Training on mechanized farming in Indonesia dates back to 1951. In view of the increase in the double-cropping area in the country, and in order to meet with the accompanying need to introduce mechanized farming techniques among the cultivators to enable them to take full advantage of their infra-structural improvements, however, its further expansion is necessary. Therefore, training on mechanized farming primarily for the agricultural extension officers and the agricultural co-operative staff will be conducted at the Agricultural Machinery Dept., Directorate-General of Agriculture (currently, Agricultural Machinery Dept., Directorate-General of Technique) at Pasarminggu. Each group of some 40 trainees will receive elementary and basic training on mechanized farming for three months, under two Japanese experts, and then undergo practical training for another three months at the Mechanical Training Center at Sukamandy. Machinery, implements and materials necessary for such training will be provided from Japan.

III: Technical and Managerial Assistance towards Implementing BIMAS Program at Tjihea State Farm

BIMAS requires a district where achievements can be made to serve as a model for the remaining project-areas. Model achievements in such a district must be supported by a series of experiments aimed at identification of the best sets of approaches to the common problems, demonstration of universally applicable know-how, and deployment of most effective patterns of farmer-guidance, centered at a few key-places. The State Farm at Tjihea was thus selected as one of the key-places to make West Java the model district for the whole BIMAS area. For this purpose, Japanese experts assigned to this project will visit Tjihea Farm as often as required to give pertinent advices and suggestions to the Indonesian technical personnel there.

1-2 Historical Background

The Tjihea Farm extends over to Bodjung Pidjung District and Tjirandjang District, Tjandjur, West Java, and covers an area of 1,086 ha., comprising 750 ha. in the former and 336 ha. in the latter. It is a farm designed exclusively for paddy rice cultivation under the jurisdiction of the West Java Government. The farm may be reached by a local road extending from Tjiandjur town which is situated along the trunk road running between Djakarta and Bandung. Its official name is Perusahaan Pertanian Tjihea (P.P. Tjihea).

The historical background which led to the farm becoming the present Corporation-owned farm will be discussed hereinafter.

Because of extremely damp soil condition, Tjihea district had been under constant threat of such diseases as malaria, etc., for many years. From around 1820 the residents of this district attempted land improvement on many occasions to improve marshy land but failed in their attempt mainly due to the lack of technique and funds. The project was later resumed by the Dutch Government which began surveying the area in 1879 as the Tjihea Irrigation Project and completed it 5 years later. The Irrigation Department was newly established in the Ministry of Public Works in 1885 and the work of the Tjihea Irrigation Project began the following year in 1886 and the whole project was completed in 1904.

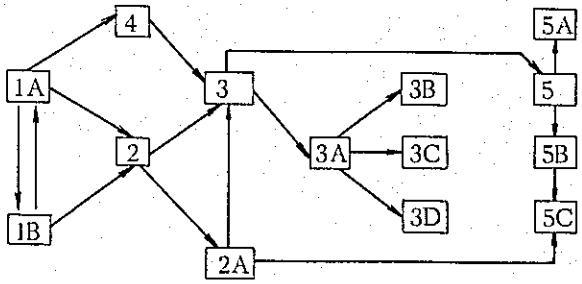
Settlers began moving into the area around the time of completion of the work, and the settlement of the Whole Tjihea Area was completed in 10 years by 1914.

The Dutch Government, being aware of the fact that the Tjihea Area was favored by adequate rainfall, abundant labor force and fertile soil, designated the district as estate for exclusive rice cultivation in 1919.

However, following the withdrawal of the Dutch from Indonesia, the outbreak of such diseases as malaria, etc., became frequent again in the Tjihea Area because of the dampness of the soil. In 1929 the Indonesian Government began the purchase of land from landowners in the Area in an attempt to rehabilitate the land, and finally, in 1969, it transferred the ownership of 836 ha. of land to the farmers, who had been engaged in farming on the purchased land, with the aim of fostering owner-farmers in the Tjihea Area. In 1970 the West Java Government established a state-owned corporation in Tjihea with the following objectives and transferred to the corporation the ownership of 250 ha. of land for its direct management. The objectives were: firstly, to develop high-productivity varieties of rice; secondly, to produce rice for

general consumption on a paying basis; and thirdly, to provide extension service on the improvement of varieties of rice to the farmers around the corporations farm (mainly for the owner-farmers in the transferred 836 ha. of land and those farmers living around Tjihea Area).

An Organization Chart of the Tjihea Corporation is shown below:



1A ; Director General of Agriculture

1B ; Governer of West Java

2 ; Inspector of Agriculture W. Java

2A ; Extention Service Tjiandjur

3 ; Project Manager

3A ; Deputy

3B ; Assistant Agr. Engineering

3C : Assistant Management and Organization

3D ; Assistant Agronomy

4 ; Derectorates / Experts

5A ; Farmers Council

5 ; Charman Farmers Association / Cooperative

5B ; Action Commettees

5C ; Tjihea Farmers

1-3 Outline of Project

The scope of technical cooperation by the Japanese Government will include the Tjihea Project Area extending over 1,086 ha. for the implementation of an integrated agricultural development project including land improvements, establishment and extension of agricultural techniques and promotion of farmers' organizations.

In conjunction with the above project, the commercial production and distribution of seeds will be implemented as projects related to the production and diffusion of seeds now being carried out in Muara.

The main items of cooperation are as follows:

(a) Land Improvement

Guidance and instructions on the improvement of irrigation and drainage facilities and farm roads and on effective water management for the land covering an area of 100 ha. which constitutes the nucleus of the Tjihea Farm, in accordance with the plan described in Chapter 4.

(b) Assistance for the improvement of agricultural techniques including the following:

(1) A model farm for rice cultivation having a total area of about 3 ha. will to be established within the project area for experiment and demonstration of agricultural techniques and water management.

(2) Training of technical staffs of the Indonesian Government on the operation of agricultural machines at the model farm.

(3) For extension service on agricultural techniques, an extension (model) farm having an area of about 3 ha. will be provided within the Tjihea Farm as necessary for guidance on farming techniques at each stage of cultivation.

(c) Assistance for production, storage and distribution of commercial seeds

Guidance and instruction will be provided on technical matters related to the above to be carried out at the West Java Government Farm (Approximately 250 ha.) on the basis of the results of practical tests conducted at the model farm.

(d) Assistance for establishment of agricultural co-operatives

Guidance and instructions will be provided on matters related to the establishment of agricultural cooperatives, including storage and sale of farm products, purchase and distribution of supplies, management of farm machinery and water management.

(e) Cooperation to be extended by the Japanese Government

For the implementation of this project, the Japanese Government will extend its cooperation in the following fields:

(1) Assignment of Japanese experts.

(2) Supply of materials and equipment.

(3) Training of Indonesian technicians in Japan.

(f) Cooperation to be extended by the Indonesian Government

For the implementation of the project, the Indonesian Government will be responsible for the following:

(1) Implementation of land readjustment programs.

(2) Assignment of Indonesian counterparts.

(3) Acquisition of land and construction of buildings.

(4) Construction of facilities necessary for the accommodation of Japanese experts.

(g) Establishment of a management committee

To ensure smooth and proper implementation of the project, a management committee comprising Japanese experts and Indonesian counterparts will be established.

(h) Period of cooperation

Cooperation to be extended by the Japanese Government for the above project will cover a period of 3 years.

CHAPTER 2 PROJECT AREA

CHAPTER 2 PROJECT AREA

2-1 Location

The Tjihea Pilot Project Area is formed of the central part of the Whole Tjihea Irrigation Development Area located in the south-south-east far about 120 kilometers from Djakarta city. The Project Area lies in the latitude 6°49'-53' of south and in the longitude 107° 8'-11' of east consisting of the paddy fields of 1,086 ha. out of the Whole Tjihea, 5,409 ha.

The Whole Tjihea may be said to be shaped like a triangle which is surrounded with the Tjitarum river in the east boundary and its tributary, the Tjisokan river, in the west and the mountain range at the southern bottom.

The railway and the highway, Bogor-Bandung route, pass through adjacently in the middle of the Area in parallel with the triangle base.

The Whole Tjihea situated at Tjiandjur Prefecture in West Java province is divided into two districts, Tjirandjang and Bodjong-pidjung; the former is northern half, the latter southern rest.

Tjirandjang town with a railway station occupies the important commercial position for the Whole Area.

The Project Area spreads out south from the railway between the Tjirandjang river and the Tjibodas river, separated also into the two districts; Tjirandjang and Bodjong-pidjung.

2-2 Physical Features

2-2-1 General Geology

The Project Area belongs to the alluvium with the developed paddy fields. The southern mountains in which the Tjitarum and the Tjisokan river rise connects with the ranges traversing Java.

The land slants northward situated at an elevation of between 200 and 300 meters above sea level.

Its inclination at the Pilot Farm of 100 ha. shows 1 to 200 on an average. The soil in the Area consists of clay formed from andesites which are exposed in some paddies and hills.

2-2-2 Area

The area of 1,295 ha. is composed of the residential quarters of 209 ha. and the paddies of 1,086 ha. classified in the following groups:

Administrative classification

Paddies in Tjirandjang District	336 ha.
Paddies in Bodjong-pidjung District	750 ha.
Total	1,086 ha.

Possessory classification

Paddies under Perusahaan Pertanian Tjihea	250 ha.
Paddies possessed by farmers	836 ha.
Total	1,086 ha.

The paddies under P.P. Tjihea belong to Bodjong-pidjung District.

2-2-3 Climate

(a) Rain Fall

The climate of Java island, lying within the inner tropics along the equator, is generally dominated by the monsoons. The west monsoon which prevails mainly from November to February usually brings rain.

The east monsoon, from May to September, brings a relatively dry season with less rain.

According to these climatic features, a year is classified in two seasons; dry season, from October to April and wet season, from May to September.

Mean monthly rainfalls recorded at P.P. Tjihea for 9 years are shown comparing to those in Djakarta and in Bandung as the followings:

	Tjihea	Djakarta	Bandung
Jan.	290 mm	308	176
Feb.	193	300	182
Mar.	307	206	230
Apr.	277	143	239
May	252	112	131
Jun.	86	91	70
Jul.	113	62	30
Aug.	82	42	49
Sept.	92	70	84
Oct.	171	110	152
Nov.	283	148	228
Dec.	303	198	191
mean annual rainfall	2,309	1,790	1,768

Being situated at south east of Mt. Pangrango and Mt. Gede, over 3,000 m high, Tjihea has much more rain than Djakarta and Bandung.

The maximum daily rainfall at Tjihea reached to 325 mm on November 21, 1962. The drought year was recorded in 1963 having very little rain under 10 mm for a month, during June, July and August.

(b) Temperature

The temperatures in Java are those usual in the inner tropics, high but not excessive throughout the year. The annual mean near sea level is about 26°C and the monthly mean range is 1.1°C in maximum.

The daily maximum mean is about 30°C and the minimum mean is about 23°C.

Temperature falls approximately 0.6°C for 100 meters difference in altitude. The annual mean in Bogor, Djakarta and Bandung are shown as the followings: (Appendix B. 5)

Bogor	25.1°C	250 m above sea level
Djakarta	26.2°C	8 m
Bandung	22.5°C	730 m

The temperatures in Tjihea would be similar to those of Bogor situated in almost the same altitude. The daily maximum during the investigations ranges from 28°C to 31°C.

(c) Wind

The west monsoon showing its force of 0.25 m/sec in November reached to the velocity of 5 m/sec in December during the investigations but its mean was the velocity of 0.94 m/sec.

(d) Evaporation

The evaporation pan set at P.P. Tjihea during the investigation recorded small range of daily evaporation. The daily mean is 3.2 mm.

2-3 History

History of Tjihea was begun with a start of reclamation works of marshes which were malaria infected areas. Necessity of Tjihea marsh development for rice production as well as for eradication of malaria was already recognized since the early years of 1800. It has been recorded that various land improvement project was planned by the inhabitants of the area since about 1820. However, these plans were never been brought up to a large scale irrigation project and to a stage of implementation because of a limited engineering ability and power of organization available at those times.

After that, these plans were taken over by the Hollanders. But, again with so little number of engineers available in the whole of Java Island, about 3 engineers in 1829 and about 5 of

them in 1844, the plans were never been developed to materialization. In 1847, a considerable amount of engineering forces and funds were invested into 2 irrigation projects, namely Sampean Project and Tjirebon Project, and projects were actually initiated for the first time.

After the initiation of these projects engineering forces were secured by the Department of Public Works in 1854.

In 1872, based on these strengthened engineering forces and more funds made available the irrigation projects namely of Bagelen, Madiun and Besuki were initiated respectively.

In 1876, investigations were newly started for the projects of Tegal, Kendal, Gerobogan and Bengawan Solo and in 1879, investigations and land survey were started for Tjihea Irrigation Project. Approximately 5 years of time was spent for this investigation.

In 1885, to cope with the progress of these irrigation projects and based on the necessity thereof, Bureau of Irrigation was established in the organization of the Department of Public Works. In 1886, construction works of the Whole Tjihea Irrigation Development Project was finally started based on the strengthened administrative organization, and in 1898, construction of intake dam, main canal and appurtenant structures was completed. Following this, construction of tertiary canals and secondary dams were added and whole construction work was completed in 1904. Total expenditure for this construction works was recorded as 962,000 guilders of Holland currency of those days.

Migration of settlers was started at almost the same time as that of the completion of the construction and land development in the Whole Tjihea Area like the present condition was approximately completed 10 years after that in 1914.

This irrigation system thus completed about 70 years ago is still functioning and in operation at present with only a minor repair made to it. It is still irrigating paddy field of 5,409 ha. with the almost same capacity as that of the time it was constructed.

2-4 Present State of Agricultural Management

2-4-1 Outline of Project Area

The Tjihea Project Area comprises 5 desa (villages), with a total area of paddy field extending over 1,086 ha. In the past all of the paddy fields were under the control of the Perusahaan Pertanian Tjihea of West Java, and all of the upland fields and building lots were under private ownership. A small portion of the paddy field was under direct management of P.P. Tjihea and most of the paddy field were tenanted by local farmers.

The tenant farmers paid their rent in kind in the amount equivalent to 1/10 of the total production. This revenue supported the operation of P.P. Tjihea and the services proveded to the farmers.

The paddy fields under direct management of P.P. Tjihea were used for the production of government rice seeds. More specifically, the farm had been engaged in the production of government rice seeds from the government pure-line reserve allocated by Lembaga Pusat Peneritean Pertanian (Central Agricultural Research Institute) and in the distribution of seeds to various government seed farms.

On October 3, 1969, the government sold 836 ha. of the paddy fields to 2,477 farmers and transferred 250 ha. to the direct management of P.P. Tjihea. These measures were taken for the following two reasons:

(1) For the implementation of various projects by P.P. Tjihea, revenues from 250 ha. of paddy field were considered sufficient.

(2) It was considered necessary to promote owner-farmers.

Qualifications required of farmers for the purchase of government-owned paddy field, acreage of paddy field sold and the number of farmers involved are as follows:

	Qualifications for purchase	Acreage to be sold	Number of farmers making purchase
1.	Tenant farmers who have been farming in Tjihea for more than 8 years	76% of his tenant land	2,210
2.	Tenant farmers who have been farming in Tjihea for less than 8 years	60% of his tenant land	98
3.	Non-farmers who had previously owned paddy fields which were later purchased by the Dutch Government	Uniformly 0.25 ha.	169
		Total	2,477

The selling prices of paddy field per ha. are as follows:

1st Class paddy field	Rp 60,000
2nd Class paddy field	Rp 50,000
3rd Class paddy field	Rp 40,000

The prevailing prices of paddy field in the neighboring district are said to range from Rp 600,000 to 650,000 per ha. Payment for the purchase of paddy field was to be made either by immediate payment or on a 5-year instalment plan to be paid every six months at no interest. Consequently, only few farmers made immediate payment and the majority chose to pay on instalment plan.

Transfer of ownership of paddy field purchased by farmers was prohibited for a period of 5 years following the purchase, and as a measure to prevent such transfer, certificates of title were held in the custody of P.P. Tjihea.

2-4-2 Survey Method

A request was made to Mr. Memed, Director of P.P. Tjihea for the selection of typical farm households of each stratum among farm households in each Desa. The selected farmers were asked to report to SRMP of P.P. Tjihea for personal interviews during a period from November 16 to 26. For some farm households, members of the survey team visited the households for interview. The survey was made through personal interviews with each farmer according to the survey list with the cooperation of staffs of the P.P. Tjihea, teachers at SRMP and such Japanese experts as Mr. Masaaki Funada and Mr. Takeo Kagami.

The survey covered a total of 166 farm-households, of which 20 were not adequately covered by the survey. Therefore, the results on these household were not complete, and only the findings on the remaining 146 households were tabulated.

The survey was made on the size of families, acreage of land owned by the farmers and the amount of capital investment at the time of survey. The survey on other matters was made as of the period from October 1969 to September 1970. (In Java Island the climate may be roughly divided into the rainy season which lasts from October to April and the dry season which lasts from May to September.)

2-4-3 Size of Farm Management

(1) Land

As stated previously, 836 ha. of paddy field were sold to farmers in Tjihea district in 1969. As the land was sold to a total of 2,477 farmers with the aim of establishing owner-farmers, the area of paddy field allocated to each farm household was very small, averaging 0.33 ha. Though the number of households classified according to the size of farm management was could not be completely surveyed, the number of farmers classified according to size of farming from among the 146 households interviewed is as follows with the maximum acreage of land owned by each farmer being 4.0 ha. and the minimum being 0.069 ha.

A.	More than 0.75 ha.	16 households
B.	Less than 0.75 ha. and more than 0.5 ha.	49 "
C.	Less than 0.5 ha. and more than 0.25 ha.	45 "
D.	Less than 0.25 ha.	36 "
	Total	146 households

Of the above, 77 farmers own upland fields, orchards, bamboo forests, etc., in addition to paddy fields, but the weight of such land is not so great as to influence directly the life of the farmers. All of these farmers own land for housing on their farms.

(2) Capital Investment

As is evident from Table 1, the number of farmers who own buildings other than their dwellings is very small, and the farmers who own warehouses (storage buildings) number only 18 (12% of the total number of farmers surveyed). The ratio of farmers who own warehouses is particularly small in the case of farmers whose cultivation area is small. As shown in Table 2, the average floor space of a warehouse is 17.1 m^2, of which about 1/3 is used for commercial storage purposes by part-time farm households or as work rooms (mainly for rice-polishing for home consumption) and kitchen.

The majority of warehouses used exclusively for agricultural purposes (mainly for storage of rice) have a floor space of less than 12 m^2. As most of the agricultural implements owned by each farm household are small hand-made implements and are small in quantity, the warehouse is used mainly for the storage of farm products. However, the quantity of harvested crops is not so large as to require exclusive use of the warehouse, and as a result; most farmers store their crops in their dwellings.

As fertilizer and agricultural chemicals are being used by 37 farm households (26%) under Project BIMAS (BIMAS Project), powered sprayers have been introduced. However, no other types of machinery have been introduced so far for use by general farmers.

The agricultural implements in general use in this district are as follows. Apparently, a number of implements are less efficient because of their construction.

Patjul (Hoe)
Garp (Fork)
Linggis (Picks used for digging)
Pentjedock or sekop (Scoop)
Landak or lalandak (Hand weeder)
Home-made paddy tiller
Tjaplak (Liner, home-made line maker for rice planting)
Parang (Hatchet for grass-cutting)
Arit (Sickle)
Ani-ani (Knife for cutting rice stalk)
Leoung (Rice mortar)
Sepeda (Bicycle) - For transportation

Of the above implements only four types numbering 6 pieces on the average are owned by each farm household for use in tillage, rice transplanting, weeding, plant protection and for harvesting of crops as shown in Table 3. As far as threshers and processing and transport equipment are concerned, it may be said that practically no farmers have these equipment. The types and numbers of agricultural implements owned by farmers are almost the same for all the farmers regardless of the size of the farms.

As shown in Table 4, livestock raising is practiced by a total of 110 households (Approximately 75%), and the ratio of livestock raising is higher in the case of farmers having a large tract of land. However, the number of animals raised by each household averages 5 heads of cattle and 3 goats, and is fewer on smaller farms, as

shown in Table 5.

As for poultry raising, ducks, swans and geese are being raised in addition to chicken, but most of them are of local breed and are inferior in size. The same applies to goats.

In any event, the planning of a gradual increase in fixed assets including buildings, machinery and equipment and domestic animals through the introduction of modern techniques will be the basic posture required of the farmers as an immediate step toward leveling up their standard of living in the protect area.

(3) Manpower

The average size of a family surveyed was 6.01 members, which is not too large compared with the average size in Java Island. Assuming that the productive age is from 15 to 60 years old as in the case of Japan, the number of family members falling under this category is 2.94 per family on the average. This figure may be said to be excessively large compared with the size of farm land owned by each household.

2-4-4 Management System

As most of the land owned by farmers in the project area are paddy fields, rice cultivation forms the center of farm management with two-crops-a-year cultivation, one in the dry season (April - September) and the other in the rainy season (October - March). Furthermore, fruits, vegetables, pulse and bamboo are being raised on upland fields or in parts of dwelling area for their own use. Pulse is raised also on the borders of puddy fields in small quantities for the same purpose.

As started previously, the majority of farmers raise domestic animals but the number of animals is small, being intended only for self-use. In general, the size of a family and available family labor are too large for the area under cultivation, thus compelling most of the farmers to become part-time farmers. According to Table 6, more than half of the total number of farmers in the project area are regarded as part-time farmers.

As far as the table is concerned, the ratio of part-time farmers to the total number of farmers is not related to the scale of farming. However, the local farmers do not seem to consider the farm labor hired by other farmers as part-time farming. Therefore, it an accurate survey is made by counting this type of labor as part-time farmers, the number of part-time farmers will increase further. Moreover, as part-time farming of this type is more frequent in small-scale farm households, it may be said that the majority of small-scale farmers are actually part-time farmers. As for types of side jobs, the share of day laborers is overwhelmingly large, followed by those in commerce, as shown in Table 7.

2-4-5 Land Use

During the rainy season, irrigation water is sufficient to cover the entire district of Tjihea. In the dry season, however, there is a shortage, and for this reason, the district is divided into two blocs, A and B, for alternate irrigation every other year. However, even in the bloc not irrigated that particular year, the irrigation water is not drained after the harvest of the rainy season crop but is utilized for the following crop.

Rice Plantation Area in Tjihea District Classified by Variety

Planting season	National variety	IR-5 (PB-5)	Local variety		Total
			Tjere	Bulu	
	ha	ha	ha	ha	ha
Rainy season, 1964/65	271,703	---	597,747	217,363	1,086,813
Dry season, 1965	249,967	---	782,505	54,342	1,086,813
Rainy season, 1965/66	293,440	---	597,747	195,626	1,086,813
Dry season, 1966	217,363	---	815,109	54,342	1,086,813
Rainy season, 1966/67	304,308	---	608,615	173,890	1,086,813
Dry season, 1967	271,703	---	782,505	32,605	1,086,813
Rainy season, 1967/68	315,176	---	619,384	152,154	1,086,813
Dry season, 1968	336,912	163,022	565,143	21,736	1,086,813
Rainy season, 1968/69	358,648	271,703	347,780	108,682	1,086,813
Dry season, 1969	271,703	434,726	369,516	10,868	1,086,813
Rainy season, 1969/70	304,307	456,462	271,703	54,342	1,086,813

Note: Survey by P.P. Tjihea

Of the households surveyed by the team, however, the number of rice growing households classified by variety is as follows: It is noted that the Sentral is most widely cultivated followed by PB-5 (IR-5) and that these two varieties account for a majority of the varieties of rice planted in the district.

According to a survey conducted recently by P.P. Tjihea, the rice plantation area classified by variety is as follows: Since 1968 the use of local variety is gradually declining and that of PB-5 (IR-5) is gaining in popularity. In the rainy season of 1969/70, the national variety was planted in 304 ha., IR-5 in 456 ha. and local variety in 326 ha.

Number of Rice Growing Households Classified by Variety

Variety	Rainy season 1969/70	Dry season 1970
Sentral	85	89
IR-5 (PB-5)	66	48
Bengawan	6	7
Djelita	2	7
Shinta	-	6
C-4	4	-
Begon Roti	2	1
Gonbol	-	4
Djerah	1	1

As mentioned previously, the paddy fields in the project area are used for two-crops-a-year cultivation, but the period of land use for the households surveyed is 265 days per year on the average. More specifically, the field is not utilized for a total of about 71 days from the time of harvest in the dry season to the start of plowing for the rainy season cropping and for 30 days until the start of rice transplanting. Similarly, the fields are not used for a total of about 58 days - 27 days from the time of harvest of the rainy season crop to the start of plowing for the dry season crop and 31 additional days until the beginning of rice transplanting. In other words, unharvested crop on the paddy fields for about 130 days per year. Naturally, the growing period of rice differs considerably depending on the variety. Since, however, improved varieties require a shorter growing period in general, the number of days the paddy fields is used for cultivation is expected to be reduced further in the future following the diffusion of improved varieties.

The variety now cultivated includes such local varieties as Djelita, Gambal and Segon Roti, but the most widely used are PB-5 (IR-5), Sentral, Bengawan, Shinta and C-4. All of these varieties are improved varieties suitable, for intensive cultivation. However, the amount of fertilizer and agricultural chemicals used is very small, as will be discussed later, and for this reason, it cannot be said that the paddy fields are being fully utilized for intensive cultivation.

Because of a shortage of irrigation water during the rainy season, the district is divided into two blocs and each bloc is irrigated in alternate years. As a result, 1/2 of the paddy fields is used for rice cultivation without irrigation each year. Moreover, the irrigation water is under the control of the Ministry of Public Works, and therefore, there is a possibility that the fields will not be provided with appropriate irrigation at the proper time.

Thus it may be said that the problem of irrigation water is one of the factors which prevent intensive use of the paddy fields.

As previously mentioned, the land other than paddy fields is being used for raising fruits, vegetables and pulse for the self-use of the farmers or as a bamboo forest, but in most cases, this type of cultivation is extensive (one) with no fertilizer and very little labor.

Table 1

Size of Farm Management	(1) Total	(2) House	(3) (2)/(1)	(4) Warehouse	(5) (4)/(1)	(6) Stable	(7) (6)/(1)	(8) Others	(9) (8)/(1)
ha									
A. >0.75	16	16	100%	6	38%	0	0%	2	13%
B. 0.75 - 0.50	49	49	100	5	10	1	2	2	4
C. 0.50 - 0.25	45	45	100	4	9	0	0	0	0
D. <0.25	36	36	100	3	8	0	0	0	0
Total	146	146	100	18	12	1	2	4	13

Table 2

Size of Farm Management	House	Warehouse	Stable	Others
A. >0.75 ha	71.50 m^2	28.6 m^2	- m^2	18.0 m^2
B. 0.75 - 0.50	56.85	11.7	8.0	28.8
C. 0.50 - 0.25	58.59	23.2	-	-
D. <0.25	39.58	7.0	-	-
Mean	56.63	17.1	8.0	26.8

Table 3

Size of Farm Management	Implements for Plowing Kinds	Implements for Plowing Numbers	Implements for Thrash Kinds	Implements for Thrash Numbers	Implements for Transport Kinds	Implements for Transport Numbers	Total Kinds	Total Numbers
A. >0.75 ha	4.3	8.0	0.25	0.31	0.31	0.31	4.86	8.62
B. 0.75 - 0.50	4.4	6.8	0.20	0.20	0.10	0.10	4.70	7.10
C. 0.50 - 0.25	4.3	5.6	0.16	0.16	0.16	0.16	4.62	5.92
D. <0.25	4.1	5.3	0.09	0.09	0.06	0.06	4.25	5.45
Mean	4.3	6.2	0.17	0.17	0.13	0.13	4.60	6.65

Table 4

Size of Farm Management	(1) Total	Farm House Feeding Domestic Animals (2) Households	(3) (2)/(1)	Farm House Feeding Domestic Fowls (4) Households	(5) (4)/(1)	Farm House Feeding Rabbits (6) Households	(7) (6)/(1)	Farm House Feeding Goats and Sheep (8) Households	(9) (8)/(1)	Farm House Feeding Cows (10) Households	(11) (10)/(1)
ha											
A. >0.75	16	14	88%	13	81%	0	0%	5	31%	1	6%
B. 0.75 - 0.50	49	40	82	39	80	0	0	14	29	0	0
C. 0.50 - 0.25	45	33	73	33	73	1	2	5	11	0	0
D. <0.25	36	23	64	23	64	0	0	0	0	0	0
Total	146	110	75	108	74	1	1	24	16	1	1

Table 5

Size of Farm Management	(1) Fowls	(2) Rabbit	(3) Goats and Sheep	(4) Cows
A. >0.75	6.2	-	5.6	5
B. 0.75 - 0.50	6.7	-	4.2	-
C. 0.50 - 0.25	4.1	6	3.0	-
D. <0.25	3.4	-	-	-
Mean	5.1	6	4.3	5

Table 6

Size of Farm Management	(1) Total	Farmer (2) Households	(3) (2)/(1)	Side work farmer (4) Households	(5) (4)/(1)
A. >0.75	16	6	38%	10	64%
B. 0.75 - 0.50	49	23	47	26	53
C. 0.50 - 0.25	45	21	46	24	54
D. <0.25	36	11	31	25	69
Total	146	61	42	85	58

Table 7

Size of Farm Management	(1) Total Side Work Farmer	Laborer (2) Households	(3) (2)/(1)	Salaried Man (4) Households	(5) (4)/(1)	Trader (6) Households	(7) (6)/(1)	Others (8) Households	(9) (8)/(1)
A. >0.75	10	4	40%	1	10%	5	50%	0	0%
B. 0.75 - 0.50	26	16	62	0	0	7	26	3	12
C. 0.50 - 0.25	24	19	79	3	13	1	4	1	4
D. <0.25	25	14	56	6	24	5	20	0	0
Total	85	53	62	10	12	18	21	4	5

Table 8

Average days from harvest time of dry season to plowing time of wet season	41.4 days
Average days from plowing time of wet season to rice-planting season	29.5
Total	70.9
Average days from harvest time of wet season to plowing time of dry season	27.2
Average days from plowing time of dry season to rice-planting season	31.1
Total	58.3

2-5 Present Situation of Irrigation

2-5-1 Whole Tjihea Irrigation System

Whole Tjihea Irrigation System is taking its water from Tjisokan River by Tjisokan Diversion Dam. From this Dam, water is conveyed to the area by main canal and further conveyed to every nook and corner of the area by 6 lines of secondary canals and networks of tertiary canals irrigating the whole paddy field of 5,409 ha.

(a) Tjisokan Diversion Dam

Tjisokan Diversion Dam is located at a point immediately downstream of the junction of two rivers, namely Tjisokan River and Tjibubuaj River, a small tributary to Tjisokan River. It is a concrete consisted of stationary portion and movable portion with 2 sets of sand sluice. Maximum quantity of intake by this Dam is 7.0 m^3/sec. Operation and maintenance of this Dam is being carried out by Tjirandjan Branch of Tjirandjan Office, Department of Public Works.

This Diversion Dam has been functioning ever since its completion in 1898, however, superannuation of the entire structure is quite severe and immediate repair is considered necessary. Repair program of the Tjihea Irrigation System set out by the Department of Public Works is giving lst priority for the repair of this Dam.

(b) Main Canal

Main Canal runs from Tjisokan Dam through the area at the foot of mountain on the south side and stretches 17 km in total length. First portion of about 1.5 km of this canal is in tunnel and the rest of it is earth canal with a trapezoidal cross section with an exception of some portion. Since the canal is running through rugged terrain, numerous drop structures are provided. Crossing over the rivers is done by aqueduct as the rivers in the area are forming deep gouges. There are number of inverted syphons, and other kind of structures as well. Major turn-outs are provided at 13 points on this 17 km main canal in the Project Area. Quantity of flow in this main canal according to the measurement made during the month of December was 7.0 m^3/sec. at the upstream at the point of Sukaram aqueduct. (See Appendix B. 4-1)

Operation and maintenance of this canal is carried out as same as that of the weir, also by the Department of Public Works. Superannuation of the main canal is also progressed to a stage which requires repair works over the entire length of the main canal. Gradient of the canal in majority portion is maintained at 1/1,000 - 1/1,500 by number of drop structures, however, considerable erosion can be seen at some portions of the canal where gradient is quite steep. Partial repair is being carried out by the Department of Public Works who is, at the same time, considering 5 year program for repair works on entire line of the main canal.

(c) Lateral

Lateral is classified into 2 types: One is called as Secondary Canal which directly branches out from the main canal, or which starts from a headwork built on the river to divert irrigation water once discharged from the main canal. The other is called as Tertiary Canal which is considered of a canal which branches out from the Secondary Canals.

Total length of these canals are as follows:

Secondary Canal	53.7 km
Tertiary Canal	200.2 km

Operation and maintenance of Secondary Canal is in the hand of the Department of Public Works and the operation and maintenance of Tertiary Canal and smaller canal is carried out by the farmers.

(d) Drainage Canal

Number of rivers running in the area such as Tjitalahab, Tjibareg beg, Tjirandjang, Tjibiuk, Tjihandeuleun, etc., are acting as main drainage canals and drain into Tjisokan and Tjitarum rivers.

Total length of drainage canals is 178 km.

2-5-2 Mode of Whole Tjihea Irrigation System

(1) Mode of Irrigation System

Due to the fact that the discharge of Thisokan River during the draught season is not sufficient for the total water requirements for the whole area, rotation block irrigation system has been adopted by dividing the whole area into two blocks.

By this irrigation system, the whole area is divided into Block (1) and Block (2) and during the rainy season the whole area is to be irrigated while during the dry season only half of the whole area, either one of Block (1) or Block (2) is planned to be irrigated. Water requirements being designed is 7.0 m^3/sec. for rainy season and 3.5 m^3/sec. for dry season, while unit water requirement is 1.2 liters/ha.

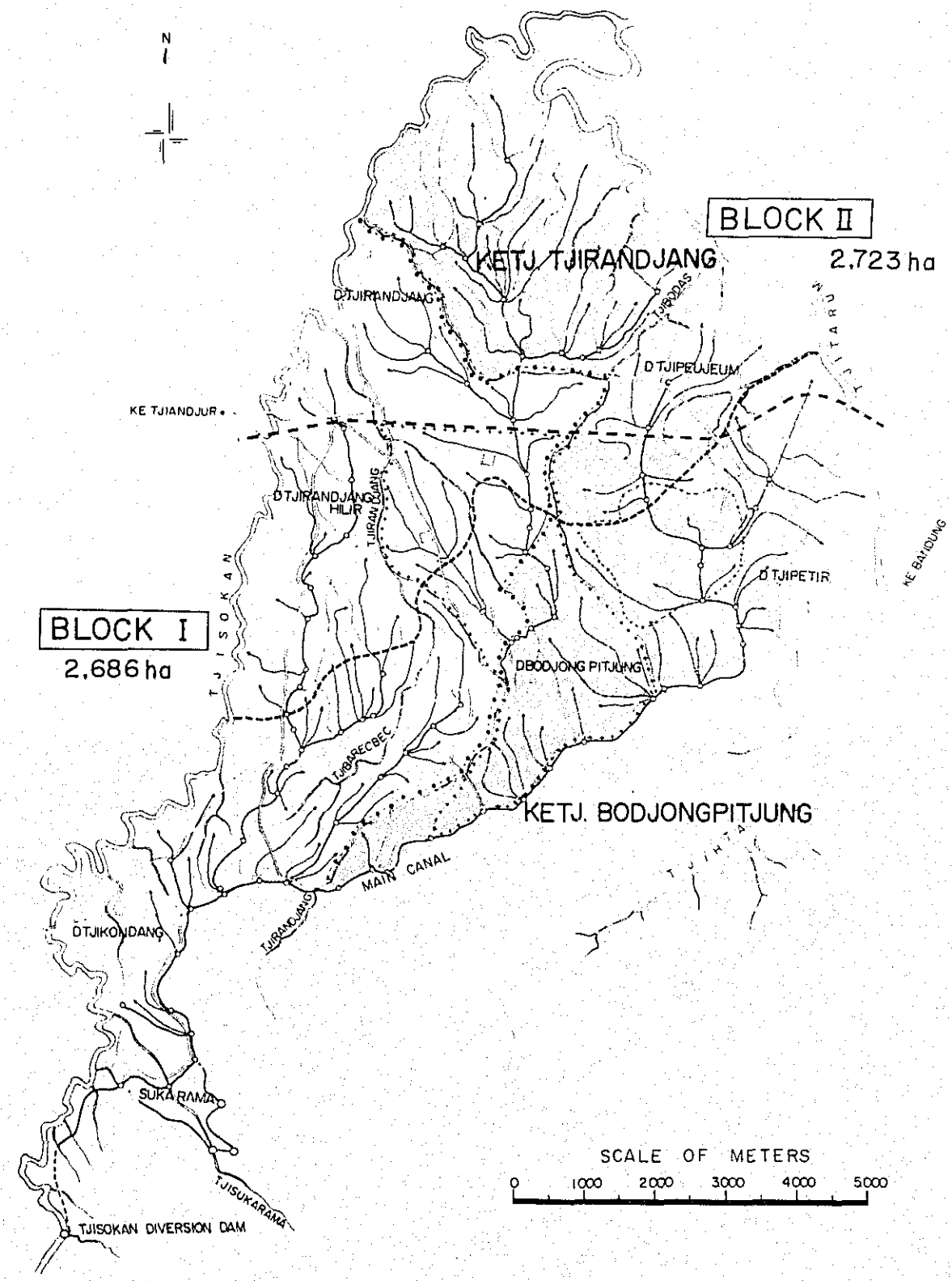
The boundary of Block (1) and Block (2) is shown in the map attached and each area is shown in the following:

Block (1)	2,686 ha
Block (2)	2,723 ha
Total	5,409 ha

Supply of water is being carried out based on the Water Supply Schedule as indicated on the circular diagram.

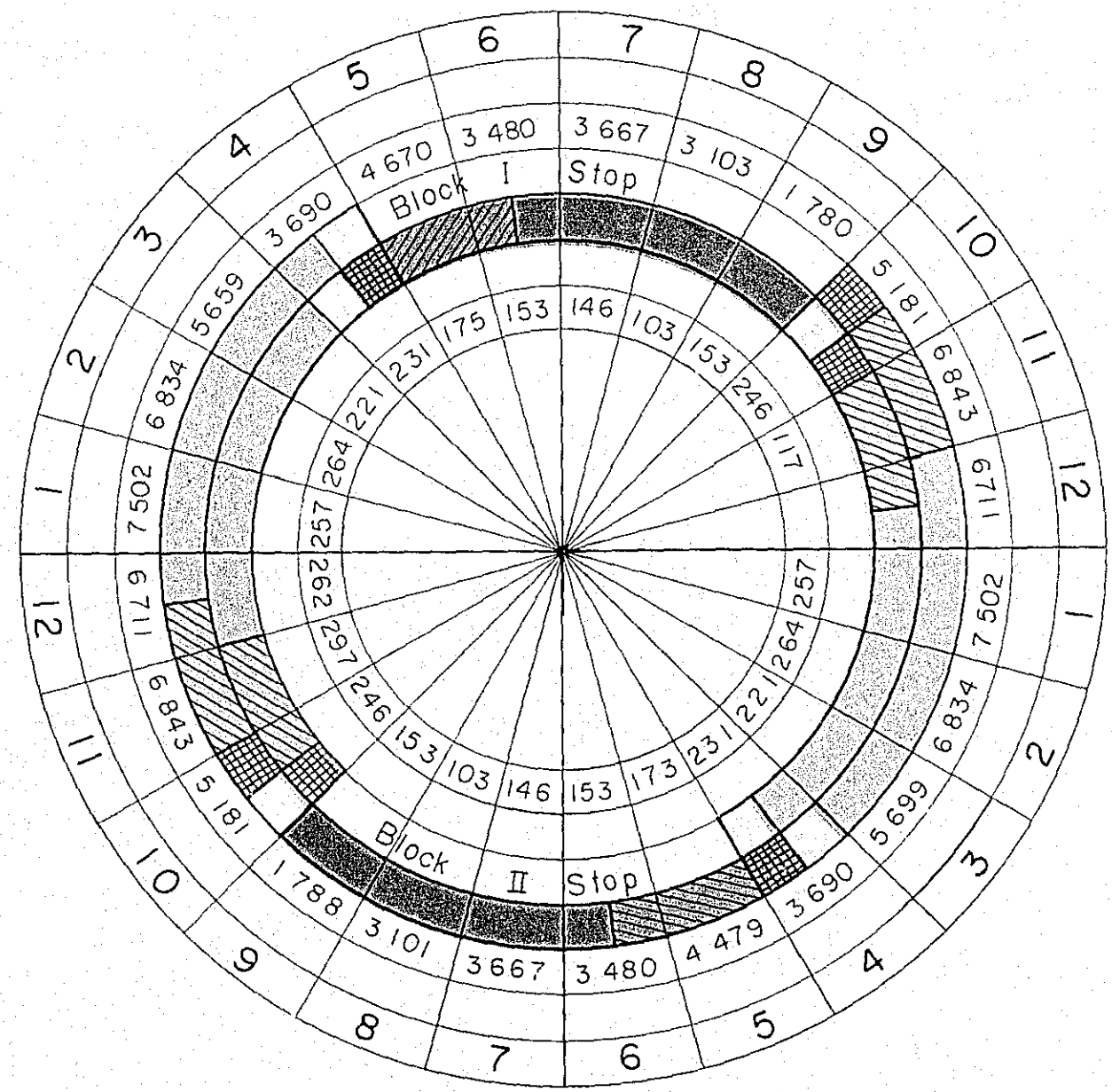
This circular diagram indicates that 2 year period is being made into 1 irrigation circle and 1 irrigation circle is being divided into 24 equal parts. 1 year period is being divided by 12 different months. It indicates from the inner portion of the circular that effective monthly rainfall, Block (2) zone, Block (1) zone and designed water requirements respectively. Green portion for both Block (1) and Block (2) indicates the cropping during the rainy season while red portion indicates the cropping during the dry season. White portion indicates the times for fallow. Accordingly, this diagram indicates that Block (2) in 1969 and Block (1) in 1970 are to be laid fallow during the dry season respectively.

Irrigation for the Whole Tjihea has been carried out in accordance with such Water


N
BLOCK II
KETJ. TJIRANDJANG
2,723 ha
D.TJIRANDJANG
TJIRODAS
D.TJIPEUJEUM
KE TJIANDJUR
D.TJIRANDJANG HILIR
TJIRANDJANG
TJISOKAN
BLOCK I
2,686 ha
D.TJIPETIR
KE BANDUNG
D.BODJONG PITJUNG
TJIBARECBEC
KETJ. BODJONGPITJUNG
TJIHEA
MAIN CANAL
TJIRANDJANG
D.TJIKONDANG
SUKARAMA
TJISUKARAMA
TJISOKAN DIVERSION DAM
SCALE OF METERS
0 1000 2000 3000 4000 5000

WATER SUPPLY SCHEDULE
in TJIHEA IRRIGATION SYSTEM

1970



1969

··· Wet Season

··· Harvest Time

··· Dry Season

··· Seeding

··· Plow and Rice Planting

Supply Schedule.

(2) Tjisokan River and Water Requirement

Nevertheless the Water Supply Schedule is stipulated as a basic rule as above described, it has been observed that rice cropping in the Tjihea Area has been carried out in the entire area of Tjihea throughout the year, regardless of the seasons, for the past several years. Such fact indicates that Tjisokan River was capable of supplying sufficient water for the whole area even during the draught season.

In order to clarify a relationship between the irrigation plan and the discharges of Tjisokan River it will be necessary to obtain the data of observation of Tjisokan River discharges for a long period. Such data were not available for the recent years but the record of observations for the period of 11 years since 1922 to 1932 were found. The relationship between the two factors were studied based on this record. (Appendix B. 5)

Cropping of rice during the dry season is scheduled to start from the middle of April and end at the middle of October while fallow of the other block during this period is scheduled to be between the early part of May and the end of September.

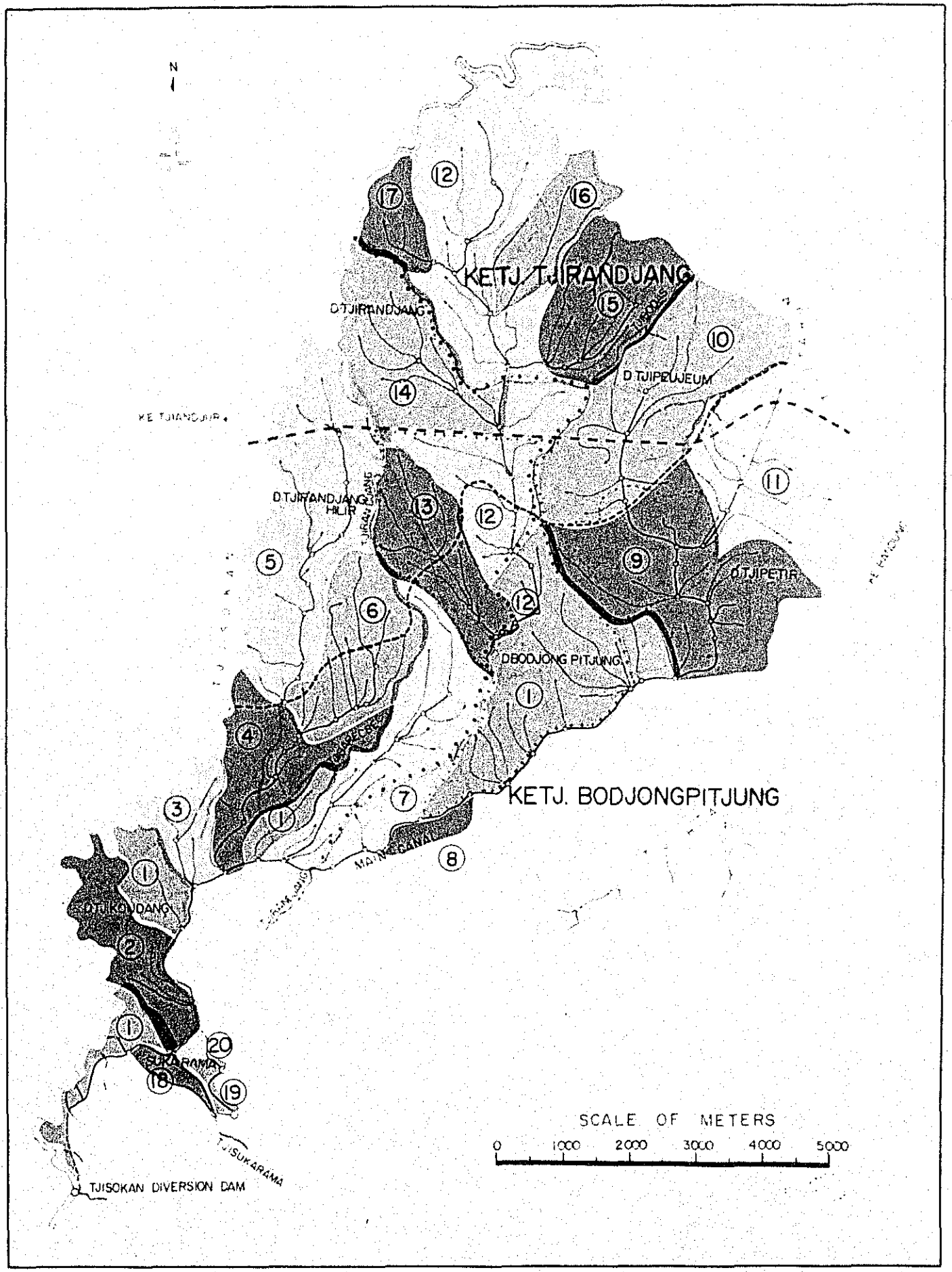
During the scheduled fallow period, May, June, and until the middle of July, irrigation water requirement reaches maximum because growth of rice goes through the periods of tiller, ear premordia stage, and ear sprouting. Then, it will be possible even for scheduled fallow area to have cropping if the discharges of Tjisokan River amounts to about 6.0 m^3/sec. during this period.

According to the discharge table on the Tjisokan River for 11 years, minimum mean monthly discharge in May shows 14 m^3/sec. and that in July was 7.41 m^3/sec. with an exception of 3.54 m^3/sec. which was recorded in 1925. In July, there were discharges of less than 6 m^3/sec. recorded 4 times. These records indicate that the Tjisokan River discharges are capable of supplying water to fallow blocks with an exception of one draught year in 10 year period.

From these facts and figures it is apparent that double crop farming has been done almost every year in the entire area of the whole Tjihea Area.

(3) Areas and Irrigation System

Whole Tjihea Area has been divided into 20 different Areas depending on the irrigation system as follows:


N
KETJ. TJIRANDJANG
D.TJIRANDJANG
D.TJIPEUJEUM
D.TJIRANDJANG HILIR
D.TJIPETIR
D.BODJONG PITJUNG
KETJ. BODJONGPITJUNG
D.TJIKOEDJANG
SUKARAMA
TJISUKARAMA
TJISOKAN DIVERSION DAM
MAIN CANAL
SCALE OF METERS
0 1000 2000 3000 4000 5000

1.	Tjisokan district	843 ha
2.	Tjikondang	101
3.	Tjitalahab	91
4.	Tjidukuh	189
5.	" (West)	382
6.	" (East)	360
7.	Tjibarengkok	372
8.	" (A)	50
9.	Tjipetir	515
10.	" (West)	466
11.	" (East)	266
12.	Tjirandjang	718
13.	Pasirdawuan	310
14.	Tjikorondjo	326
15.	Tjibanteng	167
16.	Ngamprah	117
17.	Sampih	58
18.	Tjisukarama	50
19.	Tjileueur	6
20.	Tjikadu	22
	Total	5,409 ha.

Tjisokan Area out of the above 20 districts is the only Area which is being irrigated directly from the main canal through Tertiary Canal or irrigation ditches. The rest of 19 Areas are being irrigated directly from the Secondary Canal or canals connected to the Secondary Canal and Areas are therefore named after the names of each canal by which they are irrigated. Districts numbered 2, 3, 4, 5, 6, 7, 8, 12, 13, 14, 18, 19, 20 and upstream portion of Area No. 1 belong to Block (1) and the rest of Areas belong to Block (2).

2-5-3 Project Area

(1) Canal

(a) Main Canal

Main Canal runs into the Project Area at the point of 10 km downstream from Tjisokan Diversion Dam and stretches 4.6 km within the Project Area. After it passes through the Project Area it runs about 2.4 km before it reaches the terminal point.

Structures on the Main Canal are shown on Appendix B. 4-3. Most important structures among these are the turnouts and spillways. These structures function to regulate the quantity of irrigation water which is once discharged from the Main Canal into Tjirandjang River and then taken into the Secondary Canal at the intake weir located about 3 km downstream at the intersection with Bodjong pitjung provincial road. Turnouts by which the irrigation water is taken out directly from the Main Canal to (1) Tjisokan Area are provided at 10 places along 4.6 km section of the Main Canal.

(b) Secondary Canal and Tertiary Canal

Secondary Canal in the Project Area begins from the Bodjong pitjung intake weir and runs along the east side of the Project Area in parallel with Tjibodas River as it is irrigating the Project Area and further it advances toward North and runs out of the Project Area after intersecting with the railroad. Length of the Secondary Canal in the Project is 4.5 km and it shoot out a branch at the point 648 m downstream of the intake weir. Branched Secondary Canal runs about the center of 100 ha. of pilot farm and its length is 800 m. Secondary Canal which was extended out of the Project Area further runs toward North and branch off to irrigate districts of (14) Tjikorondjo, (15) Tjibanteng, (16) Ngamprah, and (17) Sampih. These Secondary Canals are earth canal and various drop structures are provided. Tertiary Canals are started out from these drop structures. Location of structures are shown on (Appendix B. 4-3).

Length of Tertiary Canals in the Project Area is too short in comparison with the area to be irrigated in the Project Area. For this reason, there are very few paddies irrigated directly by the Tertiary Canals and most of paddies are irrigated by plot-to-plot irrigation method.

(c) Drainage Canals

Three rivers in the Project Area, Tjibodas in the east, Tjirandjang in the west and Tjibiuk in the center are functioning as drainage canals and they all drain into Tjisokan River. There are many cases which some part of the Secondary Canals and Tertiary Canals are acting as drainage canals as topography of the Project Area is comparatively inclined.

(2) Irrigation Blocks

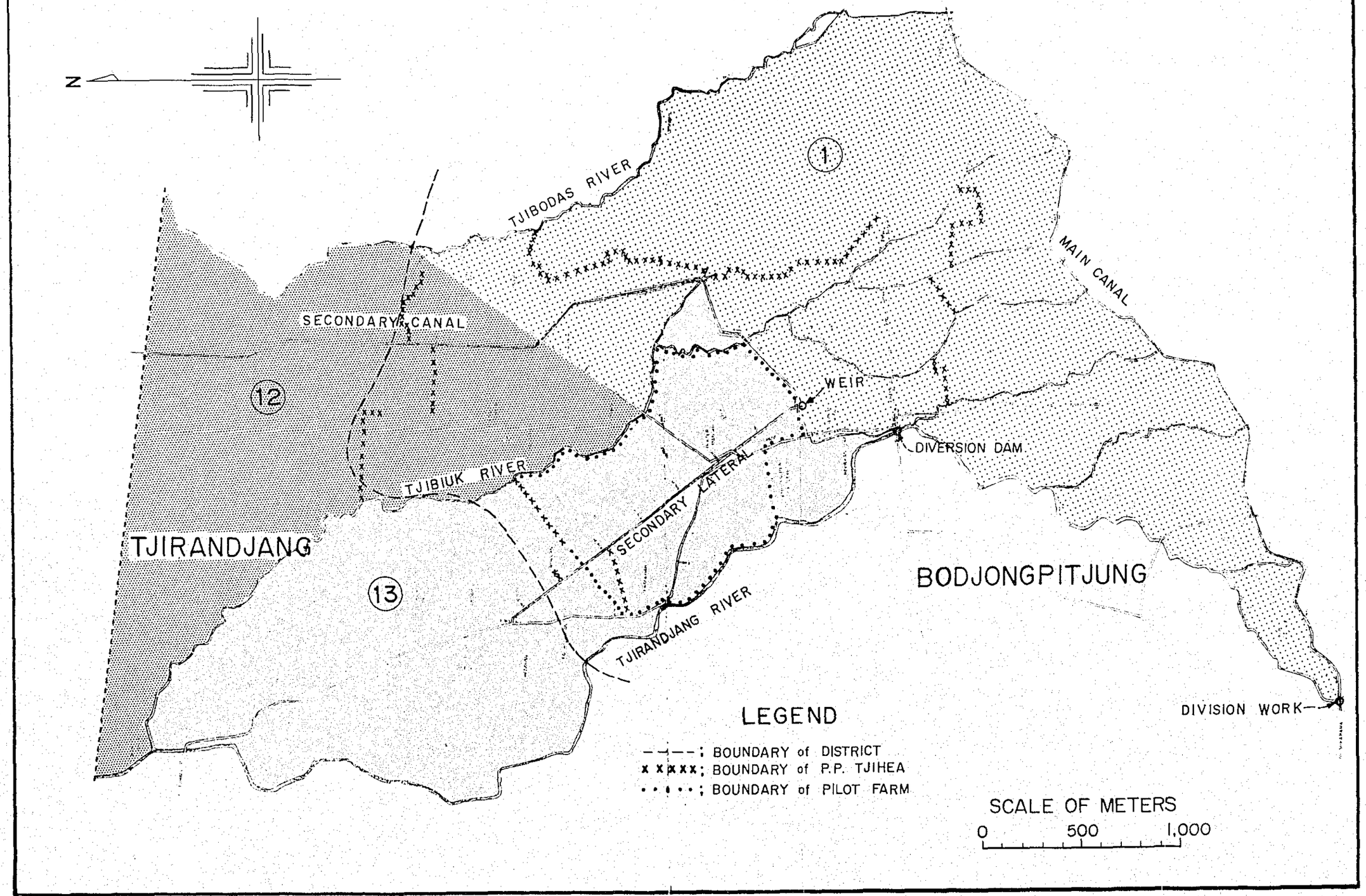
The Project Area of 1,086 ha. is divided into irrigation Block (1) and Irrigation Block (2). Area of (1) Tjisokan is irrigated directly by the Main Canal on the South-side of the area. Districts (12) Tjirandjang and (13) Pasirdawuan are irrigated by the Secondary Canal and belong to Block (1).

Block (1)	
(12) Tjirandjang	310 ha.
(13) Pasirdawuan	300 ha.
Block (2)	
(1) Tjisokan	476 ha.
Total	1,086 ha.

The proposed Pilot Farm of 100 ha. in the Project Area belong to the district (13) Pasirdawuan. Farms of 250 ha. belong to and operated by P.P. Tjihea are located adjacent to the districts (1), (12), and (13).

2-6 State of Road Facilities

P.P. Tjihea, the center of Bodjongpitjung District, is located in the Project Area and the


N
TJIBODAS RIVER
1
MAIN CANAL
SECONDARY CANAL
12
WEIR
DIVERSION DAM
TJIBIUK RIVER
SECONDARY LATERAL
TJIRANDJANG
13
TJIRANDJANG RIVER
BODJONGPITJUNG
DIVISION WORK
LEGEND
; BOUNDARY of DISTRICT
; BOUNDARY of P.P. TJIHEA
; BOUNDARY of PILOT FARM
SCALE OF METERS
0
500
1,000

following provincial roads are connecting the Project Area to the outside.

(a) Bodjongpitjung - Tjirandjang Route

This provincial road is connecting the center of each district and connecting to national highway and railroad station at Tjirandjan and is considered a most important road in the Project Area. Total length of this road is 4.9 km out of which 4 km is running within the Project Area with width of 7 - 10 m. Road surface is paved with coarse gravels. The road has been used without any repair and maintenance for a long time that damages on the road condition is so severe that motor vehicle become impassable during the time of raining. For this reason, repair work has been started at present and upon completion of the work, the road will be paved with asphalt and is expected to function as trunk route which connects to P.P. Tjihea.

(b) Bodjongpitjung - Tjipeujeum Route

This road connects Tjipeujeum which is located along the national highway with the Tjirandjang Route at the point about 100 m north of P.P. Tjihea and runs through the villages located on the east side of the Project Area and reaches to the national highway. This road is important as connecting road between the villages. Total length of this road is 4.5 km out of which 2.1 km is running within the Project Area with width of 7 - 10 m. This road is also surfaced with coarse gravels, damaged severely and becomes impassable by motor vehicle during the time of raining. Immediate repair works on several spots on this road is desirous.

(c) Bodjongpitjung - Tjipater Route

This road is connecting the villages located along the national highway, namely Tjipater and Bodjongpitjung, and reaching to Djati located south-west of the Whole Tjihea Area. This road runs east and west at the south side of the Whole Tjihea Area and is considered an important road connecting all the districts. Total length of this road is 6 km from Bodjongpitjung to Tjipater and 2.2 km within the Project Area and 3.6 km to Djati out of which 1.7 km is within the Project Area. Width of the road is 4 - 8 m. It requires repairs at some portions of the road but motor vehicle is passable in general.

There are some more roads, connecting the villages in the Project Area, and some farm roads existing other than 3 routes of roads as described above. However, these roads are mostly of narrow width with clayish material and are impassable by motor vehicle.

CHAPTER 3 PLANNING

CHAPTER 3 PLANNING

3-1 Management Plan

3-1-1 Organization of Farm Management

As the average acreage of paddy fields owned by each farm household in the district is only 0.33 ha. and there is a very small area of upland field available, the direction for the improvement of farm management will have to be sought in diversified farming.

In other words, multiple farming centering on rice cultivation with emphasis placed on the improvement of productivity of land combined with livestock raising (animal husbandry) will be the most desirable pattern of farm management.

As for livestock raising, the introduction of poultry raising will be most practical for general farmers except for some who will gain more benefits by raising cattle and goats. With regard to rice cultivation, 5 crops in 2-year cultivation through the introduction of improved varieties or the introduction of upland crops for the period immediately after the harvest of the dry season crop until the start of rice transplanting for the rainy season crop is conceivable as a means to increase the intensity of cropping and prevent deterioration of land productivity. It will be of particular importance to plan for the maximum use of surplus labor force.

The scale of pultry farming should be determined according to the size of the paddy fields owned by each farmer or, in other words, the amount of the production of chaff and bran for the feed required. Under present conditions, therefore, the raising of about 20 matured chicken on the average will be most appropriate as the size of poultry farming for each household.

3-1-2 Farm Management Pattern

In order to increase the productivity of land, it is essential to plan for the improvement and popularization of farming techniques and to aim at the uniformity of farm products from the standpoint of marketability. The farm management pattern that will fulfill the above requirement is cooperative farm management.

For rice cultivation, an attempt should be made to introduce gradually cooperative work into such areas as the use of cultivators for plowing, soil preparation, rice transplanting and plant protection. Of course, this would be possible only after the adoption of cooperative (joint) water management on the condition that there is complete readjustment of arable land.

It is also desirable to utilize cooperative (common) facilities for processing farm products after harvesting and to plan for cooperative storage and selling of farm products.

On the other hand, efforts should be made to shift gradually to a cooperative system in every field of farm management including the purchase of fertilizers and agricultural chemicals and the acquisition of agricultural loans. In other words, plans should be made to establish a multilateral agricultural cooperative. With regard to poultry farming, it is considered desirable to plan for large scale cooperative poultry farming in the future.

3-1-3 Goal of Production

With the implementation of the land readjustment program, coupled with appropriate irrigation and drainage, extension of improved cultivation techniques, progress of mechanization and increased fertilization, it will be possible to achieve not only an increase in production of the single annual rice crop but also a sharp increase in annual production per unit area since 5-crop cultivation in 2-years will become possible.

However, the land readjustment program cannot be implemented immediately for the whole project area. It will be appropriate, therefore, to implement the farm management improvement program immediately in anticipation of the situation following the implementation of the land readjustment program, without waiting for its actual implementation, and to proceed with the program in stages.

(1) Minimum Attainable Goal of Rice Production Prior to Implementation of Land Readjustment Program.

The average production goal of paddy rice per ha. is to be 4.2 tons (padi) for the rainy season crop and 3.8 tons for the dry season crop.

At present, the average yield per ha. for the surveyed households is 3.71 tons for the rainy season crop and 3.08 tons for the dry season crop. However, when chemical fertilizer amounting to more than Rp. 5,000 in value is applied to such varieties as Sentral and PB-5 per cropping, the average yield is more than 4 tons for the rainy season crop and 3.5 tons for the dry season crop, as shown in Table 11. In some cases, the average yield exceeds 6 tons for the rainy season crop and 5 tons for the dry season crop

At the seed-bed of P.P. Tjihea, the following chemical fertilizers and agricultural chemicals are applied per ha. and an average of 3 tons of gabar-kering is being produced. This is approximately 3.9 tons in terms of padi.

Urea	200 kg	Rp. 5,000
T.S.P.	100 kg	Rp. 2,500
Endrin	4 ltr.	Rp. 1,100
Total		Rp. 8,600

The results of experimental cultivations conducted by the Mitsubishi Bimas Project Assistance Team show a padi kering yield of more than 5.5 tons for PB-5 and more than 4.2 tons for Bengawan when chemical fertilizers in the value of Rp. 10,640 are applied per ha., as shown in Table 20.

These examples show that the attainment of the above objective is possible if chemical fertilizers in the value of approximately Rp. 7,000 and natural fertilizers such as chicken droppings are applied together with the diffusion of corresponding cultivation techniques.

In this case, the emphasis of the technical improvement should be placed on the management of seedling beds, methods of fertilization and chemical spraying.

The amount of chemical fertilizer used is almost equivalent to Bimas or Packet A of Tani Makmur credit. Therefore, it will be possible to attain this production

goal through the present promotion of the Tani Makmur Project.

(2) Goal of Rice Production Following the Completion of Land Consolidation Program

The goal is to be set at 5 crops in 2-year cultivation with an average yield per cropping of 4.2 tons (padi) per ha. In the event the 5 crops in 2-year cultivation is not possible, the minimum average yield is to be 4.6 tons for the rainy season crop and 4.2 tons for the dry season crop.

When the land consolidation program is carried out and reasonable usage of water materializes, the application of fertilizer in increased quantities will be possible. An increase in yield is also conceivable through deep tillage with the use of cultivating machines.

Application of chemical fertilizers in the value of approximately Rp. 10,000 per crop will result in a yield of at least 4.6 tons for the rainy season crop and 4.2 tons for the dry season crop. The annual average yield of 5 tons per cropping will also be possible through improvements in variety and effective fertilization.

In the case of 5 crops in 2-year cultivation, some decrease in soil fertility must be taken into consideration and the yield is expected to decrease compared with that in the case of two crops a year cultivation. Nevertheless, an average yield of at least 4.2 tons per crop will be possible.

(3) Goal of Poultry Production

An average of 20 chicken is to be raised by each household, and approximately 3,400 eggs and 20 chicken for eating are to be produced annually. Assuming that one hen lays about 170 eggs each year, a total of 3,400 eggs by 20 hens can be obtained. Assuming that 20 eggs are hatched for replacement of old hens and that 10 of the 20 hatched chickens are cocks, these 10 cocks plus 10 replaced hens may be used for meat.

Of course, the introduction of improved breeds will result in an increase in egg production and also in the number of hatchings, thus making it possible to use part of the layers for increased meat production.

3 1-4 Income and Expenditure

(1) Rice Production Prior to the Implementation of Land Consolidation Program

If the above goal is attained, the earning and expenditure per ha. for one cropping will be as follows:

Income

Padi	4 ton	@20 Rp/kg	Rp. 80,000

Expenditure				
Fertilizer		Packet A		Rp. 6,517
Agr. Chemical		Packet A		2,395
Sprayer		Packet A		600
Seed		Packet A		1,000
Wage:				
for hired	Male:	50	@ Rp. 150	
labor	Female:	40	@ Rp. 70	10,300
Cost of materials				3,000
Total				Rp. 23,817
Balance				Rp. 56,183

As large-scale farm households depend more on the hired labor, the expense for wages will be larger than that shown above, while on the other hand, small-scale farm households are more dependent on family lands and the expense for wages will be less.

Since the two-crop a year cultivation is practiced in the district, the annual income per ha. amounts to Rp. 112,366. Accordingly, the annual income for a farmer cultivating 0.33 ha. of land will be Rp. 37,081 on the average.

(2) Rice Production Following the Completion of the Land Consolidation Program

The income and expenditure per ha. for each cropping in the case of the 5 crops in 2-year cultivation will be as follows:

Income			
Padi	4.2 tons	@20 Rp/kg	Rp. 84,000
Expenditure			
Fertilizer			Rp. 10,000
Agr. Chemical			2,500
Sprayer			600
Seed			1,000
Wage for hired labor			4,000
Rent of tiller			3,000
Cost of materials			3,000
Total			Rp. 23,100
Balance			Rp. 59,900

Accordingly, the annual income per ha. will be Rp. 149,750. The average annual income per ha. for a farmer whose cultivation area is 0.33 ha. will be Rp. 50,317. Income and expenditure per ha. for each cropping in the case of two-crops a year cultivation will be as follows:

Income			
Padi	4.4 tons	@20 Rp/kg	Rp. 88,000
Expenditure			
Same as for the 5 crops in 2-year cultivation			Rp. 23,100
Balance			Rp. 64,900

Therefore, the annual income per ha. will be Rp. 129,800 and the average annual income for a farmer whose cultivation area is 0.33 ha. will be Rp. 42,834.

If upland crops are introduced in addition to paddy rice, as mentioned previously, income from these crops will be added to the above earnings.

(3) Poultry Farming

If the previously set goal is attained by raising 20 chickens, income and expenditure will be as follows :

Income			
Eggs	3,400	Rp. 10	Rp. 34,000
Meat chicken	20	Rp. 100	Rp. 2,000
Total			Rp. 36,000
Expenditure			
Feed: Rice bran 1,000 kg (home-made feed)			
Others			Rp. 700
Depreciation expense (Chicken and poultry facilities)			Rp. 1,500
Total			Rp. 2,200
Balance			Rp. 33,800

Products have been evaluated at lower than market prices in consideration of home consumption in part.

Chicken droppings are not included in the calculation. The annual profit of an average farm household whose cultivation area is 0.33 ha. engaged in both rice cultivation and poultry farming will be as follows:

i. Prior to the Implementation of Land Consolidation Program

Profit from rice cultivation	Rp. 37,081
Profit from poultry farming	Rp. 33,800
Total	Rp. 70,881

ii. After Implementation of Land Consolidation Program

Profit from rice cultivation (5 crops in 2-year cultivation)	Rp. 50,317
Profit from poultry farming	Rp. 33,800
Total	Rp. 84,117

3-2 Planning of Farmers' Organizations

3-2-1 Cooperative Work

The purpose of the Tjihea Tani Makmur Project is the modernization of agriculture through the introduction of up-to-date agricultural techniques and thereby to elevate the standard of living and strengthen the economy of farm households in the area. In other words, the project aims at readjustment of arable land, improvement of rice cultivation techniques and promotion of farmers' organizations.

To attain these objectives, the following new techniques will be required:

(1) Cultivation Techniques

Introduction of improved varieties, and improvement and diffusion of new techniques in fertilization, water management and plant protection (prevention and control of insect damage).

(2) Introduction of agricultural machinery and implements and facilities

Improvement of agricultural machinery and implements, introduction of modern farm machinery, construction of farm products storage facilities, improvement of water-use facilities and diffusion of techniques used for such purposes.

(3) Cooperative work

As the works described in the previous paragraphs (1) and (2) cannot be accomplished by individual farmers, there must be a cooperative work system. This will require cooperative nurseries, rice transplanting and plant protection and joint use of agricultural machines and facilities. At present, the introduction and diffusion of new farming techniques in relation to the works described in previous paragraphs (1) and (2) are being promoted in Tjihea district by experts of various fields centering around P.P. Tjihea. As for agricultural machines and implements and facilities, required, these have already been provided through aid from Japan. For the effective utilization of these machines and also for the improvement of cultivation techniques with the use of the machines, readjustment of arable land will be one of the indispensable factors.

Promotion of farmers' organization and cooperative farm work following the expansion of readjustment of arable land to the entire district will be the key to the success of this pilot project.

3-2-2 Joint (Cooperative) Management of Irrigation Water

(1) Necessity of Joint (Cooperative) Management of Irrigation Water

For the effective utilization of new techniques in rice cultivation and promotion of cooperative farm work, there must be proper water management, that is, appropriate distribution and management of irrigation water corresponding to the growth of the rice-plant and required field work. This will necessitate the partici-

pation of farmers in water management.

This point is important not only because it has direct bearing on the promotion of productivity but also because it stimulates the willingness of farmers for production which is indispensable for the future development of agriculture.

For the realization of cooperative work and cooperative (joint) water management, there must be a well-selected common basis for the solidarity of farmers in the district and an organization founded on this basis.

(2) Common Basis of Organization

The characteristics of community pattern in West Java, particularly in the Tjihea district, is that a village (Desa) consists of several Kampung, which in turn consists of several Ketjamatan. A Ketjamatan is made up of 5 to 6 households.

This unique feature of the community originates in the development pattern of the hamlet centering on paddy rice cultivation following the introduction of paddy fields into West Java after the 18th century. In other words, the number of households increased in proportion to the increase in the area of paddy fields in a Kampung, which in a later stage developed into a village.

The fact that the increase in the area of paddy fields contributed to the formation of villages one after another is an indication of strong desire for individual possession of land resulting from private ownership of paddy fields. On the other hand, village control over the land was very weak and as a result, there was very little public land in the village. The Tjihea Project Area was completely owned by the government until 1969 when 836 ha. of land, with the exception of 250 ha. were released to local farmers. Although conditions in the project area differ somewhat from the rest of Tjihea Area, it is the same as the whole Tjihea Area as far as the development pattern of the village is concerned.

The fact that the village does not have strong control over the land is an indication of the weakness in solidarity among the villages. Therefore, the basis for community awareness in the Tjihea Area must be found in the joint, use of irrigation canals which may be said to be the life-blood of the rice crop, the common product of the farmers in the district. Such a practice will soon lead to joint (cooperative) water management and will build up the foundation for organizations of farmers.

(a) Irrigation Network and Water Management

The irrigation system in the Whole Tjihea Area consists of the Diversion Dam, main canal, secondary canals and tertiary canals. The standard area to be covered by the secondary canal and its branch canals is set at 200 ha. and the system has been set up to function well within this limit. Therefore, the tertiary canal which follows the secondary canal is designed to cover paddy fields of less than 200 ha. in area. At present, the main canal and the secondary canal are under the control of the Water Management Office of the Ministry of Public Works and the distribution of irrigation water is controlled in accordance with official standards.

The standards were established when the system was set up for the first time and has been followed for over a half of a century until today. The past method is valuable in that it was instrumental in the simplification of otherwise complicated water allocation and that it helped establish a rice cultivation system adaptable to the fixed water allocation system each year. However, for the improvement of productivity through introduction of new cultivation techniques and water management, distribution of water corresponding to the progress of cultivation will be required as a function of the whole irrigation system.

Though the branch canals following and including the tertiary canals are said to be under the control of farmers, only the intake of water is allowed the farmers during the period of diversion from the secondary canal.

(b) Basis of Cooperative Work

For the puddling stage when the allocation of water becomes a most important in rice cultivation, it will be most appropriate to consider the paddy fields covered by the tertiary canal as common property and provide cooperative (joint) work. Some of the areas covered by the canal extends over 200 ha, but the majority is covered by tertial canals and the area controlled by one tertial canal is about 30 ha. on the average. It is desirable, therefore, to divide paddy fields into sections of about 30 ha, and use this section as a standard unit. This is recommended for the following reasons:

(i) In Tjihea Area, roads and drainage canals often divide paddy fields into sections of about 30 ha.

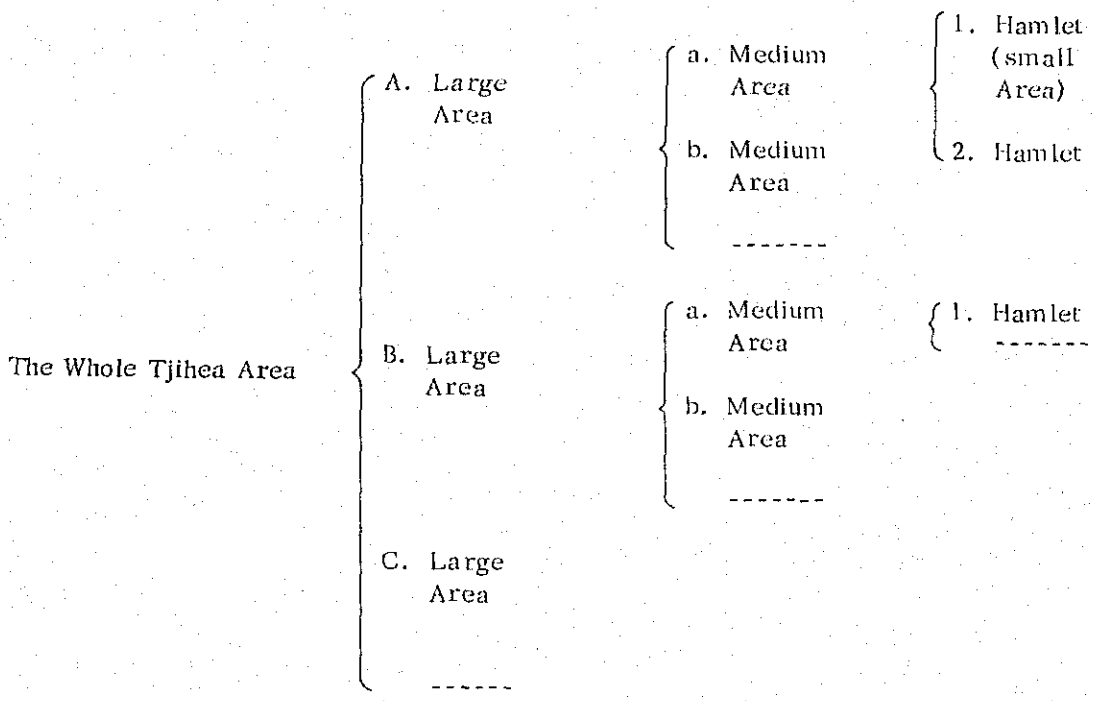
(ii) The average acreage of paddy fields owned by each farmer in the district is 0.3 ha. Therefore, a section of 30 ha. covers about 100 households as a unit.

(iii) The size of the unit is also appropriate for the management of farm machines to be used in cooperative work.

For example, 6 cultivators are planned for a unit of 30 ha.

(iv) The size of the unit is considered appropriate for the farmers to receive training in new farming techniques and their diffusion.

The minimum unit of a community is to be a hamlet and a group of hamlets will form a medium district as a standard community. A group of standard communities linked together through the secondary canals will make up a large district.



(3) Water Management

It is desirable that the standard units covered by the tertiary canals and their branch canals from a group; that several groups of this type in the whole area benefited by secondary canals from a large area; and that the water management in this area be carried out by representatives of the farmers. The ideal form will be for representatives of each large area to cooperate in forming an organization for water management in the whole Tjihea Area and for water management reflecting the will of the farmers to be integrated into the water management of the main canal by the Ministry of Public Works.

The Tjihea project area extending over 1,086 ha. may be divided into two large areas according to the irrigation system.

One is the area which gets irrigation water directly from the main canal and the other the area which takes mater from the secondary canals.

Each of these two areas will be further divided into 10-20 medium areas.

3-3 Land Consolidation Plan

3-3-1 Scope and Policy of the Plan

Firstly, land consolidation with the object of agricultural development of the Project Area of 1,086 ha. is to be planned with a consolidation of an approximately 100 ha. as a pilot farm out of 250 ha. of farm land which belongs to and comes under the management of Corpo-

ration. The policy of the plan is to extend over the whole area gradually the experience and effect obtained from the Pilot Farm. Accordingly, investigation and planning for this Project are phased into followings:

(1) Basic planning for the Project Area of 1,086 ha.

(2) Detail design which can be used for immediate implementation for 100 ha. area.

(3) Planning for 250 ha. as priority area for implementation next to 100 ha. area.

The scope of the plan is to be determined as follows based on the result of investigation on the present situation of Tjihea and taking into consideration the existing habitual practice on water management administration.

(1) Rehabilitation of main and secondary canal is to be excepted from this land consolidation plan as a rule.

(2) Irrigation system within the project area is to be left intact with an exception of some limited portions.

(3) Irrigation and drainage planning is to be considered separately from this plan as a rule.

Planning and design for land consolidation are to be conducted based on the above principles.

3-3-2 Determination of Paddy Divisions

(1) Topographical Condition and Farm Plot

Topography of the Tjihea Project Area in general is inclined from south to north and its south end is located at the foot of a mountain with steep terrain which is eased off gradually toward north. Gradient in the Pilot Farm of 100 ha. proposed which is located in the center of the Project Area is 1/100 - 1/200. Farm plot is to be plotted so as that its longer side is to be in parallel with the contour lines. Consequently, there will be no particular limitation caused by the condition of terrain as far as longer side of farm plot is concerned. However, determination of shorter side of farm plot is to be influenced on the following points depending on the condition of terrain.

(a) One farm plot is to be plotted on one same elevation as a rule and, therefore, as shorter side of a farm plot becomes longer the quantity of earth leveling work will be increased.

(b) When a difference in elevations of one farm plot and its adjacent plot becomes more than 30 cm., the difference in elevations at the top of plot ridge and its adjacent paddy become more than 60 cm. and this situation is to require particular slope protective works.

(c) When difference in elevations of paddies become more than 30 cm., carrying in and out of farm machinery will become difficult.

In view of the above described points, it is considered that length of shorter side of one farm plot is most adequate with 30 m.

(2) Machinery and Equipment Plan

In July 1970, the Directorate General of Agriculture has announced an implementation program for the Tjihea Tani Makmur Pilot Project. In this program, a policy for utilization and extension of agricultural machinery and equipment as a part of agricultural development project was indicated. According to this policy, machinery and equipment to be adopted for the project are tillers, power sprayers, threshers, grain dryers, rice mills, trucks and trailers. Use of tillers is planned to be introduced into 250 ha. farm of Corporation and 100 ha. farm land in the vicinity thereof as first stage and is planned to be extended out to other areas gradually.

Crop Year	Land of Corporation	Farmers' Land	Number of Tillers Required
1970/71	250 ha.	100 ha.	60 units
1971/72	250	250	85
1972/73	250	500	125
1973/74	250	836	181

Number of tillers which can be used at present is 25 but this number is expected to be increased to 130 in the near future. Power sprayers, speed sprayers and power dusters are to be used for spraying agricultural chemicals and insecticides. 10 units of these machineries can spray the entire area by having them work 3 weeks time provided that each machine will work 8 hours to spray 5 ha. of area. Rice mill is to be provided in the center of the Project Area. A building for this rice mill is already prepared. Capacity of rice milling machine is to be set at 1.0 - 1.2 tons per hour based on a 200 working day basis. As to the dryer, 2 to 3 of them are planned to be provided taking into consideration that some amount of the drying works can be done by sun drying as auxiliary.

Tillers and power sprayers, whose utilization plan among all other machinery and equipment, are considered to have direct influence upon the determination of paddy divisions in the land consolidation planning. Therefore, studies on the use of tillers and power sprayers are made in the following pages.

(3) Mechanized Farm Works

(a) Tillers

Relationship between the works done by tillers and the size of unit paddy block is considered as follows:

For the tilling works, a paddy block with longer side is advantageous as idling at turning and operational loss are minimized. On the other hand, for the works which require supplying of material such as fertilizer and chemicals, a paddy block with longer side is disadvantageous as idle time of the tiller for supply of material is increased. The results of test on relationship between the number of ploughing cycles by tiller and the ratio of longer side

and shorter side of paddy block are as follows:

Ratio of Longer Side & Shorter Side	Number of Ploughing Cycles	Total Time Required for Ploughing Cycles
1 : 1	293 cycles	1 hr. 37 min. 40 sec.
1 : 1.5	239	1 19 40
1 : 2.7	179	0 59 40
1 : 4.2	143	0 47 40
1 : 6.0	119	0 39 40

It is indicating a tendency that the time required for ploughing is decreasing rapidly till the ratio of longer side and shorter side gets to 1 : 2.7 and, from there on down, time decrease becomes gradual. Therefore, ratio of 1 : 3 or somewhere around this can be considered as changing point in the efficiency of working time.

Because of topographical condition of Tjihea, length of the shorter side of a block is to be restricted to 30 m so that if the length of longer side is made to be 100 m, the ratio will be 1 : 3.3 which falls within an advantageous range. Relationship between the amount of work done by one tiller per day and a farm plot with an area of 0.3 ha. with sizes of 30 m for shorter side and 100 m for longer side is studied as follows: Tillers, presently in use at Tjihea and to be also used in the future, are of somewhere around ps 6.5 - 8 and, therefore, they are the ones which were studied herein.

Rotary plough width which is a theoretical working width is 48 - 60 cm and working speed is 35 cm/sec. or 1.26 km/hr. on first gear and 50 cm/sec. or 1.8 km/hr. on second gear. Amount of work in the paddy block can be formularized as follows:

$$C = 1/10\ W \times V \times E$$

Proviso:
- C: Amount of work in paddy block (ha./h)
- W: Effective working width (m)
- V: Theoretical working speed (km/h)
- E: Efficiency of works in paddy block
  0.8 in case of rotary tiller

Where: $W = 0.5$ m, $V = 1.5$ km and $E = 0.7$

$$C = 0.1 \times 0.5 \times 1.5 \times 0.8 = 0.06 \text{ ha./h}$$

When working hours per day is 8 hours, amount of work per one tiller per day will be 0.48 ha./day and 0.3 ha. of this assumed paddy block falls within the range of one day working capacity by one tiller.

(b) Prevention Machinery

Power sprayer, speed sprayer and power duster are to be used as prevention machinery and their efficiencies are as follows, when they are used from the farm road through rubber hoses or directly to the paddies. Maximum reaching

distance of 50 m have been adopted here.

	Power Sprayer	Speed Sprayer	Power Duster
Efficiency	20 lit./min.	60 lit./min.	5 kg/min.
Time Required to cover 1 ha.	50 min. (with 1,000 lit. spraying capacity)	17 min. (1,000 lit.)	6 min. (30 kg.)
	60 m Rubber hose Spraying width = 6 m	100 m Spraying width = 25 m	50 m

These machineries are either traction type or mounted type and are to be run on the farm road. As these machineries can spray for 50 m width with one spraying operation, it is considered adequate to provide the farm roads at 100 m intervals in order to attain better efficiency of the operation.

Therefore, paddy blocks are to be made with ridge on 100 m longer side and farm road on shorter side.

(4) Farming System

Rice cropping in the Tjihea Area is being practiced twice a year, once in the rainy season and once in the dry season. Cropping in the rainy season is being done with rice planting from the middle and latter part of October to November and harvesting from the middle part of February to the end of March while cropping in the dry season is being done with planting from the middle and latter part of April to May and harvesting from the middle and latter part of August to September.

Among all the farming works involved for these rice cropping, ploughing and levelling works are being done by using machinery at 250 ha. farm of Provincial Government and are being done by man-power and animal-power in other areas. Farming system to be planned out for the Pilot Farm is to lay emphasis on mechanized farming mainly for the works of ploughing, levelling and spraying of chemicals and insecticides, with an intention to extend this mechanized farming to the entire area of Tjihea and to increase the productivity. It is anticipated that farming system in the future will be a combined system which is based mainly on man-power and animal-power and partially on effective mechanical-power.

Mechanization of planting work is still under the stage of study and development and it is considered that planting by hand is to be continued for sometime more to come because of soil condition of paddies in Tjihea. Mechanization of ploughing and spraying works has to be progressed through the stages of organization of farmers and grouping them together for mechanized farming. During these progress is taking place and due to the paddy condition in some cases, ploughing and spraying works have to depend on man-power and animal-power also.

Paddy blocks are required to be suitable also for manual works due to the above described farming system.

Planting work is studied on an assumed 30. 100 m block of paddy as follows:

If the size of one paddy block is too large, planting work by hand will encounter with increased difficulty, therefore, paddy block with the size on which the planting can be finished in one day is desirous. It is assumed that a man can finish picking of young rice and planting of them for 5 a. in a day so that 4 - 6 men ca.. finish rice planting for 20 - 30 ha. in a day.

One farm plot of 0.3 ha., which is situated on the same elevation and can be divided by borders as required, is considered a suitable block even for manual works.

Relationship between puddling works and paddy block is studied as follows:

Mechanized puddling work aims at the savings in man-power, time and water requirements and thereby attempts to shorten the time required in rice crop rotation. By doing so, there will be a possibility of terminating 3-crops-in-2-years situation, which can be seen at some portion of the area, and also possibility for upland farming will be exploited.

At present, more than 2 month time is being required for preparation of paddies after harvesting previous crop and before going onto next crop. If it is attempted to shorten this period from 2 months to about 30 days, a period required for from ploughing through levelling and puddling shall be limited to 20 days. Accordingly, possibility of finishing such farming works in 20 days has to be studied. 100 ha. of pilot farm is to be divided into Tracts A, B, C and D and Tract B is to be selected as typical farm plot for which a farming plan for 20 days is to be established. One farm plot is, as previously assumed, 0.3 ha. with dimensions of 30 m x 100 m. A typical unit paddy block is consisting of 12 farm plots and its total area is 3.6 ha. Tract B is consisting of 8 unit paddy blocks and its total area is about 35 ha. including a block located along the river.

Efficiency of a tiller, as previously calculated, is 0.05 ha. per unit per hour and is 0.48 ha. per day on 8-working-hours-per-day basis. Rotary ploughing and crushing works are normally done twice. Therefore, 2 farm plots of 0.6 ha. can be finished in 2 days for the works of ploughing to levelling. Accordingly, if 2 tillers are mobilized into one unit paddy block, all the works involved can be finished in 6 days, and further, 6 tillers are mobilized into the entire area of Tract B, all the works can easily be finished within 20 days even taking into the account those farm plots located along the river.

This plan coincides with the machinery and equipment plan described previously in this report, in which 60 tillers are planned to be used for its first stage for the areas of 250 ha. of Corporation land and 100 ha. of privately owned land. This means that 60 tillers for the total area of 350 ha. equals to 6 tillers for the area of 35 ha.

As a consequence of these studies, it can be said that division of areas of 0.3 ha. for one farm plot and 3.6 ha. for one unit paddy block is well adapted with the farming system.

(5) Irrigation and Drainage Operations

It has been determined that the standard farm plot which can satisfy various requirements is to be 0.3 ha. with the dimensions of 30 x 100 m. In view of the water managements, unit paddy block has to be studied. A unit paddy block is a block of paddy land which is enclosed by roads and irrigation and drainage canals and is consisted of several farm plots. In this project, one unit paddy block consisting of 10 - 12 farm plots is considered as a standard unit paddy block. For instance, Tract B has the unit paddy block of 3.6 ha. consisting of 10 farm plots, the dimensions of 100 m x 360 m. Irrigation and drainage operation for the consolidated land is to be designed so as that separate operation by each farm plot is possible taking into consideration the case of some farm plot is to be under the management of an individual. However, water management is to be considered on one unit paddy block basis as utilization of tillers is required to be carried out by a joint operation system. Mechanized works at the time of puddling after water is being filled into the paddy is better to be finished in a shortest time possible so as to increase the efficiency and to minimize the water requirement. It is said in general that about 0.5 ha. of farm plot can be filled with water in several hours, although it varies depending on the conditions of soil and paddy surface. Therefore, 0.3 ha. of area for one farm plot is considered adequate. Standard area for one unit paddy block on this project is 3.6 ha. and if water management is to be carried out based on these unit paddy blocks, there will not be a need for changing existing water distribution system including the quantity and period in the distribution process which starts from the main canal to secondary canals and to tertiary canals.

Drainage is to be done through open ditch as a rule, and this will bring up vertical side length of a farm plot as a problem to be studied. Since this project area is in the zone of clayish material, it is considered that the distance from the farm plot to smaller drainage canal at the farthest portion is limited to 100 m. Small drainage ditches are to be provided along the horizontal side of each farm plot and connected to drainage laterals in order to improve the existing poor condition of drainage.

3-3-3 Road Plan

In the Project Area, 3 provincial roads are running centering on Bodjongpitjung, connecting the project area to the other areas. Among these 3 roads, Tjirandjang route and Tjipenjeum route are connected to national highway. Tjirandjang route is a most important route as it provides a shortest route to national highway from P.P. Tjihea and functions as connecting route for centers of 2 districts. These provincial roads become impassable by motor vehicles during the rainfall but improvement works have been progressed on Tjirandjang route and it is expected that this route will function sufficiently upon completion of the improvement works. A functional networks of roads are planned to be provided for in the Project Area not only for farming but for connecting each village in the Area and villages to the farm roads.

(1) Access Roads

These roads are to be provided for connecting villages and agricultural facilities and will function as community road which will provide basic means of communication for farm activities and social activities. These roads are designed to

have a width of 4 m and surfaced with gravel so as to enable the truck transportation.

Improvement of Existing Roads

Secondary canal which starts from Bodjongpitung and runs on the east side of the Project Area has a road for management on both banks of the canal. Road on the left bank is passable by motor vehicle with an exception of few spots. Connection with outside of the Project Area is being hindered at the railroad crossing because there is no crossing facilities. So, by building these facilities and by improving the road surface, these roads can be made into the access road comperatively easily and economically.

Left bank of the main canal is being used as management road. This road also can be made into access road by repairing few of superanuated bridges and improving the road surface. Road between Bodjongpitjung and main canal is also planned to be as access road by some widening and repairing.

Construction of New Road

Roads to be newly provided are to connect between Provincial road, improved access road and the villages. Provincial road and access roads are running in the direction from south to north. Accordingly, this new roads will be running in the direction from east to west at the interval of 500 m as a rule but final location of the roads is to be adapted with villages and topography.

(2) Farm Roads

Little number of farm roads with a width of 2-3 m are existing in the Project Area. They are constructed mostly by clay material of the paddy surface and their bearing power is too small for transporting agricultural machineries. Therefore, all the farm roads are to be constructed newly.

Width of farm roads is designed to be 2.0 m as the widths of machineries to be used for farming and transportation of products are 1.0 m-1.4 m.

3-3-4 Land Consolidation for Pilot Farm

For the purpose of spreading out land consolidation for the Project Area, a Pilot Farm was proposed to be set up as a complete model and the area of 102.6 ha. was selected out of 250 ha. paddies belonging to P.P. Tjihea.

The Pilot Farm is situated almost in the middle of the Project Area and has the advantages as follows:

(1) It is included in one irrigated area which is called Pasirdawuan.

(2) It is effective in demonstration because of being situated along two Provincial Roads: Bodjongpitjung-Tjirandjang Route and Bodjongpitjung-Tjipeujeum Route.

(3) Land slope keeping 1/100 to 1/200 shows the average of the Project Area and

it is not difficult to start land consolidation work.

The Pilot Farm is divided into 4 Tracks A, B, C and D by Secondary Canal and two Provincial Roads: Tract A is southern east part, Tract B northern east, Tract C southern west and Tract D northern west part.

The areas of these Tracts are as follows:

Tract A	30.4 ha.
Tract B	36.5 ha.
Tract C	18.0 ha.
Tract D	17.7 ha.
Total	102.6 ha.

Each Tract is composed of unit paddy blocks which consist of farm plots: one standard unit paddy block consists of 12 farm plots and one farm plot is 0.3 ha. measuring 100 m by 30 m. Exceptionally the longer side of a farm plot in Tract A is limited to 80 m so as to adjust topographical condition.

The Pilot Farm is designed to have the following unit paddy blocks and farm plots:

	Number of unit paddy blocks	Number of farm plots
Tract A	11	103
Tract B	11	108
Tract C	5	59
Tract D	6	60
Total	33	330

At present there are about 2,100 paddy plots in the proposed Pilot Farm and in order to consolidate them into 330 plots land leveling is indispensable.

Land leveling is contrived so that earth for leveling may move only within one plot, which causes economical construction and early completion.

In planning on canals its scope is limited to tertial canals and irrigation ditches, excluding the main canal and secondary canals and separation of irrigation and drainage canals are considered in principle.

Irrigation canals, tertial canals and ditches, are designed to be earth and tertial canals are planned to be improved according to the designed duty of water for irrigation ditches basing on water requirement in depth at paddies: tertial canals are three kinds and ditches one type. One irrigation ditch covering two unit paddy blocks has the capacity of conveying irrigation water at the beginning of puddling and distributing water for the outer area.

Ditches are designed to keep their bottoms at the elevation of adjacent paddy surface so as to supply water for paddies at any discharge and determined to meet the gradient a at designed paddy plot elevation.

As the rivers, Tjibodas, Tjirandjang and Tjibiuk,have enough capacity to drain,

drinage canals combining paddies with these rivers are proposed: earth canal and one type. Designed drainage discharge is based on probability rain fall for 10 years and one standard and unit paddy block.

Subsoil of paddies in the Area consists of clay of which permeability coefficient is very low and so underdrainage system is considered effective.

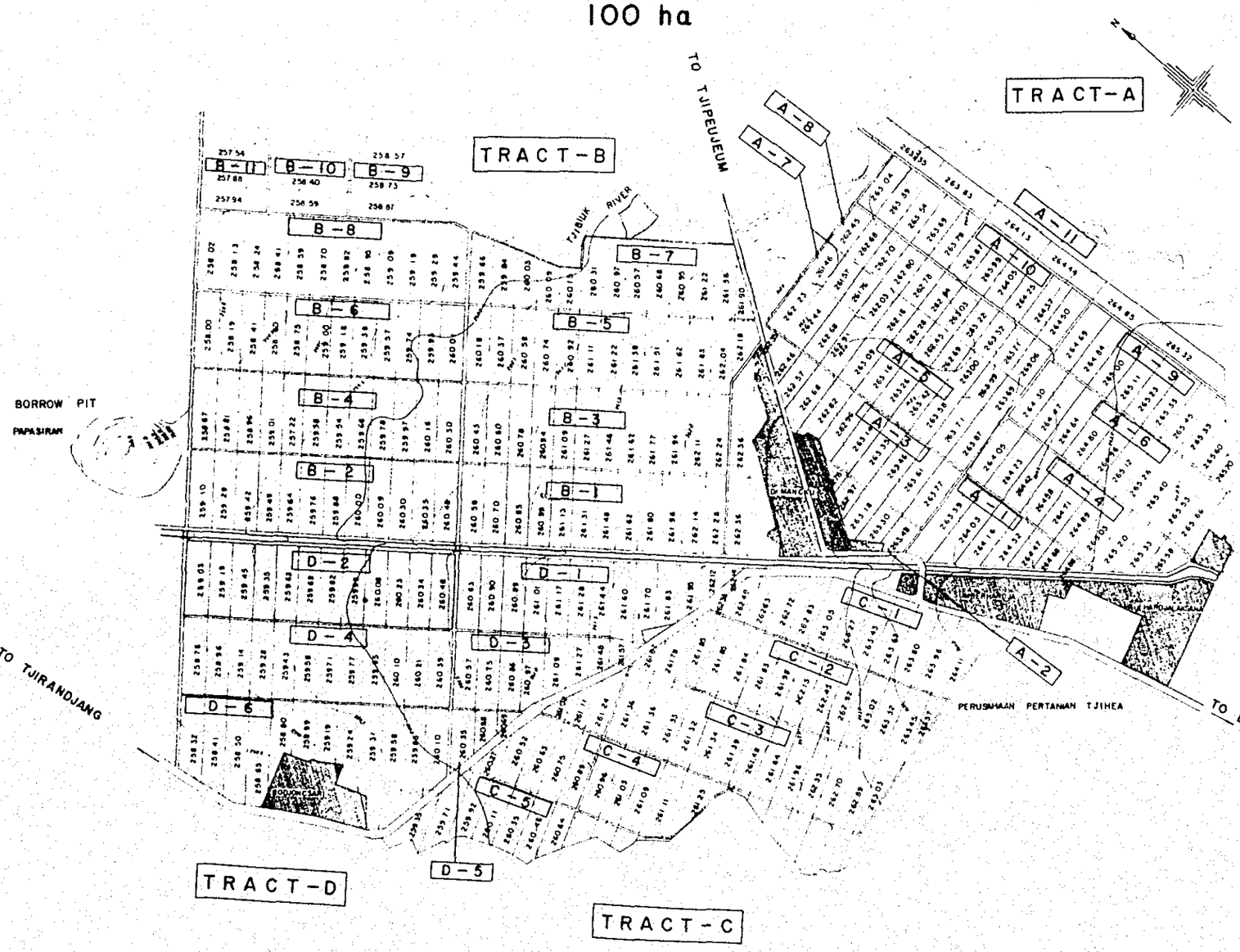
In order to check its effect, one unit paddy block D-2 is selected as a test paddy.

Related structures, distribution works, drop works and culverts are planned to be set up and to have the ability of repeating use of water according to demand.

Layout for the proposed Pilot Farm of 100 ha. is given the following.

LAND CONSOLIDATION PLAN

100 ha



SCALE OF METERS

0 50 100 200

CHAPTER 4 DESIGN

CHAPTER 4 DESIGN

4-1 Design of Canals

4-1-1 Water Requirement

In planning of irrigation canal, survey of water requirement in depth in the existing paddies is essential, so implements of type N were placed in a paddy selected from Tract C. Water kept 10 cm in the implement at the beginning of survey dried up two days later.

The following reasons are considered:

(a) Leakage through paddy border could not be prevented.

(b) Implement bottom driven into paddy mud at the depth of 5 cm was too shallow to keep water inside it.

Therefore, new implements were contrived to meet the existing conditions: a half cut drum can, 55 cm in diameter and 45 cm in length, was substituted for the Type N.

4 paddy plots, one for each of Tract A, B, C and D, were chosen as suitable test plots which could keep water without a large amount of leakage through borders. A half cut can was driven into the paddy at the depth of 20 cm and 4 or 5 rice plants were held in it.

As the results of 8 days' survey, it became clear that there was almost no difference among Tracts and water requirement in depth showed 6.5 mm/day in average. (Appendix B.4-1) And pan evaporation was 3.2 mm/day in average during the period.

Water requirement comprises percolation and evapotranspiration: the latter composes of evaporation from paddy surface and transpiration from plant. The ratio of evapotranspiration to pan evaporation varies between 0.9 and 1.7 in Japan and gives 1.2 in average in Malaya according to the research report by Mr. Katsuo Sugimoto. ("Studies on the Growth and Effect of Fertilizer Application to Rice Plants in Malaya")

Therefore the ratio in the Project Area can be estimated to be 1.2 and evapotranspiration is 3.9 mm/day in average. Percolation, changing as topographical and cultivation conditions, can be divided into vertical and border one, but in this survey border percolation can be neglected because of enough driving of implement. Accordingly, percolation shows 2.6 mm/day, extracting estimated evapotranspiration 3.9 mm/day from water requirement survey value 6.5 mm/day.

As this analysis is based on the survey value during wet season, it is necessary to estimate pan evaporation during dry season which may show larger value. There were no available data on pan evaporation in the Project Area during dry season but those obtained on other areas, Djakarta, Lembang and Buitenzorg are as follows:

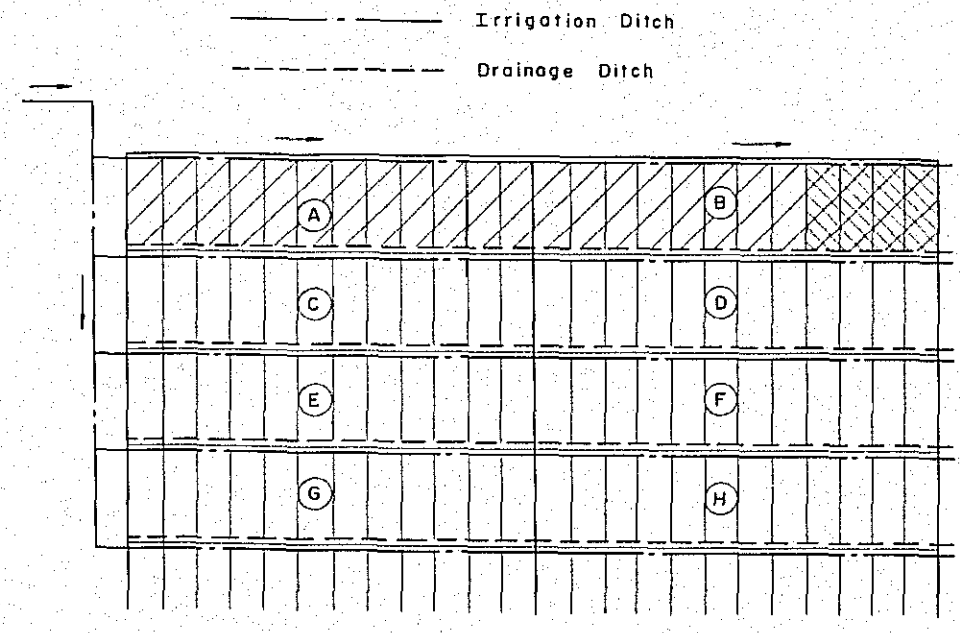
	Djakarta (lat. 6°11' S long. 106°50' E altitude 8 m)	Lembang (lat. 6°50' S long. 107°37' E altitude 1,300 m)	Buitenzorg (lat. 6°35' S long. 106°48' E altitude 250 m)
Jan.	1.4 mm/day	1.4 mm/day	1.7 mm/day
Feb.	1.3	1.4	1.6
Mar.	1.4	1.3	1.9
Apr.	1.5	1.3	2.0
May	1.5	1.4	2.2
Jun.	1.6	1.5	2.3
Jul.	1.9	2.0	2.6
Aug.	2.3	2.3	3.0
Sept.	2.4	2.4	2.9
Oct.	2.1	2.0	2.6
Nov.	1.8	1.5	2.0
Dec.	1.6	1.4	1.8

Daily pan evaporation shows maximum value in August and September, the ratio to that in December being 1.5 to 1.7. Then ratio of evaporation in wet season to that in dry season is determined to be 1.6 and evapotranspiration is 6.1 mm/day, 1.6 times of the survey value 3.2 mm/day. Therefore water requirement in depth during dry season can be led to be 8.7 mm/day, above value 6.1 mm/day plus percolation 2.6 mm/day. Then gross duty water, net duty of water 1.0 liter/ha. plus 20% of it, is given to be 1.2 liters/ha.

The main canal has the capacity of 6.5 m^3/sec. which is equivalent to water requirement in depth 1.2 liters/ha. for the Whole Tjihea Irrigation Area of 5,409 ha.

4-1-2 Irrigation Ditch

Section of irrigation ditch is determined to meet cultivation plan in the proposed Pilot Farm and in planning Tract B is examined as a standard paddy. In Tract B unit paddy blocks consisting of farm plots are illustrated as below:



In cultivation planning plowing and puddling in Tract B is proposed to finish within 20 days by employing 6 tillers. As 2 tillers are planned to be employed in one unit paddy block at the same time, one ditch should supply water for this condition.

(1) Duty of Water

Two unit paddy blocks, A and B, irrigated by one ditch are 7.2 ha. Duty of water at the end of puddling is given the following equation:

$$Q = (A_1 q_1 + A_2 q)(1 + a)$$

Where, A_1 : Area supplied irrigation water by one ditch in a day. A = 1.2 ha.
A_2 : $A_2 = A - A_1 = 7.2 - 1.2 = 6.0$ ha. A is 2 unit paddy blocks.
q_1 : Puddling water requirement 150 mm/day
q_2 : Supplementary water 30 mm/day
a : Conveyance loss 20%

Then, $Q = (12{,}000 \times 0.15 + 60{,}000 \times 0.03) + (1 + 0.2) = 4{,}320\ m^3/day = 50$ lit./sec.

On the other hand duty of water at the beginning of puddling is calculated by the below:

$$Q = A\ q\ (1 + a)$$

Where, A : 7.2 ha.
q : Irrigation water at the beginning of puddling.

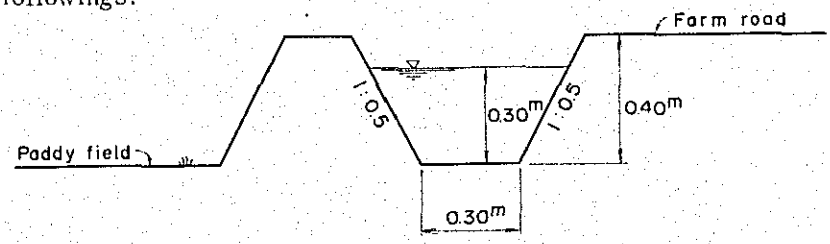
$$Q = 72{,}000 \times 0.6 \times (1 + 0.2) = 5{,}184\ m^3/day = 60\ lit./sec.$$

Irrigation water at the beginning of puddling is larger than that of the end, so 60 lit./sec. is adopted as designed duty of water.

(2) Capacity of Irrigation Ditch

In designing of irrigation ditch, it is necessary to add design duty of water to irrigation water for outer area. Through puddling two unit paddy blocks, irrigation water 25 lit./sec. for outer area is assumed to be conveyed indispensably. Therefore capacity of irrigation ditch is 85 lit./sec.

On the base of these conditions, irrigation ditch in the Pilot Farm is designed as the followings:



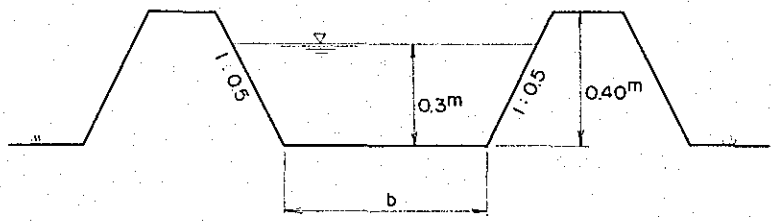
Ditch bottom keeps almost the same elevation as surface of adjacent paddies so that irrigation water can be supplied to every paddy plot at any discharge. Dit- Ditches in Tract A, C and D are also designed to meet the same condition above.

Irrigation ditches and related structures are shown in (Appendix B-3-3).

4-1-3 Tertial Canal

A tertial canal distributing irrigation water to ditches is planned to renovate so as to have three times capacity of a ditch. In Tract A there are two tertial canals, one of them is enough to have two times capacity of a ditch.

Tertial canals in Tract A, B, C and D are determined as follows:



Tract	Gradient	Bottom width	Discharge
A	1/200	0.9 m	255 lit./sec.
A	1/500	0.9 m	161 lit./sec.
B	1/500	1.5 m	275 lit./sec.
C	1/300	1.2 m	281 lit./sec.
D	1/300	1.2 m	281 lit./sec.

4-2 Design of Drainage Canal

The rivers, Tjibodas, Tjirandjang and Tjibiuk, have enough capacity to drain the Project Area and drainage canals flowing into the rivers are designed.

(1) Rainfall

Probability rainfall is calculated according to rainfall records at P.P. Tjihea as below:

Year	Rainfall
2	97 mm
3	107
4	113
5	119
10	130
15	140
20	143

10 year probability rainfall is adopted as the basic rainfall for drainage. This rainfall is between the maximum and the second one recorded.

As the rainfall in Tjihea was found for only several hours in the afternoon, designed rainfall intensity is based on the assumption of consecutive three hours rainfall.

(2) Designed Drainage Discharge

Designed drainage discharge can be calculated the following equation.

$$Q = 0.2778 \cdot f \cdot r \cdot A$$

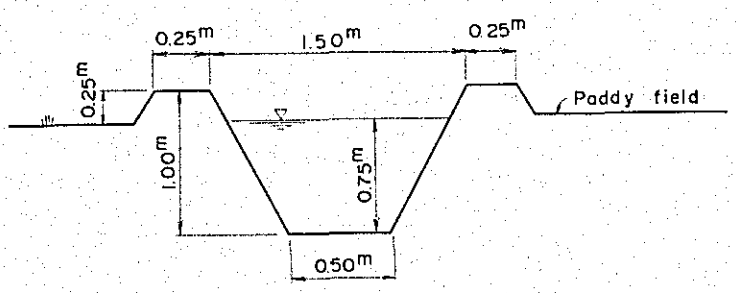
Where, Q : Designed drainage discharge $m^3/sec.$
f : Runoff coefficient 0.8
r : Rainfall intensity 43 mm
A : Drainage area km^2

Drainage discharge of unit area 1 ha. is given as below:

$$Q = 0.2778 \times 0.8 \times 43 \times 0.01 = 0.1\ m^3/sec./ha.$$

(3) Standard Section of Drainage Canal

A standard drainage canal is designed on a unit paddy block of 3.6 ha. consisting of 12 farm plots. The standard canal is earth and has capacity of 0.69 $m^3/sec.$ as follows:



(4) Underdrainage

Paddy soil in the Project Area comprise clay which shows its permeability coefficient 8.95×10^{-8} cm/sec. While such impermeable soil paddy needs underdrainage system so as to drain well and rapidly, it should be considered well to apply for the Project Area after making an experiment at small area.

Accordingly a unit paddy block in Tract D is selected as the experimental paddy, which is divided into two areas; vinyl chloride pipe line area and bamboo pipe area.

(a) Subsurface Drainage Discharge

Subsurface drainage discharge per unit area can be given by the following equation.

$$q = \frac{R \times P \times 10{,}000 \times 1{,}000}{D \times 1{,}000 \times 86{,}400}$$

Where, q : Discharge per unit area lit./sec./ ha.
R : Monthly rainfall 550 mm
P : Permeability ratio 1/3
D : Period to drain 15 days

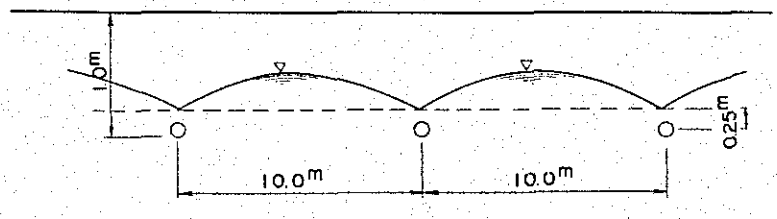
then,

$$q = \frac{550 \times 1/3 \times 10{,}000 \times 1{,}000}{15 \times 1{,}000 \times 86{,}400} = 1.4 \text{ lit./sec./ha.}$$

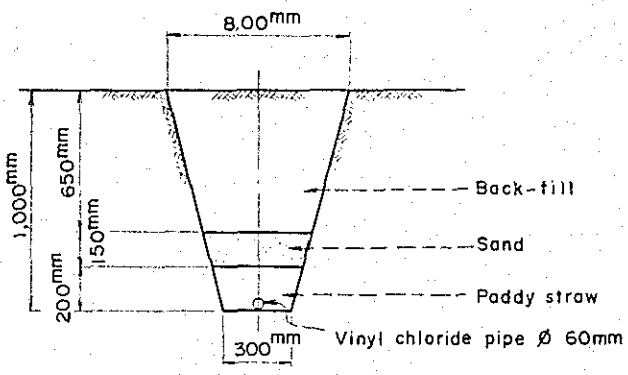
(b) Depth and Intervals of Absorbing Pipe

In consideration of groundwater level, root of rice plant and machinery operation, depth of pipe to burry is to be 1 m and its interval 10 m.

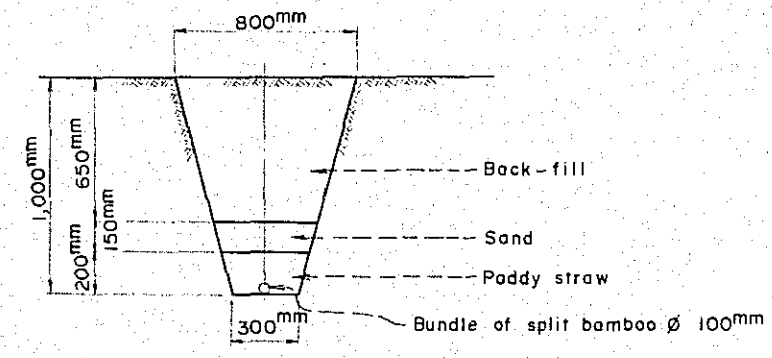
Layout of underdrainage is illustrated as follows:



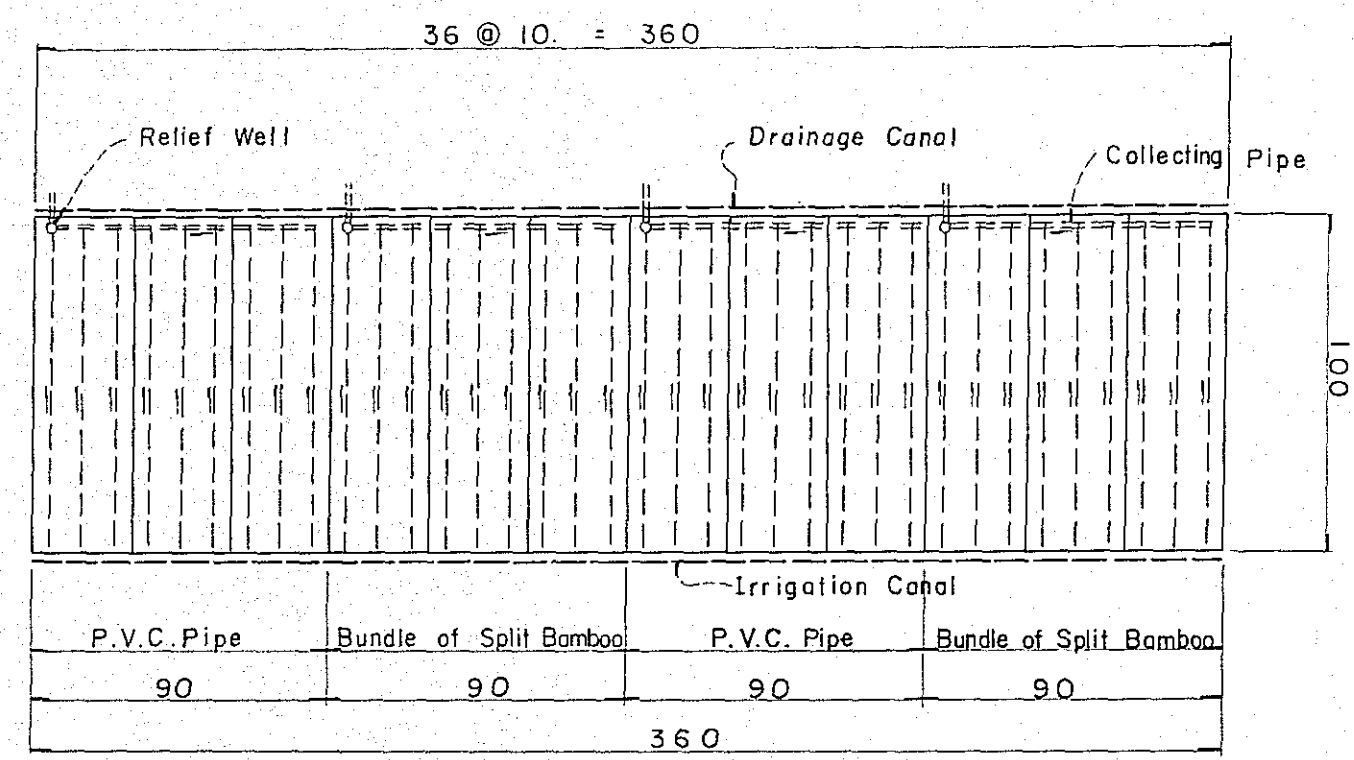
Vinyl Chloride Pipe



Bundle of Split Bamboo



Plan of Under Drainage Test Farm



4-3 Design of Roads

4-3-1 Access Road

Access road is divided into two classes; improvement of existing road and proposed road. The former has enough width and bearing capacity for cars and so only improvement of road surface and gravel pavement are required for its running.

As most of the proposed roads are planned to go through the paddy fields, having weak clay foundation, bearing capacity of their foundation and material of embankment become problem of utmost importance.

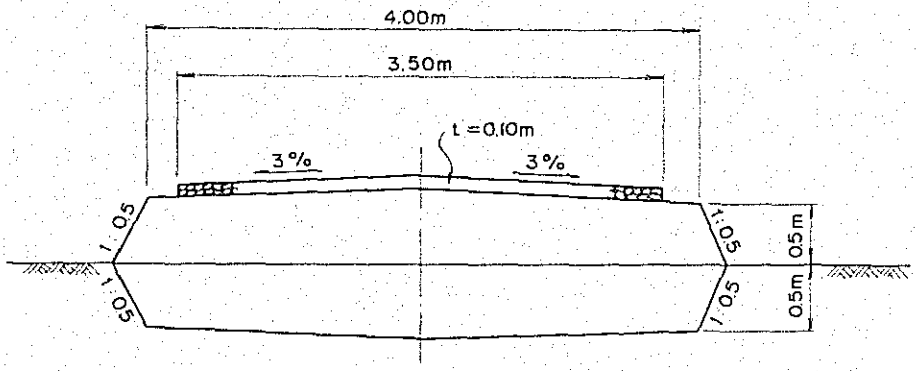
Access road is designed to have total width of 4 m: 0.5 m shoulders and 3.5 m effective width paved with crushed stone of 10 cm thick. Average height from ground surface to shoulder top is 50 cm and transverse gradient is 3 per cent.

It became clear after the soil survey (Appendix B. 4-2) that clay soil in the paddy fields was not suitable for embankment material of road.

After the investigation (Appendix B. 4-2), the hill lying north of the pilot farm of 100 ha. was clarified to be a suitable borrow pit that had proper and abundant material for road construction. As a lot of hills like this are found in the Project Area of 1086 ha., roads in the Area can be built in the same manner as that of the Pilot Farm by making use of them as borrow pits.

(1) Bearing Capacity of Base

A standard section of the proposed road is assumed to be the following: a base of 50 cm thick in the paddy field is exchanged for soil from the borrow pit.



In the case of banking on weak foundation, settlement and failure should be considered by use of Terzaghi formula. Terzaghi classifies failure of foundation into two cases: one is general shear failure and the other is local shear failure. In most cases the former occurs at compact sand and clay that has small sensitivity ratio and the latter is found at loose sand and clay of large sensitivity ratio.

Ultimate bearing capacity for load of B width is given in the followings:

In the case of general shear failure

$$q_u = c(N_c) + \gamma \cdot B(\ 1/2\ N_r) + \gamma \cdot D(N_g)$$

In the case of local shear failure

$$q_u = c(\ 2/3\ N'_c) + \gamma \cdot B(1/2\ N'_r) + \gamma \cdot D(N'_q)$$

where, q_u : ultimate bearing capacity (t/m^2)
c : cohesion (t/m^2)
γ : unit weight of soil (t/m^3)
B : foundation width (m)
D : depth of plane of action from surface (m)
N_c, N_r, N_q, N'_c, N'_r, N'_q : bearing capacity factor

The bearing capacity of the clay in this Project Area should be calculated according to local shear failure as safety side. The angle of internal friction of the clay shows zero, ($\phi' = 0$) Then above formula can be rearranged by substituting this value,

$$N'_c = 5.7,\ N'_r = 0,\ N'_q = 1.0$$

$$q_d = 3.8C = \gamma \cdot D$$

in which C is unknown value. So as to get C, cone penetration test was carried out in the Pilot Farm. (Appendix B. 4-2)

There is the following relation between cone resistance in cohesive soil and unconfined compression strength.

$$q_c = 5q_u$$

Then relation between cohesion in soil with angle of internal friction, zero and unconfined compression strength is shown to be

$$q_u = 2C\ .$$

Therefore,

$$q_c = 10C$$

Where, q_c = cone resistance (kg/cm^2)
C = cohesion (kg/cm^2)

Then ultimate bearing capacity equation can be changed as the follows:

$$q_d = 3.8q_c + \gamma \cdot D$$

It is necessary to add safety factor 3 on the above.

Then,

$$Qa = \frac{1}{3} qd = \frac{1}{3} (3.8\ qc + 1.53\ D)$$

qc = 3.03, D = 0.5, substitute into this.

$$qa = 4.09\ t/m^2$$

(2) Surcharge

Dead load, embankment load, and live load, car load, act on the fundamental plane.

i) Embankment Load

$$Wb = \gamma_1 \cdot h_1 + \gamma_2 \cdot h_2$$

where,

Wb = embankment load (t/m^2)
γ_1 = unit weight of bank material 1.8 t/m^3
h_1 = height of bank 1.0 m
γ_2 = unit weight of crushed stone 2.0 t/m^3
h_2 = thickness of crushed pavement 0.1 m

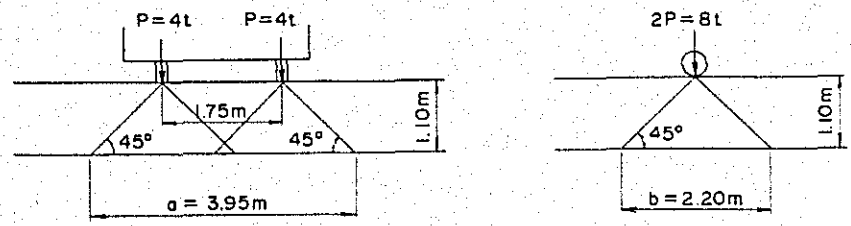
therefore,

$$Wb = 2.0$$

ii) Car Load

T - 10	total load	10 t
	fore wheel load	1 t
	back wheel load	4 t

Load distribution on foundation is shown as follows:



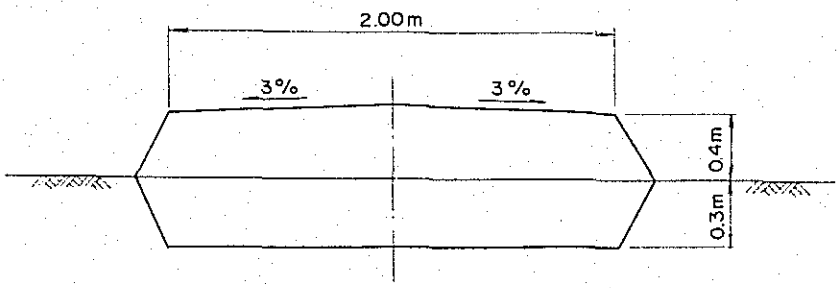
(3) Determination of Standard Section

Bearing capacity of the foundation of 50 cm deep from ground surface is larger than load acting on that. Therefore presumptive section designated to exchange clay for earth from the borrow pit is determined because of being safety enough for loads.

4-3-2 Farm Road

Farm road is planned to have capacity for power tiller and its trailer. Presumptive section is shown in the followings:

cross grade	3%
excavation depth	30 cm
banking height	40 cm



Examination of excavation depth

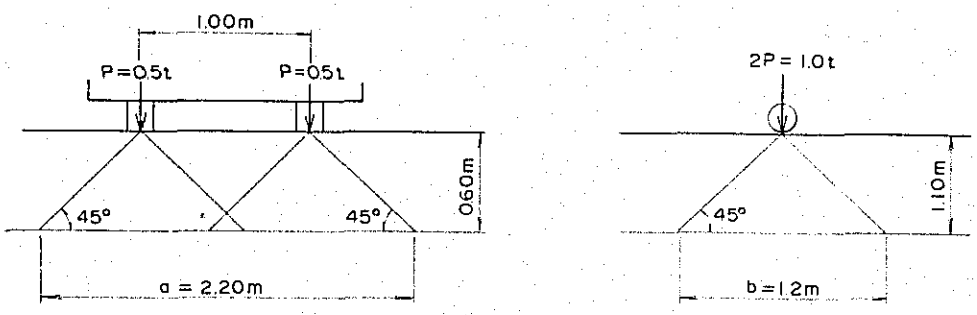
Allowable bearing capacity at a depth of 30 cm from ground surface can be calculated by substituting cone resistance ($qc = 1.2\ kg/cm^2$) into the equation.

$$qa = 1.67\ t/m^2$$

Total load acting on the foundamental plane is

$$Wb = 1.26\ t/m^2$$
$$Wt = 0.30\ t/m^2$$
$$W = Wb + Wt = 1.56\ t/m^2.$$

This apparently indicates that excavation and exchange of 30 cm thickness are suitable for designed loads.



4-4 Land Leveling

In order to save construction cost and shorten its periods on land consolidation, it is essential to minimize earth to move for leveling. Designed paddy elevation is determined so that a parcel of paddy can be leveled by moving earth only within itself and calculated by the following equation.

$$E = \frac{A\,E + A\,E + \cdots\cdots\cdots\cdots + A\,E}{A + A + A \cdots\cdots\cdots\cdots A}$$

where;

E : designed paddy elevation
A : existing paddy area within a proposed parcel.
E : existing paddy elevation within a proposed parcel.

Designed paddy elevations in the Pilot Farm and volume of earth to move are shown in (Appendix, B 3-5).

Exceptionally few paddies need earth for leveling from next to paddies.

CHAPTER 5 CONSTRUCTION PLANNING

CHAPTER 5 CONSTRUCTION PLANNING

5-1 Construction Periods

Prior to operation of land consolidation in Tjihea, it is necessary to provide dry condition on fundamental ground where the paddy always keeps weak in order to carry out effective and rapid job. Dry season should be appropriated for construction period because it is easy to drain and keep paddy dry.

At present two rice cultivation is widely applied in Tjihea and rice growing is found individually in dry and wet season. So as to minimize decrease of paddy yields, the main works of the land consolidation should be built strictly within dry season.

According to monthly rainfall and frequency calculated from the last ten years records in Tjihea, months recorded under 100 mm were June, July, August and September in which no rain was found for more than 24 days in each month.

Banking of road which requires very dry condition is planned to be carried out in these months. Prior to initiation of banking, at the beginning of May, it is necessary to drain the paddies.

As the works of each stage can not be finished within 4 or 5 months, land leveling in which dry condition is not always required can be performed during soil surface puddling at the beginning of wet season.

Therefore a half year, from May to October, is proposed as annual workable term for the land consolidation.

The Pilot Farm belonging to Pasirdawuan (13) in Block (1) is not limited on the construction period on the point of water management and it might be feasible to finish the consolidation works within a short term, if a lot of labors were used for it.

It is desirable that the land consolidation of the Pilot Farm can be finished within 3 years dividing into each independent stage because of the following reasons:

(1) Workable duration in a year is limited within 6 months.

(2) Construction roads are less than necessary number for short term completion.

(3) It is impossible to convey banking materials to each area until roads connecting the provincial road with borrow pit is built.

5-2 Construction Schedule

(1) Phase and Operation

Pilot Farm can be divided into 4 Tracts called A, B, C and D Tract by topographical condition: Secondary Canal running through at the center of the Area and 2 Provincial

Roads. Each Tract is independent of water supply and can be initiated to construct.

Priority of construction is determined to be B, D, C, and A according to the following reasons:

(a) After Tract B lying in the nearest to borrow pit is completed, the other tracts can be easily and economically constructed by use of access roads and farm roads at Tract B.

(b) As Tract B is flatter than the others, it is easy to construct. Laborers in the Area should be trained in carrying out land consolidation works at this area.

(c) Tract B is the most effective demonstration place because it has 8 standard unit paddies and their parcels form standard rectangular.

(2) Job Layout

Land consolidation is classified into irrigation canal, drainage canal, access road, farm road, and land leveling work.

At the first stage, drainage canal work has to be built for the purpose of making paddies dry. Then road work which is the most difficult and biggest job among these follows and at the last stage land leveling work is performed.

(a) Irrigation and Drainage Canal

These are earth canals excavated by manpower. Side slopes are 1 to 0.5 shown as the Drawings. Related structures consist of division works, turnouts, outlets, drops and box culverts.

(b) Roads

Banking materials are conveyed from borrow pit to proposed right of way by trolleys and trucks. Roads in Tract B and D can be banked only by use of the trolleys but those in Tract A and C have to be built by both trolleys and trucks because Tract A and C are too far from borrow pit to convey materials by only trolley. Trucks convey them from borrow pit to proposed place to pile in Tract A and C and from there trolleys relieve.

(c) Borrow pit

Stones obtained from borrow pit are crushed and used for pavement of access roads.

5-3 Construction Program

Land consolidation works are divided into 3 stages to average in each stage.

First Stage

Tract B: Access Roads, Farm Roads, Irrigation Canals, Drainage Canals, and Land Leveling.

Tract D: Access Roads

Second Stage

Tract B: Land Leveling, Farm Road, Irrigation and Drainage Canals.

Tract D: Irrigation Canals, Drainage Canals, Farm Roads and Land Leveling.

Tract C: Farm Roads, Irrigation Canals, Drainage Canals, and Land Leveling.

Tract A: Farm Roads.

Third Stage

Tract A: Farm Roads, Irrigation Canals, Drainage Canals, and Land Leveling.

Tract C: Land Leveling.

Tract D: Land Leveling.

Location and amount of works are shown in the next construction schedule table and map.

Construction Plan

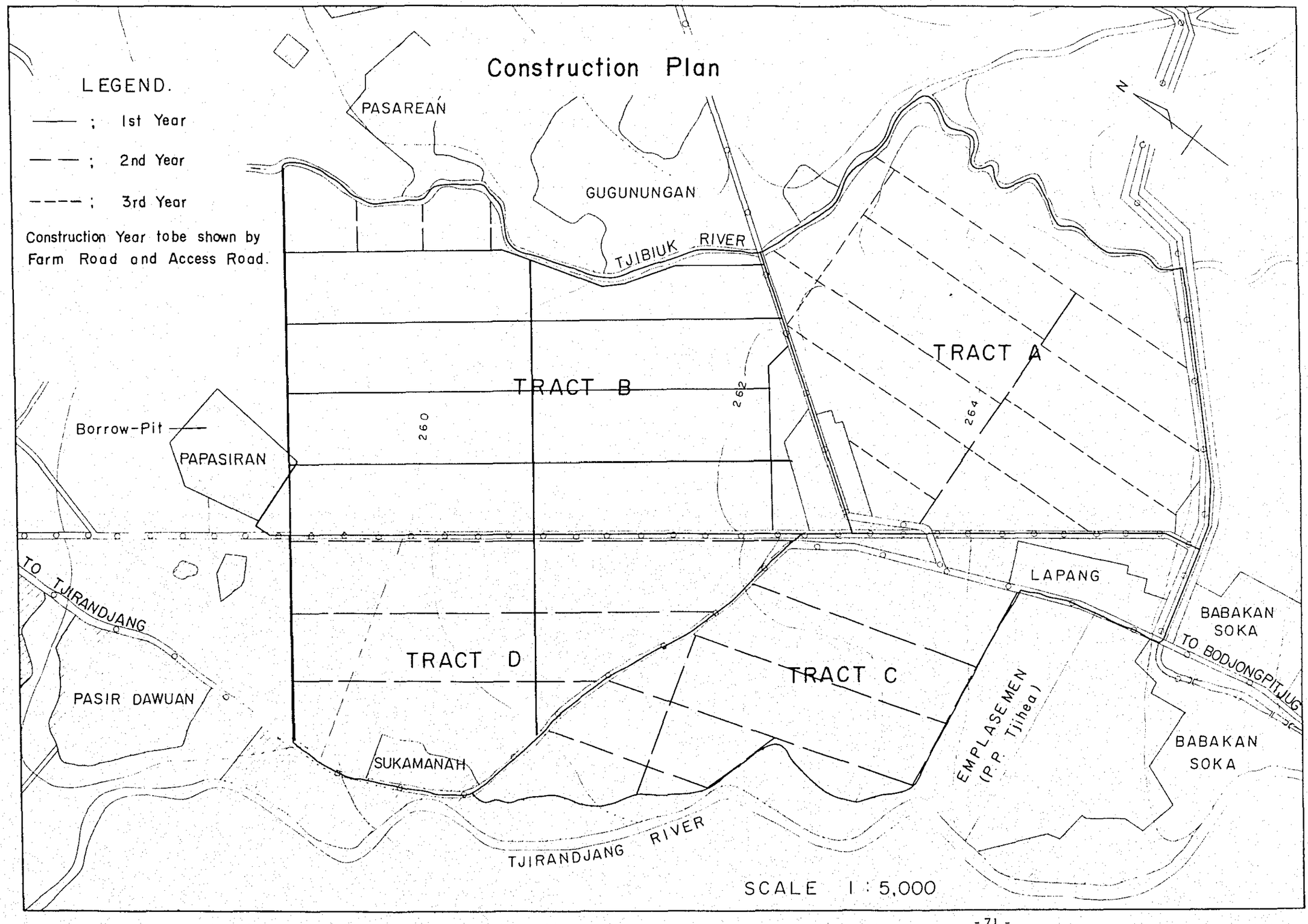
LEGEND.

——— ; 1st Year

— — ; 2nd Year

– – – – ; 3rd Year

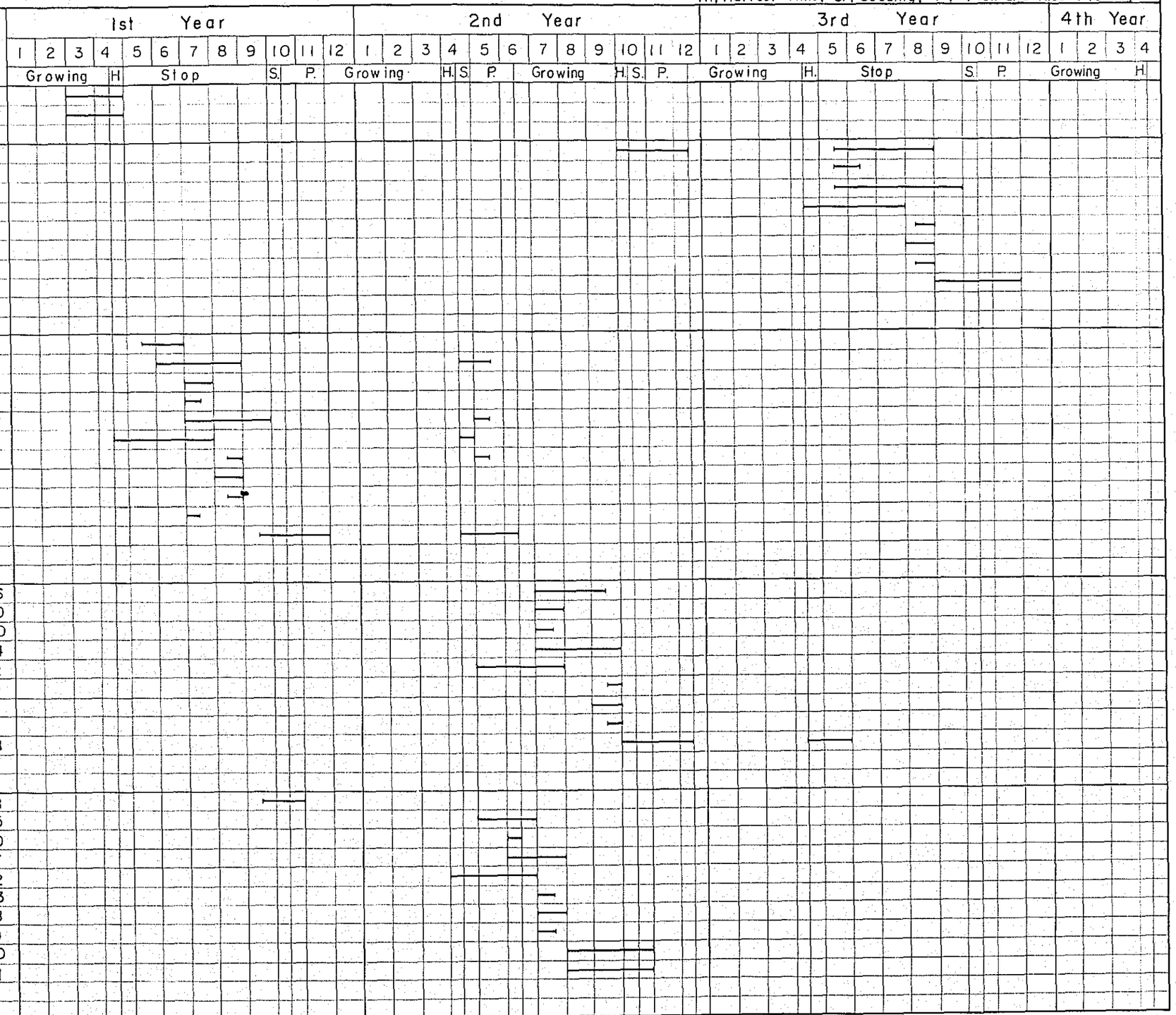
Construction Year tobe shown by Farm Road and Access Road.



Construction Schedule

H.; Harvest Time, S.; Seeding, P; Plow and Rice Planting

Tract	Item	Unit	Amount
Preparatory Works	Preparatory Works.	Set	1
	Construction Machime	"	1
A	Farm Roads	m	3,446
	Irri. Canal Type C	"	425
	" " " D	"	4,109
	Drainage Cara I	"	3,718
	Drops	Nos.	8
	Culverts	"	25
	F. B. Weir	"	20
	Leveling	m^3	14,177
B	Access Roads	m	982
	Farm Roads	"	3,586
	Irri. Canal Type A	"	415
	" " " C	"	100
	" " " D	"	3,809
	Drainage Canal	"	4,260
	Drops	Nos.	13
	Culverts	"	38
	F. B. Weir	"	16
	Bridges	"	2
	Leveling	m^3	17,697
C	Farm Roads	m	2,206
	Irri Canal Type B	"	360
	" " " C	"	230
	" " " D	"	2,694
	Drainage Canal	"	1,842
	Drops	Nos.	10
	Culverts	"	17
	F. B. Weirs		10
	Leveling	m^3	8,348
D	Access Roads	m	628
	Farm Roads	"	1,855
	Irri Canal Type B	"	380
	" " " D	"	1,917
	Drainage Canal	"	2,392
	Drops	Nos.	3
	Culverts	"	18
	F. B. Weirs	"	9
	Leveling	m^3	8,890
	Under Drainage	Set	1
	Test Farm		



CHAPTER 6 COST ESTIMATE

Cost Estimate of Tjihea Pilot Farm 100 ha.

Item	Domestic Currency Rp	Foreign Currency Rp	Total Rp
Tract A			
2nd Year	160,000	-	160,000
3rd Year	3,580,000	250,000	3,830,000
Sub-total	3,740,000	250,000	3,990,000
Tract B			
1st Year	5,100,000	1,550,000	6,650,000
2nd Year	1,020,000	--	1,020.000
Sub-total	6,120,000	1,550,000	7,670,000
Tract C			
2nd Year	2,020,000	160,000	2,180,000
3rd Year	230,000	-	230,000
Sub-total	2,250,000	160,000	2,410,000
Tract D			
1st Year	760,000	-	760,000
2nd Year	3,930,000	590,000	4,520,000
Sub-total	4,690,000	590,000	5,280,000
Construction Machinery			
1st Year	-	2,310,000	2,310,000
Total			
1st Year	5,860,000	3,860,000	9,720,000
2nd Year	7,130,000	750,000	7,880,000
3rd Year	3,810,000	250,000	4,060,000
Total	16,800,000 (164,000 Rp/ha)	4,860,000 (48,000 Rp/ha)	21,660,000 (212,000 Rp/ha)

Break-down of Estimated Cost

Description of Items	Quantity	Unit	Domestic Currency Rate Rp	Domestic Currency Cost Rp	Foreign Currency Rate Rp	Foreign Currency Cost Rp	Total Cost Rp	Remarks
Tract A								
2nd Year								
Farm Road	428	m	335	144,000	-	-	144,000	
Others	10	%	-	16,000	-	-	16,000	
Sub-Total				160,000			160,000	
3rd Year								
Farm Road	3,018	m	335	1,012,000	-	-	1,012,000	
Irrigation Canal								
Type C	425	m	8	4,000	-	-	4,000	
Type D	4,109	m	8	33,000	-	-	33,000	
Drainage Canal	3,718	m	46	172,000			172,000	
Drop								
Type A	2	nos.	393	1,000			1,000	
Type B	3	nos.	393	2,000			2,000	
Type C	2	nos.	393	1,000			1,000	
Type D	1	nos.	393	1,000			1,000	
Culvert								
Type B	13	nos.	4,014	53,000	7,245	95,000	148,000	
Type C	2	nos.	6,649	14,000	14,490	29,000	43,000	
Type G	8	nos.	10,265	83,000	11,743	94,000	177,000	
Type H	2	nos.	12,079	25,000	14,912	30,000	55,000	
Flash Board Weir								
Type A	13	nos.	5,571	73,000	-	-	73,000	
Type B	6	nos.	12,514	76,000	-	-	76,000	
Type C	1	nos.	6,471	7,000	-	-	7,000	
Land Leveling	14,177	m^3	120	1,702,000	-	-	1,702,000	
Others	10	%	-	321,000	-	-	321,000	
Sub-Total				3,580,000		250,000	3,830,000	
Total				3,740,000		250,000	3,990,000	
Tract B								
1st Year								
Access Road	982	m	1,101	1,082,000	-	-	1,082,000	
Farm Road	3,303	m	135	1,107,000	-	-	1,107,000	
Irrigation Canal								
Type A	415	m	8	4,000	-	-	4,000	
Type C	100	m	8	1,000	-	-	1,000	
Type D	3,529	m	8	29,000	-	-	29,000	
Drainage Canal	4,095	m	46	189,000	-	-	189,000	
Drop								
Type B	3	nos.	393	2,000	-	-	2,000	
Type C	2	nos.	393	1,000	-	-	1,000	
Type D	5	nos.	393	2,000	-	-	2,000	

Description of Items	Quantity	Unit	Domestic Currency Rate Rp	Domestic Currency Cost Rp	Foreign Currency Rate Rp	Foreign Currency Cost Rp	Total Cost Rp	Remarks
Culvert								
Type A	10	nos.	6,196	62,000	11,109	112,000	174,000	
Type B	10	nos.	4,014	41,000	7,245	73,000	114,000	
Type C	2	nos.	6,649	14,000	14,490	29,000	43,000	
Type E	1	nos.	9,446	10,000	21,735	22,000	32,000	
Type F	1	nos.	14,351	15,000	18,640	19,000	34,000	
Type G	7	nos.	10,265	72,000	11,743	83,000	155,000	
Type H	7	nos.	12,079	85,000	14,912	105,000	190,000	
Flash Board Weir								
Type A	9	nos.	5,571	51,000	-	-	51,000	
Type B	4	nos.	12,514	51,000	-	-	51,000	
Type C	1	nos.	6,471	7,000	-	-	77,000	
Type E	2	nos.	7,572	16,000	-	-	16,000	
Land Leveling	10,877	m^3	120	1,306,000	-	-	1,306,000	
Bridge No. 1	1	nos.	242,099	243,000	550,000	550,000	793,000	
No. 2	1	nos.	243,597	244,000	550,000	550,000	794,000	
Others	10	%	-	466,000	-	-	466,000	
Sub-Total				5,100,000		1,550,000	6,650,000	
2nd Year								
Farm Road	283	m	335	95,000	-	-	95,000	
Irrigation Canal								
Type D	280	m	8	3,000	-	-	3,000	
Drainage Canal	165	m	46	8,000	-	-	8,000	
Drop								
Type B	2	nos.	393	1,000	-	-	1,000	
Type D	1	nos.	393	1,000	-	-	1,000	
Land Leveling	6,820	m^3	120	819,000	-	-	819,000	
Others	10	%	-	93,000	-	-	93,000	
Sub-Total				1,020,000			1,020,000	
Total				6,120,000		1,550,000	7,670,000	
Tract C								
2nd Year								
Farm Road	2,206	m	335	740,000	-	-	740,000	
Irrigation Canal								
Type B	360	m	8	3,000	-	-	3,000	
Type C	230	m	8	2,000	-	-	2,000	
Type D	2,694	m	8	22,000	-	-	22,000	
Drainage Canal	1,842	m	46	85,000	-	-	85,000	
Drop								
Type B	6	nos.	393	3,000	-	-	3,000	
Type C	4	nos.	393	2,000	-	-	2,000	
Culvert								
Type B	11	nos.	4,014	45,000	7,245	80,000	125,000	
Type G	3	nos.	10,265	31,000	11,743	35,000	67,000	
Type H	3	nos.	12,079	37,000	14,912	45,000	82,000	

Description of Items	Quantity	Unit	Domestic Currency Rate Rp	Domestic Currency Cost Rp	Foreign Currency Rate Rp	Foreign Currency Cost Rp	Total Cost Rp	Remarks
Flash Board Weir								
Type A	7	nos.	5,571	39,000	-	-	39,000	
Type B	1	nos.	12,514	13,000	-	-	13,000	
Type C	2	nos.	6,471	13,000	-	-	13,000	
Land Leveling	6,648	m^3	120	798,000	-	-	798,000	
Others	10	%	-	187,000	-	-	187,000	
Sub-Total				2,020,000		160,000	2,180,000	
3rd Year								
Land Leveling	1,700	m^3	120	204,000	-	-	204,000	
Others	10	%	-	26,000	-	-	26,000	
Sub-Total				230,000			230,000	
Total				2,250,000		160,000	2,410,000	
Tract D								
1st Year								
Access Road	628	m	1,101	692,000	-	-	692,000	
Others	10	%	-	68,000	-	-	68,000	
Sub-Total				760,000			760,000	
2nd Year								
Farm Road	1,855	m	355	622,000	-	-	622,000	
Random Rubble Masonry	150	m^3	4,380	657,000	-	-	657,000	
Irrigation Canal								
Type B	380	m	8	4,000	-	-	4,000	
Type D	1,917	m	8	16,000	-	-	16,000	
Drainage Canal	2,392	m	46	111,000	-	-	111,000	
Drop								
Type B	1	nos.	393	1,000	-	-	1,000	
Type C	1	nos.	393	1,000	-	-	1,000	
Type D	1	nos.	393	1,000	-	-	1,000	
Culvert								
Type A	6	nos.	6,196	38,000	11,109	67,000	105,000	
Type B	3	nos.	4,014	13,000	7,245	22,000	35,000	
Type D	1	nos.	8,814	9,000	21,735	22,000	31,000	
Type F	4	nos.	14,351	58,000	18,640	75,000	133,000	
Type G	2	nos.	10,265	21,000	11,743	24,000	45,000	
Type H	2	nos.	12,079	25,000	14,912	30,000	55,000	
Flash Board Weir								
Type A	4	nos.	5,571	23,000	-	-	23,000	
Type B	4	nos.	12,514	51,000	-	-	51,000	
Type D	1	nos.	7,122	8,000	-	-	8,000	
Land Leveling	8,890	m^3	120	1,067,000	-	-	1,067,000	
Underdrainage	1	set	839,192	840,000	344,302	345,000	1,185,000	
Others	10	%	-	364,000	-	-	364,000	
Sub-Total				3,930,000		590,000	4,520,000	
Total				4,690,000		590,000	5,280,000	

Description of Items	Quantity	Unit	Domestic Currency Rate Rp	Domestic Currency Cost Rp	Foreign Currency Rate Rp	Foreign Currency Cost Rp	Total Cost Rp	Remarks
Construction Machinery								
Pan Trolley	10	nos.	-	-	30,000	300,000	300,000	
Rail	1,200	m	-	-	354	425,000	425,000	
Fixed Turnout	4	nos.	-	-	30,000	120,000	120,000	
Fishplate	50	nos.	-	-	22	2,000	2,000	
Fishbolt	200	nos.	-	-	5	1,000	1,000	
Spike	2,000	nos.	-	-	5	10,000	10,000	
Truck	1	nos.	-	-	1,200,000	1,200,000	1,200,000	
Concrete Mixer	1	nos.	-	-	250,000	250,000	250,000	
Total	1			-		2,310,000	2,310,000	

APPENDIX A

Overseas Technical Cooperation Agency

O. T. C. A.

C/O EMBASSY OF JAPAN
No. 24 Djalan M.H. Thamrin
Telephone: 48148
DJAKARTA—INDONESIA

Djakarta, December 17, 1970.

The Director General of Agriculture
D e p a r t m e n t o f A g r i c u l t u r e
16, Djalan Salemba Raya - D j a k a r t a.

Dear Sir,

The Overseas Technical Cooperation Agency sent a survey mission in connection with the Tjihea Tani Makmur Project to the Republic of Indonesia, headed by Heijiro Yoshihara, Executive Director of OTCA, during the first half period of survey, and Mr. Tadashi Sakamoto, Director of Agricultural Cooperation Department of OTCA, during a later period.

The mission has stayed in Indonesia since October 28th 1970 for the purpose of working out a detailed plan on this project at the request of the Government of Indonesia. A summary of the plan based on the results of survey on the area of the Pilot Project conducted by the mission is as follows :

1. Outline of Plan

This cooperation covers the Tjihea of 1086 ha as its object, and aims at implementing of the promotion of a consistent agricultural development project connected with land consolidation, establishment of farm management technique, and extension, and bringing-up of farmers' organisations.

2. Features of Plan

The main features are shown below :

a. Land consolidation
b. Improvement of farm management technique
c. Production, storage and distribution of high yielding seeds
d. Up-levelling of Agricultural cooperatives
e. Any other work as deemed necessary

Overseas Technical Cooperation Agency
O. T. C. A.
C/O EMBASSY OF JAPAN
No, 24 Djalan M.H. Thamrin
Telephone: 48148
DJAKARTA—INDONESIA

3. Cooperation for Land Consolidation

This cooperation aims at an area of 100 ha which should be the most important core in the Tjihea farm. According to the attached paper, the construction of irrigation and drainage facilities, adjustment of paddy field, construction of roads, guidance of water management, etc. will be conducted.

4. Cooperation on the Improvement of Farm Management Techniques

a. Practical tests as well as demonstrations connected with rice culture will be conducted on the farm management techniques and water management in a model farm of about 3 ha.

b. Indonesian technical officers will be given training in farm mechanization in the above mentioned model farm.

c. For the extension of farm management, they will be given a practical guidance on each stage in an extension farm of about 3 ha in Tjihe to be set up from time to time.

5. Cooperation on Production, Storage and Distribution of High Yielding Seeds

A technical guidance will be given on the above-mentioned work which is carried out in a directly-managed farm according to the results of practical tests in the model farm.

6. Cooperation on Up-Bringing of Agricultural Cooperatives

Guidance will be given on the storage and marketing of products, procurement and distribution of materials and equipment, water management, etc.

Overseas Technical Cooperation Agency
O. T. C. A.
C/O EMBASSY OF JAPAN
No, 24 Djalan M.H. Thamrin
Telephone: 48148
DJAKARTA—INDONESIA

7. Cooperation of the Government of Japan

For the implementation of this project, the Government of Japan will undertake the following matters :

a. Dispatch of Japanese experts
b. Supply of equipment
c. Training for Indonesian technicians in Japan

8. Cooperation of the Government of Indonesia

For the implementation of this project, the Government of Indonesia will undertake the following matters :

a. Implementation of land consolidation work
b. Assignment of Indonesian counterparts
c. Supply of land and building
d. Necessary steps for the stay and discharge of the assignment of Japanese experts

9. Establishing of Steering Committee

In order to carry out this project, we will have to establish a steering committee consisting of the members selected from Indonesian and Japanese sides.

10. Duration of Cooperation

A duration of this cooperation will be within three (3) years.

ANNEX

1. Japanese Experts

rice cultivation	1 person
farm machinery	2
farm management	1
irrigation	1
coordination	1
	6 persons

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DJAKARTA—INDONESIA

NOTE : Japanese experts assigned in Indonesia at present will be given the above-mentioned assignment too.

2. Donation of Equipment

a. machinery for land consolidation and its parts
b. farm machinery and its parts
c. equipment for tests
d. chemicals and fertilizers
e. tools for repairs
f. others

3. Land and Buildings

a. model farm and supplemental facilities
b. land and godowns for machinery, management materials and equipment, and construction materials and equipment
c. office
d. work shop and garage
e. other necessities

4. Requisities

For the purpose of promoting this project most effectively, particularly your attention will be invited to the following :

a. The land consolidation work in the area of the present project will be put into practice as planned.
b. The necessary number of Indonesian counterparts for the Japanese experts will have to be assigned during a reasonable period of time.

Yours faithfully,

(Tadashi Sakamoto)
Director of Agricultural Cooperation Department of OTCA

Discussion between the Japanese Survey Term and the Indonesian Counterpart regarding the Technical Cooperation in the field of Agriculture

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This is the Record of Discussion between the Japanese Survey Mission and the Indonesian agricutural authorities concerned for the implementation of the Technical Co-operation in the field of Agriculture.

Under instructions from the Government of Japan, the Japanese Survey Mission, organized by the Overseas Technical Cooperation Agency and headed by Mr. Ishii, visited the Republic of Indonesia for the 2nd time for the purpose of implementing the survey of technical matters related to the project mentioned above.

This Mission stayed in Indonesia from 22 August to 26 September 1967, and exchanged views and discussed the above subjects with the authorities concerned of the Government of Indonesia.

The record of discussions between the Mission and the Indonesian authorities is given in the following paper.

The matters recorded herein shall not be binding legally either to the Government of Japan or to the Government of Indonesia, as the former intends to make the final decision after studying this Record of Discussion upon the return of the Mission to Japan.

This Record of Discussion should, however, form the basis for arrangement, including the formal Agreement, required for the implementation of the projects by both Governments.

Djakarta, dated the 26th day of September, 1967.

Mr. KAZUO ISHI
Japan.

Mr. SADIKIN SUMINTAWIKARTA
Indonesia.

DISCUSSION BETWEEN THE JAPANESE SURVEY TERM AND THE INDONESIAN COUNTERPART REGARDING THE TECHNICAL COOPERATION IN THE FIELD OF AGRICULTURE

I. The Japanese Survey Mission and the Indonesian Authrities concerned, promising mutual cooperation for the implementing of the Technical Cooperation in the field of Agriculture have reached the following conclusion through discussion:

The two Governments shall cooperate with each other in the implementing the following projects for the purpose of increasing rice production in Indonesia, especially in West Java.

1. Seed Inspectors training project;
2. Training project on agriculture mechanization;
3. *Establishment of Tjihea BIMAS project;*

II. In implementing the above, the Government of Japan shall, in accordance with laws and regulations in force in Japan, take necessary measures to dispatch the Japanese experts and provide machinery and equipments, while the Government of Indonesia shall assume overall responsibilities of the Projects.

III. The objectives of the Seed Inspectors training are:

1. Practical and theoretical training for the production of improved seeds;

2. Training of the extension service personnel who are in charge of the instruction of seed growers, and the supervision of the production of extension seed;

3. Training on the field inspection and distribution of the extension seed.

Note: The system of production, distribution and inspection standard shall be in accordance with the Seed Inspectors training.

IV. The objectives of the Agricultural Mechanization, Training at Sukamandi and Pasarminggu are:

1. Practical and theoretical training on the utilization of agricultural machinery;
2. Mechanization of soil tillage, harvesting and processing;
3. Improvement of storage and preservation;
4. Mechanization management of estate and farm;
5. Maintenance and repairs;
6. Workshop operation.

V. The establishement of the Tjihea BIMAS project has the following objectivies;

1. Promoting the input of higher technology to attain high rice production;

2. Promoting of agricultural mechanization;

3. Arranging of the farm plots, roads, irrigation and drainage ditches;

4. Assisting in the development of the farm cooperative through the cooperative work from soil preparation up to processing, credit supply and marketing;

5. Demonstrating of extension seed production on village level;

6. Producting Foundation Seed.

VI. In accordance with laws and regulation in force in Japan, the Government of Japan shall take necessary measures to provide at their own expense the service of the required following Japanese experts:

one	programmer
one	legislator
one	expert on seed technology
one	expert on farm mechanization
one	expert on maintenance and repair of agricultural machinery

The Government of Japan will pay the necessary expenditure, such as their salaries and transportation cost between the two countries. The Japanese experts will be dispatched for the projects early in 1968.

VII. The Japanese experts and their families shall be granted in Indonesia the privileges, exemptions and benefits no less favorable than those granted to the experts of third countries or the United Nations under similar circumstances.

VIII. In accordance with laws and regulations in force in Indonesia the Indonesian authorities responsible for the projects shall see to it that Japanese experts shall be exempted from:

1. Income tax and charges of any kind imposed on or in conncetion with the renumeration received from abroad;

2. Import and export duties and any other charges in respect of reasonably necessary personal and household effects, including one motor vehicle, one refrigerator, one air-conditioner per family, other minor electric appliances and optical instruments which may be brought into Indonesia from Japan;

3. Such other privileges, exemptions and benefits including local medical services as admissible to the experts of the third country or the United Nations assigned to Indonesia under similar circumstances.

IX. In accordance with laws and regulations in force in Japan, the Government of Japan shall take necessary measures to provide at their own expense training and teaching materials, equipments and machinery, listed below:

a. Agricultural machinery, implements and spareparts;

b. Materials for the initial period of farming such as pesticides, fertilizers etc.;
c. Tools, implements and materials for testing work;
d. Machine tools for repair work;
e. Vehicles;
f. Teaching aids including audio-visual aids;
g. Other necessary minor equipments.

X. The articles referred to above shall become the property of the Government of Indonesia upon being delivered c.i.f. at the port of Djakarta to the authorities concerned.

The articles referred to above shall be utilized exclusively for the purpose of the Project in cooperation and technical guidance of the Japanese experts.

XI. In accordance with the technical cooperation scheme in Japan, the Government of Japan will take necessary measures to grant awards for the training of Indonesian technicians engaged in the projects.

XII. The Government of Indonesia shall undertake to bear claims, if any arise, against the Japanese experts resulting from, occuring in the course of, or otherwise connected with the bonafide discharge of their functions in Indonesia covered by this cooperation.

XIII. In accordance with laws and regulations in force in Indonesia, the Government of Indonesia shall provide at their own expense:

1. Indonesian technical staff as listed in Annex I;

2. Land and building, as listed in Annex II as well as incidental facilities required therefore;

3. Supply or replacement of machinery, equipments, tools and any other materials necessary for the implementation of the projects.

XIV. At Sukamandi two suitable repaired houses without furniture for the Japanese experts will be provided. At Bogor the Indonesian authorities will help find three suitable houses to be rented by the Japanese experts.

XV. In accordance with laws and regulations in force in Indonesia, the Government of Indonesia shall meet;

1. Expenses necessary for the transportation of the articles provided by Japan within Indonesia as well as for the installation, operation and maintenance therefore;

ANNEX I

List of the Indonesian staff for each project:

(1) At Muara

Project leader
Instructor for breeding and seed production
Instructor for storage and processing
Instructor for seed technology
Instructor for seed distribution
Instructor for storages, pests and diseases
Administrative officers

(2) At Sukamandi and Pasarminggu

Project leader
Fulltime technical officer
Instructor for farm mechanisation management
instructor for farm engines
Instructor for farm machinery
Instructor for service and maintenance
Instructor for soil tillage
Instructor for harvesting and processing
Instructor for storage and preservation
Instructor for irrigation and pump
Instructor for land survey
Administrative officers

(3) At Tjihea

Project leader
Technical and administrative officers

ANNEX II

Buildings and land to be provided for each project:
Building for the following facilities at each project:

(1) At Muara

Office
Class room at Tjiawi / Muara
Laboratory at Tjiawi / Muara
Store house for agricultural machinery
Store house for chemicals and fertilizers
Audio visual room
Stock room for testing instruments
Dormitory at Tjiawi

(2) At Sukamandi

Office
Class room
Store house for agricultural machinery
Store house for chemicals and fertilizers
Covered processing ward
Store house for fuel
Dormitory
Field shed
Garage

(3) At Pasarminggu

Office
Class room
Store house for agricultural machinery
Store house for chemicals and fertilizers
Covered processing yard
Store house for fuel
Dormitory
Garage

(4) At Tjihea

Store house for agricultural machinery
Covered processing yard

Farm land

(1)	at Muara	10 Ha	(2)	at Sukamandi	40 Ha
(3)	at Pasarminggu	4 Ha	(4)	at Tjihea	130 Ha

AGREEMENT BETWEEN THE GOVERNMENT OF JAPAN AND THE GOVERNMENT OF THE REPUBLIC OF INDONESIA CONCERNING TECHNICAL COOPERATION IN THE FIELD OF AGRICULTURE IN INDONESIA

The Government of Japan and the Government of the Republic of Indonesia, desiring to advance the economic and technical cooperation between the two countries, have agreed as follows:

ARTICLE I

The two Governments shall jointly carry out the following projects (hereinafter referred to as "the Projects") in connection with the Food Production Scheme of the Government of the Republic of Indonesia:

(a) Project to provide practical and theoretical training on production, inspection and extension of improved rice seed at Muara, Bogor.

(b) Project to provide practical and throretical training on utilization of agricultural machinery and on farm mechanization at Sukamandi and Pasarminggu, Djakarta.

(c) Project to promote rice production technology, agricultural mechanization, small scale land consolidation, agricultural cooperative activities and rice seed production at Tjihea, Tjiandjur.

ARTICLE II

(1) In accordance with laws and regulations in force in Japan, the Government of Japan will take necessary measures to provide at their own expense the services of requisite Japanese technical experts (hereinafter referred to as "the Japanese experts") as listed in Annex I.

(2) The Japanese experts and their families shall be granted privileges, exemptions and benefits as listed in Annex II and shall be granted privileges, exemptions and benefits no less favourable than those granted to the experts of any third country or the United Nations under similar circumstances.

ARTICLE III

(1) In accordance with laws and regulations in force in Japan, the Government of Japan will take necessary measures to provide at their own expense equipment, machinery, tools and materials required for the Projects as listed in Annex III.

(2) The articles referred to above shall become the property of the Government of the Republic of Indonesia upon being delivered c.i.f. at the port of Djakarta to the Indonesian authorities concerned.

(3) The Government of the Republic of Indonesia shall utilize these articles exclusively for the purpose of the Projects under the guidance of the Japanese experts.

ARTICLE IV

In accordance with laws and regulations in force in Japan, the Government of Japan will take necessary measures to grant training awards to Indonesian instructors engaged in the Projects.

ARTICLE V

The Government of the Republic of Indonesia undertakes to bear claims, if any arise, against the Japanese experts resulting from, occurring in the course of, or otherwise connected with the bona fide discharge of their functions in the Republic of Indonesia covered by this Agreement.

ARTICLE VI

(1) The Government of the Republic of Indonesia shall take necessary measures to provide at their own expense:

(a) Indonesian staff as stated in Annex IV;

(b) Land and building as stated in Annex V as well as incidental facilities required therefor;

(c) Replacement of machinery, equipment and tools referred to in Article III and spare parts thereof and supply of any other material necessary for the implementation of the Projects;

(d) Suitable furnished accommodation and transportation facilities for the Japanese experts as far as practicable.

(2) The Government of the Republic of Indonesia shall take necessary measures to meet:

(a) Customs duties, internal taxes and other similar charges, if any, imposed in the Republic of Indonesia in respect of the articles referred to in Article III;

(b) Expenses necessary for the transportation within the Republic of Indonesia of the articles referred to in Article III as well as for the installation, operation and maintenance thereof;

(c) Other expenses necessary for the implementation of the Projects including those listed in Annex VI.

ARICLE VII

The Japanese experts shall give technical guidance and advice to Indonesian staff engaged in the Projects pertaining to the implementation of the Projects, and the Indoneisan authorities concerned shall be responsible for the administrative and managerial matters pertaining to the Projects. There shall be close cooperation between the Japanese experts and Indonesian authorities concerned in connection with the implementation of the Projects.

ARTICLE VIII

There shall be mutual consultation between the two Governments for the purpose of advancing the objectives of this Agreement.

ARTICLE IX

(1) This Agreement shall come into force on the date of signature and remain in force for a period of three years.

(2) This Agreement may be extended by mutual Agreement for a further specified period.

DONE in duplicate in English at Djakarta on this twenty ninth day of May. 1968.

For the Government of Japan:

For the Government of the Republic of Indonesia:

ANNEX 1

LIST OF THE JAPANESE EXPERTS

(1) Programmer on seed production

(2) Legislator on seed inspection

(3) Expert on seed technology

(4) Expert on farm mechanization

(5) Expert on maintenance and repair of agricultural machinery

ANNEX 2

PRIVILEGES, EXEMPTIONS AND BENEFITS

(1) Exemption from income tax and charges of any kind imposed on or in connnection with remuneration received from abroad.

(2) Exemption from import and export duties and any other charges in respect of reasonably necessary personal and household effects, including one motor vehicle, one refrigerator and one airconditioner per family and other minor electric appliances and optical instruments.

(3) Medical services and facilities similar to those provided to the experts of third countries.

ANNEX 3

LIST OF EQUIPMENT, MACHINERY, TOOLS AND MATERIALS

(1) Agricultural machinery, implements and spare parts

(2) Materials required for the initial period of farming such as pesticides, fertilizers etc.

(3) Tools, implements and materials for testing work

(4) Machine tools for repair work

(5) Vehicles

(6) Teaching aids including audio-visual aids

(7) Other necessary minor equipment

ANNEX 4

LIST OF THE INDONESIAN ATAFF

(1) At Muara

Leader
Technical and administrative officers

(2) At Sukamandi and Pasarminggu

Leader
Technical and administrative officers

(3) At Tjihea

Leader
Technical and administrative officers

ANNEX 5

BUILDING AND LAND

(I) Buildings

(1) At Muara

Office and facilities for training and for storing equipment and other supplies

(2) At Sukamandi and Pasarminggu

Office and facilities for training and for storing equipment and other supplies

(3) At Tjihea

Store house for agricultural machinery

(II) Farm land

(1)	at Muara	10 Ha
(2)	at Sukamandi	40 Ha
(3)	at Pasarminggu	4 Ha
(4)	at Tjihea	130 Ha

ANNEX 6

OTHER EXPENSES

(1) Travelling expense of the Japanese experts in Indonesia in connection with the Projects

(2) Electricity and water costs

(3) Farming materials necessary for the implementation of the Projects such as seeds, fertilizers and pesticides

(4) Fuel for the operation of machinery and vehicles

(5) Expenses for maintenance and repairing of machinery and vehicles

(6) Expendables such as stationery etc.

APPENDIX B

1. DETAILED BREAK-DOWN OF ESTIMATED COST

Description of Items	Quantity	Unit	Domestic Currency		Foreign Currency		Total Cost	Remarks
			Rate	Cost	Rate	Cost		
			Rp	Rp	Rp	Rp	Rp	
Access Road 1 m								
Excavation	2.13	m^3	60	128	-	-	128	
Embankment	4.37	"	180	787	-	-	787	
Crushed stone	0.35	"	500	175	-	-	175	
Crushed stone pavement	0.35	"	30	11	-	-	11	
Total				1,101		-	1,101	
Farm Road 1 m								
Excavation	0.71	m^3	60	43	-	-	43	
Embankment	1.62	"	180	292	-	-	292	
Total				335		-	335	
Land Leveling 1 m^3								
Cutting	1	m^3	30	30	-	-	30	
Carrying and Pushing	1	"	45	45	-	-	45	
Banking and Leveling	1	"	45	45	-	-	45	
Total				120		-	120	

Description of Items	Quantity	Unit	Domestic Currency		Foreign Currency		Total Cost	Remarks
			Rate	Cost	Rate	Cost		
			Rp	Rp	Rp	Rp	Rp	
Irrigation Canal 1 m								
Embankment	0.18	m^3	30	6	-	-	6	
Forming	1	m	2	2	-	-	2	
Total				8		-	8	
Drainage Canal 1 m								
Excavation	0.66	m^3	60	40	-	-	40	
Embankment	0.09	"	30	3	-	-	3	
Forming	1	m	3	3	-	-	3	
Total				46		-	46	
Drop 1 unit								
Rip rap	0.63	m^3	600	378	-	-	378	
Riprap work	0.63	"	23	15	-	-	15	
Total				393		-	393	

Description of Items	Quantity	Unit	Domestic Cureency		Foreign Currency		Total Cost	Remarks
			Rate	Cost	Rate	Cost		
			Rp	Rp	Rp	Rp	Rp	
Culvert Type A 1 unit								
Excavation	2.83	m^3	60	170	-	-	170	
Back fill	1.89	"	30	57	-	-	57	
Random rubble wet masonry	0.25	"	4,380	1,095	-	-	1,095	
Concrete	0.42	"	10,490	4,406	-	-	4,406	
Rip rap	0.64	"	600	384	-	-	384	
Riprap work	0.64	"	23	15	-	-	15	
Corrugate pipe ø 300 mm	4.60	m	-	-	2,415	11,109	11,109	
Pipe laying	4.60	"	15	69	-	-	69	
Total				6,196		11,109	17,305	
Culvert Type B 1 unit								
Excavation	1.19	m^3	60	71	-	-	71	
Back fill	0.64	"	30	19	-	-	19	
Random rubble wet masonry	0.21	"	4,380	920	-	-	920	
Concrete	0.25	"	10.490	2,623	-	-	2,623	
Rip rap	0.54	"	600	324	-	-	324	
Riprap work	0.54	"	23	12	-	-	12	

Description of Items	Quantity	Unit	Domestic Currency		Foreign Currency		Total Cost	Remarks
			Rate	Cost	Rate	Cost		
			Rp	Rp	Rp	Rp	Rp	
Corrugate pipe ø 300 mm	3.00	m	-	-	2,415	7,245	7,245	
Pipe laying	3.00	"	15	45	-	-	45	
Total				4,014		7,245	11,259	
Culvert Type C 1 unit								
Excavation	1.58	m^3	60	95	-	-	95	
Back fill	0.81	"	30	24	-	-	24	
Random rubble wet masonry	0.38	"	4,380	1.664	-	-	1,664	
Concrete	0.39	"	10,490	4,091	-	-	4,091	
Rip rap	1.10	"	600	660	-	-	660	
Riprap work	1.10	"	23	25	-	-	25	
Corrugate pipe ø 300 mm	6.00	m	-	-	2,415	14,490	14,490	
Pipe laying	6.00	"	15	90	-	-	90	
Total				6,649		14,490	21,139	
Culvert Type D 1 unit								
Excavation	2.16	m^3	60	130	-	-	130	
Back fill	1.16	"	30	35	-	-	35	

Description of Items	Quantity	Unit	Domestic Currency		Foreign Currency		Total Cost	Remarks
			Rate	Cost	Rate	Cost		
			Rp	Rp	Rp	Rp	Rp	
Random rubble wet masonry	0.45	m^3	4,380	1,971	-	-	1,971	
Concrete	0.54	"	10,490	5,665	-	-	5,665	
Rip rap	1.41	"	600	846	-	-	846	
Riprap work	1.41	"	23	32	-	-	32	
Corrugate pipe ϕ 300 mm	9.00	m	-	-	2,415	21,735	21,735	
Pipe laying	9.00	"	15	135	-	-	135	
Total				8,814		21,735	30,549	
Culvert Type E 1 unit								
Excavation	2.16	m^3	60	130	-	-	130	
Back fill	1.16	"	30	35	-	-	35	
Random rubble wet masonry	0.56	"	4,380	2,453	-	-	2,453	
Concrete	0.54	"	10,490	5,665	-	-	5,665	
Rip rap	1.65	"	600	990	-	-	990	
Riprop work	1.65	"	23	38	-	-	38	
Corrugate pipe ϕ 300 mm	9.00	m	-	-	2,415	21,735	21,735	
Pipe laying	9.00	"	15	135	-	-	135	
Total				9,446		21,735	31,181	

Description of Items	Quantity	Unit	Domestic Currency Rate	Domestic Currency Cost	Foreign Currency Rate	Foreign Currency Cost	Total Cost	Remarks
			Rp	Rp	Rp	Rp	Rp	
Culvert Type F 1 unit								
Excavation	12.10	m^3	60	726	-	-	726	
Back fill	9.91	"	30	297	-	-	297	
Random rubble wet masonry	1.05	"	4,380	4,599	-	-	4,599	
Concrete	0.74	"	10,490	7,763	-	-	7,763	
Rip rap	1.43	"	600	858	-	-	858	
Riprap work	1.43	"	23	33	-	-	33	
Corrugate pipe ø 500 mm	5.00	m	-	-	3,728	18,640	18,640	
PipPipe laying	5.00	"	15	75	-	-	75	
Total				14,351		18,640	32,991	
Culvert Type G 1 unit								
Excavation	4.57	m^3	60	274	-	-	274	
Back fill	3.30	"	30	99	-	-	99	
Random rubble wet masonry	1.05	"	4,380	4,599	-	-	4,599	
Concrete	0.43	"	10,490	4,511	-	-	4,511	
Rip rap	1.18	"	600	708	-	-	708	
Riprap work	1.18	"	23	27	-	-	27	

Description of Items	Quantity	Unit	Domestic Currency Rate	Domestic Currency Cost	Foreign Currency Rate	Foreign Currency Cost	Total Cost	Remarks
			Rp	Rp	Rp	Rp	Rp	
Corrugate pipe ø 500 mm	3.15	m	-	-	3,728	11,743	11,743	
Pipe laying	31.5	"	15	47	-	-	47	
Total				10,265	11,	11,743	22,008	
Culvert Type H 1 unit								
Excavation	7.58	m^3	60	455	-	-	455	
Back fill	5.88	"	30	176	-	-	176	
Random rubble wet masonry	1.05	"	4,380	4,599	-	-	4,599	
Concrete	0.57	"	10,490	5,979	-	-	5,979	
Rip rap	1.30	"	600	780	-	-	780	
Riprap work	1.30	"	23	30	-	-	30	
Corrugate pipe ø 500 mm	4.00	m	-	-	3,728	14,912	14,912	
Pipe laying	4.00	"	15	60	-	-	60	
Total				12,079		14,912	26,991	
Flash Board Weir Type A 1 unit								
Random rubble wet masonry	0.45	m^3	4,380	1,971	-	-	1,971	
Stone dry masonry	1.79	"	1,512	2,706	-	-	2,706	

Description of Items	Quantity	Unit	Domestic Currency Rate	Domestic Currency Cost	Foreign Currency Rate	Foreign Currency Cost	Total Cost	Remarks
			Rp	Rp	Rp	Rp	Rp	
Rip rap	0.15	m^3	600	90	-	-	90	
Riprap work	0.15	"	23	4	-	-	4	
Wooden pile	6.00	nos.	100	600	-	-	600	
Stop-log	2.00	"	100	200	-	-	200	
Total				5,571		-	5,571	
Flash Board Weir Type B 1 unit								
Random rubble wet masonry	1.01	m^3	4,380	4,424	-	-	4,424	
Stone dry masonry	4.47	"	1,512	6,759	-	-	6,759	
Rip rap	0.21	"	600	126	-	-	126	
Riprap work	0.21	"	23	5	-	-	5	
Wooden Pile	6.00	nos.	100	600	-	-	600	
Stop-log	6.00	"	100	600	-	-	600	
Total				12,514		-	12,514	
Flash Board Weir Type C 1 unit								
Random rubble wet masonry	0.63	m^3	4,380	2,759	-	-	2,759	
Stone dry masonry	1.79	"	1,512	2,706	-	-	2,706	
Rip rap	0.33	"	600	198	-	-	198	

Description of Items	Quantity	Unit	Domestic Currency Rate	Domestic Currency Cost	Foreign Currency Rate	Foreign Currency Cost	Total Cost	Remakrs
			Rp	Rp	Rp	Rp	Rp	
Wooden pile	6.00	nos.	100	600	-	-	600	
Stop-log	2.00	"	100	200	-	-	200	
Total				6,471		-	6,471	
Flash Board Weir Type D 1 unit								
Random rubble wet masonry	0.72	m^3	4,380	3,154	-	-	3,154	
Stone dry masonry	1.79	"	1,512	2,706	-	-	2,706	
Rip rap	0.42	"	600	252	-	-	252	
Riprap work	0.42	"	23	10	-	-	10	
Wooden pile	8.00	nos.	100	800	-	-	800	
Stop-log	2.00	"	100	200	-	-	200	
Total				7,122		-	7,122	
Flash Board Weir Type E 1 unit								
Random robble wet masonry	0.81	m^3	4,380	3,548	-	-	3,548	
Stone dry masonry	1.79	"	1,512	2,706	-	-	2,706	
Rip rap	0.51	"	600	306	-	-	306	
Riprap work	0.51	"	23	12	-	-	12	
Wooden pile	8.00	nos.	100	800	-	-	800	

Description of Items	Quantity	Unit	Domestic Currency Rate	Domestic Currency Cost	Foreign Currency Rate	Foreign Currency Cost	Total Cost	Remarks
			Rp	Rp	Rp	Rp	Rp	
Stop-log	2.00	nos.	100	200	-	-	200	
Total				7,572		-	7,572	
Bridge No.1 1 unit								
Excavation	34.40	m^3	60	2,064	-	-	2,064	
Emabnkment	11.63	"	30	349	-	-	349	
Back fill	21.23	"	30	637	-	-	637	
Random rubble wet masonry	29.48	"	4,380	129,122	-	-	129,122	
Stone dry masonry	2.40	"	1,512	3,629	-	-	3,629	
Concrete	9.18	"	10,490	96,298	-	-	96,298	
Superstructure	1.00	unit	-	-	550,000	550,000	550,000	
Superstructure work	1.00	"	10,000	10,000	-	-	10,000	
Total				242,099		550,000	792,099	
Bridge No.2 1 unit								
Excavation	34.10	m^3	60	2,046	-	-	2,046	
Embankment	36.54	"	30	1,096	-	-	1,096	
Back fill	22.67	"	30	680	-	-	680	
Random rubble wet masonry	29.48	"	4,380	129,122	-	-	129,122	

Description of Items	Quantity	Unit	Domestic Currency		Foreign Currency		Total Cost	Remarks
			Rate	Cost	Rate	Cost		
			R_P	R_P	R_P	R_P	R_P	
Stone dry masonry	2.88	m^3	1,512	4,355	-	-	4,355	
Concrete	9.18	"	10,490	96,298	-	-	96,298	
Superstructure	1.00	unit	-	-	550,000	550,000	550,000	
Superstructure work	1.00	"	10,000	10,000	-	-	10,000	
Total				243,597		550,000	793,597	
Underdrainage 1 set								
Excavation	2,177.60	m^3	60	130,656	-	-	130,656	
Back fill	1,550.40	"	30	46,512	-	-	46,512	
Sand	253.80	"	1,660	421,308	-	-	421,308	
Straw	3,760.00	m	4	15,040	-	-	15,040	
Vinyl chloride pipe								
ø 60 mm	1,800.00	"	-	-	111	199,800	199,800	
ø 100 mm	160.00	"	-	-	751	120,160	120,160	
ø 150 mm	18.40	"	-	-	966	17,774	17,774	
Pipe laying	1,978.40	"	15	29,676	-	-	29,676	
Bamboo-bundle	1,960.00	"	100	196,000	-	-	196,000	
Relief well	4.00	nos.	-	-	1,642	6,568	6,568	
Total				839,192		344,302	1,183,494	

Unit Cost

Item		Unit	Unit Cost	Remarks
Excavation		m^3	60^{Rp}	150^{Rp} x 0.4^{Person}
Cutting		"	30	150 x 0.2
Embankment	Road	"	180	150 x 1.2
	Canal	"	30	150 x 0.2
Leveling		"	45	150 x 0.3
Earth carrying		"	45	150 x 0.3
Back fill		"	30	150 x 0.2
Irrigation canal forming		m	2	150 x 0.01
Drainage canal forming		"	3	150 x 0.02
Concrete		m^3	10,490	
Random rubble wet masonry		"	4,380	
Stone dry masonry		"	1,512	
Crushed stone		"	500	
Crushed stone pavement		"	30	150 x 0.2
Rip rap		"	600	
Riprap work		"	23	115 x 0.15
Sand		"	1,660	
Corrugate pipe	ø 300 mm	m	2,415	
	ø 500 mm	"	3,728	
Vinyl chloride pipe				
	ø 60 mm	"	111	
Vinyl chloride pipe				
	ø 100 mm	m	751^{Rp}	
	ø 150 mm	"	966	
Pipe laying		"	15	150 x 0.1
Bamboo-bundle		"	100	
Straw		"	4	
Wooden Pipe	ø 100mm, l = 1.0 m	nos.	100	
Stop-log		"	100	
Relief well		"	1,642	
Bridge superstructure		unit	550,000	

Bill of Annual Quantity

1st Year

Item	Unit	Tract A	Tract B	Tract C	Tract D	Total
Access Road	m	-	982	-	628	1,610
Farm road	"	-	3,303	-	-	3,303
Irrigation Canal						
Type A	"	-	415	-	-	415
Type B	"	-	-	-	-	-
Type C	"	-	100	-	-	100
Type D	"	-	3,529	-	-	3,529
Drainage Canal	"	-	4,095	-	-	4,095
Drop Type A	nos.	-	-	-	-	-
Type B	"	-	3	-	-	3
Type C	"	-	2	-	-	2
Type D	"	-	5	-	-	5
Culvert						
Type A	"	-	10	-	-	10
Type B	"	-	10	-	-	10
Type C	"	-	2	-	-	2
Type D	"	-	-	-	-	-
Type E	"	-	1	-	-	1
Type F	"	-	1	-	-	1
Type G	"	-	7	-	-	7
Type H	"	-	7	-	-	7
Flash Board Weir						
Type A	"	-	9	-	-	9
Type B	"	-	4	-	-	4
Type C	"	-	1	-	-	1
Type D	"	-	-	-	-	-
Type E	"	-	2	-	-	2
Land Leveling	m^3	-	10,877	-	-	10,877
Bridge	nos.	-	2	-	-	2
Construction Machinery	set	-	-	-	-	1

2nd Year

Item	Unit	Tract A	Tract B	Tract C	Tract D	Total
Access Road	m	-	-	-	-	-
Farm Road	"	428	283	2,206	1,855	4,771
Irrigation Canal						
Type A	"	-	-	-	-	-
Type B	"	-	-	360	380	740
Type C	"	-	-	230	-	230
Type D	"	-	280	2,694	1,917	4,891
Drainage Canal	"	-	165	1,842	2,392	4,399
Drop Type A	nos.	-	-	-	-	-
Type B	"	-	2	6	1	9
Type C	"	-	-	4	1	5
Type D	"	-	1	-	1	2
Culvert						
Type A	"	-	-	-	6	6
Type B	"	-	-	11	3	14
Type C	"	-	-	-	-	-
Type D	"	-	-	-	1	1
Type E	"	-	-	-	-	-
Type F	"	-	-	-	4	4
Type G	"	-	-	3	2	5
Type H	"	-	-	3	2	5
Random Rubble Wet Masonry	m^3	-	-	-	150	150
Flash Board Weir						
Type A	nos.	-	-	7	4	11
Type B	"	-	-	1	4	5
Type C	"	-	-	2	-	2
Type D	"	-	-	-	1	1
Type E	"	-	-	-	-	-
Land Leveling	m^3	-	6,820	6,648	8,800	22,358
Underdrainage	set	-	-	-	1	1

3rd Year

Item	Unit	Tract A	Tract B	Tract C	Tract D	Total
Access Road	m	-	-	-	-	-
Farm Road	"	3,018	-	-	-	3,018
Irrigation Canal						
Type A	"	-	-	-	-	-
Type C	"	-	-	-	-	-
Type C	"	425	-	-	-	425
Type D	"	4,109	-	-	-	4,109
Drainage Canal	"	3,718	-	-	-	3,718
Drop Type A	nos.	2	-	-	-	2
Type B	"	3	-	-	-	3
Type C	"	2	-	-	-	2
Type D	"	1	-	-	-	1
Culvert Type						
Type A	"	-	-	-	-	-
Type B	"	13	-	-	-	13
Type C	"	2	-	-	-	2
Type D	"	-	-	-	-	-
Type E	"	-	-	-	-	-
Type F	"	-	-	-	-	-
Type G	"	8	-	-	-	8
Type H	"	2	-	-	-	2
Flash Board Weir						
Type A	"	13	-	-	-	13
Type B	"	6	-	-	-	6
Type C	"	1	-	-	-	1
Type D	"	-	-	-	-	-
Type E	"	-	-	-	-	-
Land Leveling	m^3	14,177	-	1,700	-	15,877

Machinery and Materials

Item	Unit	1st Year	2nd Year	3rd Year	Total
Pan trolley	nos.	10.00	-	-	10.00
Rail	m	1,200.00	-	-	1,200.00
Fixed turnout	nos.	4.00	-	-	4.00
Fishplate	"	50.00	-	-	50.00
Fishbolt	"	200.00	-	-	200.00
Spike	"	2,000.00	-	-	2,000.00
Truck	"	1.00	-	-	1.00
Concrete mixer	"	1.00	-	-	1.00
Corrugate pipe					
ø 300 mm	m	97.00	78.60	51.00	226.60
ø 500 mm	"	55.05	55.75	33.20	144.00
Bridge	nos.	2.00	-	-	2.00
Vinyl chloride pipe					
ø 60 mm	m	-	1,800.00	-	1,800.00
ø 100 mm	"	-	160.00	-	160.00
ø 150 mm	"	-	18.40	-	18.40
Relief well	nos.	-	4.00	-	4.00

2. BILL OF QUANTITY

Bill of Quantity of Pilot Farm 100 ha

Materials \ Tract	Unit	A	B	C	D	Total	Remarks
Excavation	m^3	5,754.85	8,398.97	3,404.25	6,898.01	24,456.07	
Embankment	"	349.50	448.57	173.10	224.80	1,195.97	
Borrow Material	"	5,565.30	12,082.70	3,562.70	5,740.20	26,950.90	
Earth Work for Leveling	"	14,176.66	17,697.22	8,348.06	8,890.32	49,112.26	
Back-fill	"	48.10	146.15	34.58	1,622.82	1,851.65	
Masonry with Mortar	"	22.49	86.95	13.02	164.51	286.97	
Masonry	"	34.00	26.76	16.11	13.42	90.29	
Crushed Stone	"		343.70		219.80	563.50	
Rip-rap	"	28.96	45.27	21.34	20.66	116.23	
Concrete	"	8.61	15.76	17.36	8.77	50.50	
Corrugated Pipe	m	51.00	97.00	33.00	45.60	226.60	ø 300
Corrugated Pipe	"	33.20	55.05	21.45	34.30	144.00	ø 500
Wooden Pile	Nos.	96	76	54	38	264	ø 100
Flash Board	Sheet	40	24	18	16	98	0.15x0.05x0.5
H-Bean	ton		1.854			1.854	
⊏ - Bean	"		0.582			0.582	H-446x199x8x12
Slab Plate	"		1.322			1.322	⊏-250x90x9x13
Metal Fittings	"		1.298			1.298	
Pavement Concrete	m^3		9.18			9.18	
Elastic Filler	"		0.0188			0.0188	
Sand	"				253.80	253.80	
Paddy Straw	"				263.20	263.20	
P.V.C. Pipe	m				1,800.00	1,800.00	ø 60
P.V.C. Pipe	"				100.00	100.00	ø 100
P.V.C. Pipe	"				18.40	18.40	ø 150
Bundle of Split Bamboo	"				1,800.00	1,800.00	ø 100
Bundle of Split Bamboo	"				160.00	160.00	ø 200
Relief Well	Nos.				4	4	

Bill of Quantity of Tract A

Materials \ Works		Access Road	Farm Road	Land Leveling	Irri. Canal	Drainage Canal	Culvert	F.B. Weir	Drop	Total	Remarks
Excavation	m^3		2,429.4		816.1	2,439.0	70.35			5,754.85	
Embankment	m^3					349.5				349.5	
Borrow Material	m^3		5,565.3							5,565.3	
Earthwork for Leveling	m^3			14,176.66						14,176.66	
Back fill	m^3						48.10			48.10	
Masonry with Mortar	m^3						13.99	8.50		22.49	
Masonry	m^3							34.00		34.00	
Crushed Stone	m^3										
Rip-rap	m^3						21.26	2.7	5.00	28.96	
Concrete	m^3						8.61			8.61	
Corrugated Pipe ϕ 300	m						51.00			51.00	
Corrugated Pipe ϕ 500	m						32.20			32.20	
Wooden Pile ϕ 100	Nos.							96		96	
Flash Board 0.15x0.05x0.5	Sheet							40		40	

Bill of Quantity of Tract B

Materials \ Works		Access Road	Farm Road	Land Leveling	Irri. Canal	Drainage Canal	Culvert	F.B. Weir	Drop	Bridge	Total	Remarks
Excavation	m^3	2,086.8	2,528.1		778.3	2,794.6	142.67			68.5	8,398.97	
Enbankment	m^3					400.4				48.17	448.57	
Borrow Material	m^3	4,291.3	7,791.4								12,082.70	
Earthwork for Leveling	m^3			17,697.22							17,697.22	
Back fill	m^3						102.25			43.90	146.15	
Masonry with Mortar	m^3						21.67	6.30		58.98	86.95	
Masonry	m^3							21.48		5.28	26.76	
Crushed Stone	m^3	343.7									343.70	
Rip-rap	m^3						34.44	2.70	8.13		45.27	
Concrete	m^3						15.76				15.76	
Corrugated Pipe ø 300	m						97.00				97.00	
Corrugated Pipe ø 500	m						55.05				55.05	
Wooden Pile ø 100	Nos							76			76	
Flash Board 0.15x0.05x0.5	Sheet							24			24	
H - Beam	ton									1,854	1,854	
C - Beam	ton									0.582	0.582	
Slab Plate	ton									1,322	1,322	
Metal Fittings	ton									1,298	1,298	
Pavement Concrete	m^3									9.18	9.18	
Elastic filler	m^3									0.0188	0.0188	

Bill of Quantity of Tract C

Materials \ Works		Access Road	Farm Road	Land Leveling	Irri. Canal	Drainage Canal	Culvert	F.B. Weir	Drop	Total	Remarks
Excavation	m^3		1,555.2		591.1	1,208.4	49.54			3,404.24	
Embankment	m^3					173.1				173.10	
Borrow Material	m^3		3,562.7							3,562.70	
Earthwork for Leveling	m^3			8,348.06						8,348.06	
Back fill	m^3						34.58			34.58	
Masonry with Mortar	m^3						8.61	4.41		13.02	
Masonry	m^3							16.11		16.11	
Crushed Stone	m^3										
Rip-rap	m^3						13.38	1.71	6.25	21.34	
Concrete	m^3						17.36			17.36	
Corrugated Pipe ϕ 300	m						33.00			33.00	
Corrugated Pipe ϕ 500	m						21.45			21.45	
Wooden Pile ϕ 100	Nos.							54		54	
Flash Board 0.15x0.05x0.5	Sheet							18		18	

Bill of Quantity of Tract D

Materials \ Works		Access Road	Farm Road	Land Leveling	Irri. Canal	Drainage Canal	Culvert	F.B. Weir	Drop	Under Drainage	Total	Remarks
Excavation	m^3	1,334.5	1,307.8		413.5	1,569.2	95.41			2,177.6	6,898.01	
Embankment	m^3					224.8					224.80	
Borrow Material	m^3	2,744.4	2,995.8								5,740.20	
Earthwork for Leveling	m^3			8,890.38							8,890.32	
Back-fill	m^3						72.42			1,550.40	1,622.82	
Masonry with mortar	m^3		150.00				10.98	3.53			164.51	
Masonry	m^3							13.42			13.42	
Crushed Stone	m^3	219.8									219.8	
Rip-rap	m^3						17.55	1.23	1.88		20.66	
Concrete	m^3						8.77				8.77	
Corrugated Pipe ϕ 300	m						45.60				45.60	
Corrugated Pipe ϕ 500	m						34.30				34.30	
Wooden Pile ϕ 100	Nos							38			38	
Flash Board 0.15x0.05x0.5	Sheet										16	
Sand	m^3									253.8	253.8	
Paddy Straw	m^3									263.2	263.2	
P.V.C. Pipe ϕ 60	m									1,800.0	1,800.0	
P.V.C. Pipe ϕ 100	m									100.0	100.0	
P.V.C. Pipe ϕ150	m									18.4	18.4	
Bundle of Split Bamboo ϕ100	m									1,800.0	1,800.0	
Bundle of Split Bamboo ϕ120	m									160.0	160.0	
Relief Well	Nos									4	4	

3. DESIGN

3-1 Distribution and Frequency of Rainfall

Distribution and frequency of rainfall for ten years (1961 - 1970) at P.P. Tjihea are given in Table below.

Monthly Distribution of Rainfall

Month	Rainfall		
	Maximum	Minimum	Mean
Jan.	726 mm	143 mm	290 mm
Feb.	293	125	193
Mar.	878	142	307
Apr.	550	55	277
May	406	46	252
June	201	0	86
July	360	0	113
Aug.	284	0	82
Sept.	330	0	92
Oct.	346	62	171
Nov.	821	109	283
Dec.	445	209	303

Monthly Distribution of Rainfall

Month \ Year	1961	'62	'63	'64	'65	'66	'67	'68	'69	'70	Mean
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
Jan.	284	180	156	278	266	143	151	278	436	726	290
Feb.	247	232	177	125	235	126	165	125	203	293	193
Mar.	256	437	203	192	142	329	255	188	192	878	307
Apr.	273	207	350	333	55	218	327	333	126	550	277
May	364	129	46	397	286	94	64	397	341	406	252
Jun.	12	111	7	191	42	0	0	201	131	162	86
Jul.	16	199	6	360	14	0	47	360	13	110	113
Aug.	2	38	7	284	36	50	0	284	43	75	82
Sept.	34	63	20	145	X	40	0	145	330	55	92
Oct.	97	346	62	77	82	311	125	77	206	325	171
Nov.	143	143	821	109	296	341	229	109	357	X	283
Dec.	322	331	271	209	300	240	399	209	445	X	303

Monthly Frequency of Rainfall

Rainfall / Month	mm 0	mm 0 - 5	mm 6 - 10	mm 11 - 20	mm 21 - 30	mm 31 - 50	mm More than 50 mm
	day	day	day	day	day	day	day
Jan.	14.3	3.6	5.5	3.6	1.5	1.9	0.6
Feb.	14.7	4.9	2.9	3.0	1.2	1.1	0.4
Mar.	14.5	4.6	3.3	3.6	2.7	1.2	1.1
Apr.	18.2	2.8	2.0	2.6	1.2	1.6	1.7
May	20.4	2.0	1.7	2.5	1.5	1.8	1.1
June	24.6	2.3	0.7	0.1	0.8	0.2	0.4
July	26.5	0.9	0.4	1.2	0.5	0.7	0.7
Aug.	27.2	1.1	0.8	0.8	0.2	0.3	0.6
Sept.	24.9	1.2	0.9	1.3	0.9	0.6	0.2
Oct.	22.3	3.0	1.1	1.6	1.2	0.8	0.9
Nov.	17.8	2.9	3.2	2.9	1.2	1.0	1.0
Dec.	15.7	4.7	3.3	2.4	2.0	1.8	1.6

Monthly Frequency of Rainfall

Month	Rainfall	Year										Mean
		'61	'62	'63	'64	'65	'66	'67	'68	'69	'70	
	mm	day	day	day	day	day	day	day	day	day	day	day
	0	12	17	13	16	7	18	18	16	15	11	14.3
	- 5	1	3	6	2	11	1	3	2	2	5	3.6
	- 10	10	5	7	4	5	7	5	4	6	2	5.5
Jan.	- 20	3	4	5	4	3	4	4	4	2	3	3.6
	- 30	3	1	0	3	3	1	0	3	0	1	1.5
	- 50	2	1	0	2	2	0	1	2	4	5	1.9
		0	0	0	0	0	0	0	0	2	4	0.6
	0	13	15	11	20	6	20	16	20	9	17	14.7
	- 5	5	4	7	3	10	1	4	3	8	4	4.9
	- 10	3	2	5	3	3	2	2	3	5	1	2.9
Feb.	- 20	4	3	3	1	6	3	4	1	4	1	3.0
	- 30	1	2	0	1	2	1	1	1	1	2	1.2
	- 50	1	1	2	1	1	1	1	1	1	1	1.1
		1	1	0	0		0	0	0	0	2	0.4
	0	15	14	16	17	15	10	14	17	16	11	14.5
	- 5	4	1	4	3	9	6	6	3	6	4	4.6
	- 10	3	5	4	4	3	3	4	5	1	1	3.3
Mar.	- 20	4	3	3	3	3	6	4	2	6	2	3.6
	- 30	3	4	3	4	1	5	1	4	0	2	2.7
	- 50	2	2	1	0	0	1	1	0	2	3	1.2
		0	2	0	0	0	0	1	0	0	8	1.1
	0	13	15	13	20	22	20	18	20	22	19	18.2
	- 5	6	6	3	1	4	0	3	1	3	1	2.8
	- 10	4	2	3	0	3	4	2	0	2	0	2.0
Apr.	- 20	2	3	6	3	1	4	1	3	2	1	2.6
	- 30	2	3	1	2	0	0	0	2	1	1	1.2
	- 50	3	0	2	1	0	1	4	1	1	3	1.6
		0	1	2	3	0	1	2	3	0	5	1.7
	0	14	26	26	19	17	22	28	19	13	20	20.4
	- 5	4	1	3	0	3	2	1	0	5	1	2.0
	- 10	0	1	0	1	3	4	0	1	5	2	1.7
May	- 20	4	0	2	5	3	2	0	5	2	2	2.5
	- 30	5	0	0	2	1	1	1	2	1	2	1.5
	- 50	4	2	0	1	3	0	1	1	5	1	1.8
		0	1	0	3	1	0	0	3	0	3	1.1
	0	27	24	27	17	24	30	30	17	25	25	24.6
	- 5	2	2	3	6	3	0	0	6	0	1	2.3
	- 10	1	0	0	3	1	0	0	2	1	0	0.7
Jun.	- 20	0	1	0	1	2	0	0	2	1	3	0.1
	- 30	0	2	0	2	0	0	0	2	2	0	0.8
	- 50	0	1	0	0	0	0	0	0	0	1	0.2
		0	0	0	1	0	0	0	1	1	1	0.4

Month	Rainfall	Year										Mean
		'61	'62	'63	'64	'65	'66	'67	'68	'69	'70	
	mm	day	day	day	day	day	day	day	day	day	day	day
	0	30	23	30	19	29	31	28	19	30	26	26.5
	- 5	0	3	0	2	1	0	0	2	0	1	0.9
	- 10	0	1	1	0	1	0	1	0	0	0	0.4
	- 20	1	0	0	4	0	0	1	4	1	2	1.7
	- 30	0	2	0	1	0	0	1	1	0	0	0.5
	- 50	0	1	0	2	0	0	0	2	0	2	0.7
		0	1	0	3	0	0	0	3	0	0	0.7
	0	30	26	29	21	28	29	31	21	29	28	27.2
	- 5	1	1	2	2	0	1	0	2	1	1	1.1
	- 10	0	3	0	2	1	0	0	2	0	0	0.8
Aug.	- 20	0	1	0	2	2	0	0	2	0	1	0.8
	- 30	0	0	0	1	0	0	0	1	0	0	0.2
	- 50	0	0	0	0	0	1	0	0	1	1	0.3
		0	0	0	3	0	0	0	3	0	0	0.6
	0	27	27	27	22		26	30	22	16	27	24.9
	- 5	2	2	1	1		1	0	1	3	0	1.2
	- 10	0	0	2	1		1	0	1	3	0	0.9
Sept.	- 20	0	0	0	4		2	0	4	0	2	1.3
	- 30	1	0	0	1		0	0	1	4	1	0.9
	- 50	0	0	0	1		0	0	1	3	0	0.6
		0	1	0	0		0	0	0	1	0	0.2
	0	27	17	23	25	26	14	26	25	24	16	22.3
	- 5	0	7	5	2	3	5	0	2	2	4	3.0
	- 10	0	0	1	1	1	2	3	1	0	3	1.1
Oct.	- 20	2	1	1	1	0	5	0	1	1	4	1.6
	- 30	1	2	1	2	0	2	0	2	1	1	1.2
	- 50	1	1	0	0	0	2	1	0	2	1	0.8
		0	3	0	0	1	1	1	0	1	2	0.9
	0	20	14	20	21	20	11	15	21	18		17.8
	- 5	1	7	1	2	1	3	6	2	3		2.9
	- 10	5	4	1	4	1	5	5	4	0		3.2
Nov.	- 20	2	4	2	2	4	5	1	2	4		2.9
	- 30	1	1	1	1	0	4	1	1	1		1.2
	- 50	1	0	1	0	3	1	1	0	2		1.0
		0	0	4	0	1	1	1	0	2		1.0
	0	12	11	20	17	18	15	16	17	15		15.7
	- 5	6	6	3	5	1	6	3	5	2		4.7
	- 10	5	6	3	1	4	5	4	1	1		3.3
Dec.	- 20	2	2	0	4	3	2	3	4	2		2.4
	- 30	2	3	1	3	1	1	1	3	3		2.0
	- 50	3	1	2	1	1	0	0	1	7		1.8
		1	2	2	0	2	2	4	0	1		1.6

3 -2 Probability of Rainfall

Maximum daily rainfall at P.P. Tjihea from 1961 to 1970 are below.

Year	Maximum daily rainfall
1961	77 mm
1962	107
1963	325
1964	87
1965	88
1966	80
1967	90
1968	87
1969	101
1970	120

Table arranged in order of intensity

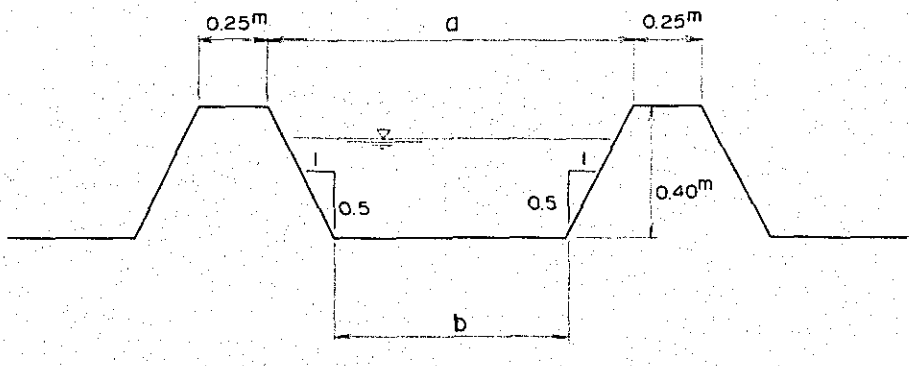
Ranking	Max. daily rainfall	Year	i/n
1 st	325 mm	1963	0.10
2 nd	120	1970	0.20
3 rd	107	1962	0.30
4 th	101	1969	0.40
5 th	90	1967	0.50
6 th	88	1965	0.60
7 th	87	1964	0.70
8 th	87	1968	0.80
9 th	80	1966	0.90
10 th	77	1961	1.00

Probability calculated by rational formula is given in Table below.

Probability	Rainfall
1/2	97 mm
1/3	107
1/4	113
1/5	119
1/10	130
1/15	140
1/20	143

3-3 Irrigation Canals and Related Structures

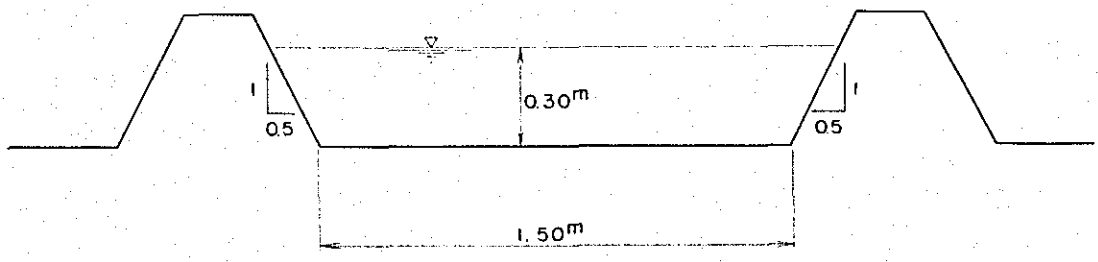
According to paddy blocks, 4 irrigation canals are designed; Type A, B, C and D. Each canal has the following section



Type A	a = 1.90	b = 1.50 m
Type B	a = 1.60	b = 1.20
Type C	a = 1.30	b = 0.90
Type D	a = 0.70	b = 0.30

Capacity is examined as follows:

(a) Type A



$$A = \frac{1}{2} (1.50 + 1.80) \times 0.30 = 0.495 \text{ m}^2$$

$$P = 1.50 + 2 \times \sqrt{0.30^2 + 0.15^2} = 2.170 \text{ m}$$

$$R = \frac{A}{P} = \frac{0.495}{2.170} = 0.228$$

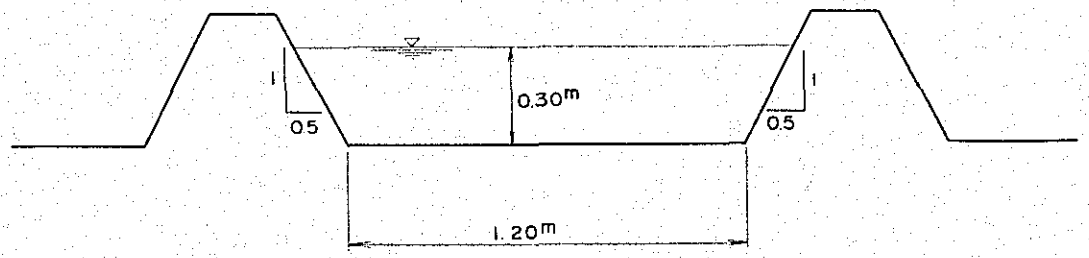
$$R^{2/3} = 0.373$$

$$I = 1/500, \quad n = 0.030$$

$$V = \frac{1}{n} \cdot R^{2/3} \cdot I^{1/2} = 1.490 \times 0.373 = 0.556 \text{ m/s}$$

$$Q = A.V = 0.495 \times 0.556 = 0.275 \text{ m}^3/\text{S} = 275 \text{ l/s}$$

(b) Type B



$$A = \frac{1}{2} (1.20 + 1.50) \times 0.30 = 0.405 \text{ m}^2$$

$$P = 1.20 + 2 \times \sqrt{0.30^2 + 0.15^2} = 1.870 \text{ m}$$

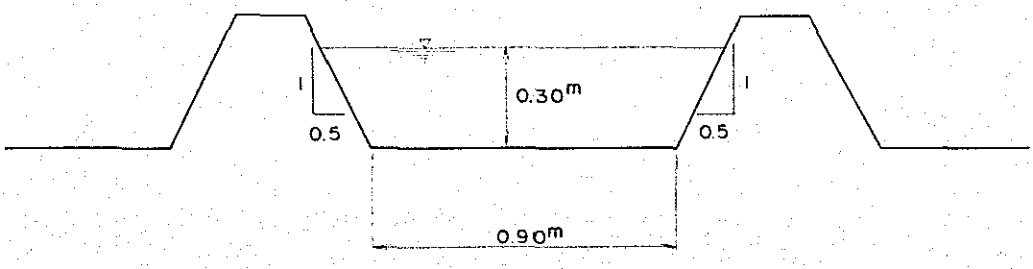
$$R = \frac{A}{P} = \frac{0.405}{1.870} = 0.217 \quad , \quad R^{2/3} = 0.361$$

$$I = 1/300, \quad n = 0.030$$

$$V = \frac{1}{n} \cdot R^{2/3} \cdot I^{1/2} = 1.924 \times 0.361 = 0.695 \text{ m/s}$$

$$Q = A \cdot V = 0.405 \times 0.695 = 0.281 \text{ m}^3/\text{s} = 281 \text{ l/s}$$

(c) Type C



$$A = \frac{1}{2} (0.9 + 1.20) \times 0.30 = 0.315 \text{ m}^2$$

$$P = 0.90 + 2 \times \sqrt{0.15^2 + 0.30^2} = 1.570 \text{ m}$$

$$R = \frac{A}{P} = \frac{0.315}{1.570} = 0.201, \quad R^{2/3} = 0.343$$

i) $I = 1/200, \quad n = 0.030$

$$V = \frac{1}{n} \cdot R^{2/3} \cdot I^{1/2} = 2.357 \times 0.343 = 0.808 \text{ m/s}$$

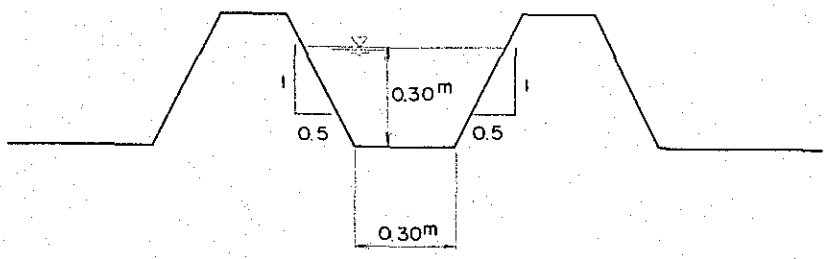
$$Q = A \cdot V = 0.315 \times 0.808 = 0.255 \text{ m}^3/\text{s} = 255 \text{ l/s}$$

ii) $I = 1/500, \quad n = 0.030$

$V = 1.490 \times 0.343 = 0.511 \text{ m/s}$

$Q = 0.315 \times 0.511 = 0.161 \text{ m}^3/\text{s} = 161 \text{ l/s}$

(d) Type D



$$A = \frac{1}{2} (0.30 + 0.60) \times 0.30 = 0.135 \text{ m}^2$$

$$P = 0.30 + 2 \times \sqrt{0.30^2 + 0.15^2} = 0.971 \text{ m}$$

$$R = \frac{A}{P} = \frac{0.135}{0.971} = 0.139$$

$$R^{2/3} = 0.268$$

$I = 1/200, \quad n = 0.030$

$$V = \frac{1}{n} \cdot R^{2/3} \cdot I^{1/2}, = 2.357 \times 0.268 = 0.632 \text{ m/s}$$

$$Q = A \cdot V = 0.135 \times 0.632 = 0.085 \text{ m}^3/\text{s} = 85 \text{ l/s}$$

Irrigation Canals and Related Structures

	Item	Unit	Tract A	Tract B	Tract C	Tract D	Total
Canal	Type A	m	–	415	–	–	415
	Type B	m	–	–	360	380	740
	Type C	m	425	100	230	–	755
	Type D	m	4,109	3,809	2,694	1,917	12,529
	Total	m	4,534	4,324	3,284	2,297	14,439
Structure	Drup	Nos.	8	13	10	3	34
	Dis. Work	Nos.	6	4	4	2	16
	Culvert	Nos.	15	23	11	10	59

Break-down of Irrigation Canals and Related Structures

Tract A

Name of Canal	Type	Grade	Length	Drop	Dis. Work	Culvert
			m	Nos.	Nos.	Nos.
IC. A - 1	Type C	I = 1/200	185	–	2	1
- 2	Type D	I = 1/200	763	4	–	3
- 3	Type D	I = 1/200	556	1	–	2
- 4	Type D	I = 1/200	549	–	1	2
- 5	Type D	I = 1/200	255	–	–	1
- 6	Type C	I = 1/500	240	–	1	1
- 7	Type D	I = 1/250	620	1	2	2
- 8	Type D	I = 1/250	620	–	–	1
- 9	Type D	I = 1/200	272	2	–	1
	Type D	I = 1/500	150	–	–	1
- 10	Type D	I = 1/200	144	–	–	–
- 11	Type D	I = 1/200	30	–	–	–
- 12	Type D	I = 1/200	30	–	–	–
- 13	Type D	I = 1/200	30	–	–	–
- 14	Type D	I = 1/200	30	–	–	–
- 15	Type D	I = 1/200	30	–	–	–
- 16	Type D	I = 1/200	30	–	–	–
Sub-Total	Type C		425			
	Type D		4,109			
Total			4,534	8	6	15

Tract B

Name of Canal	Type	Grade	Length	Drop	Dis. Work	Culvert
			m	Nos.	Nos.	Nos.
IC. B - 1	Type A	I = 1/500	203	–	1	–
	Type D	I = 1/200	300	1	–	1
	Type D	I = 1/250	465	–	–	2
- 2	Type A	I = 1/500	212	–	2	1
- 3	Type D	I = 1/200	765	1	–	3
- 4	Type D	I = 1/200	765	4	–	5
- 5	Type C	I = 1/500	100	–	–	1
	Type D	I = 1/200	119	4	–	1
	Type D	I = 1/250	275	–	–	1
	Type D	I = 1/240	370	–	1	1
- 6	Type D	I = 1/300	170	–	–	3
	Type D	I = 1/500	300	–	–	4
- 7	Type D	I = 1/200	110	–	–	–
- 8	Type D	I = 1/200	80	1	–	–
- 9	Type D	I = 1/200	90	2	–	–
	Type A		415			
Sub-Total	Type C		100			
	Type D		3,809			
Total			4,324	13	4	23

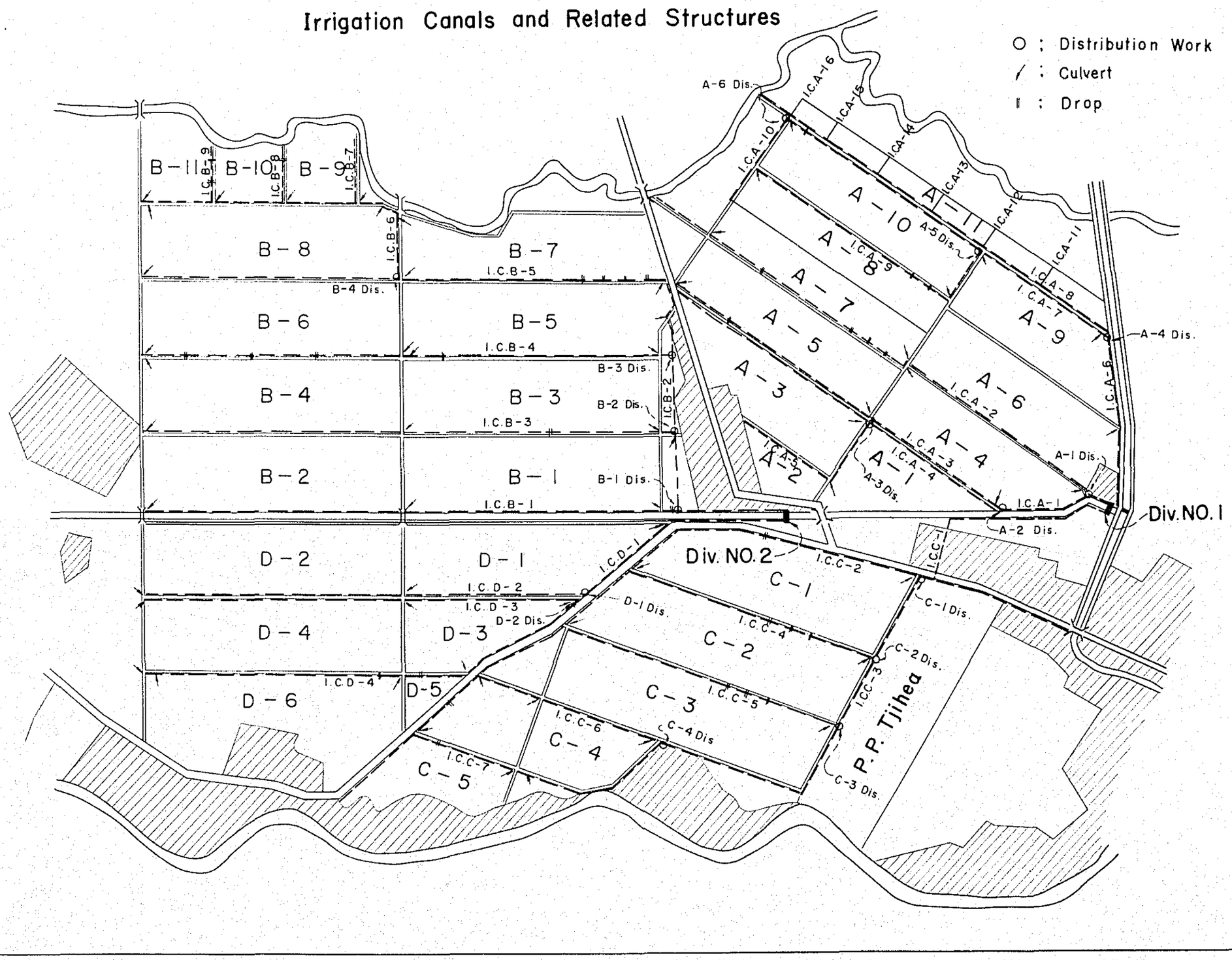
Tract C

Name of Canal	Type	Grade	Length	Drop	Dis Work	Culvert
			m	Nos.	Nos.	Nos.
IC. C - 1	Type B	I = 1/300	360	–	1	–
- 2	Type D	I = 1/200	848	2	–	5
	Type D	I = 1/230	120	–	–	–
- 3	Type C	I = 1/200	230	–	2	–
	Type D	I = 1/200	300	–	1	–
- 4	Type D	I - 1/200	146	4	–	1
	Type D	I = 1/500	200	–	–	–
- 5	Type D	I = 1/200	159	3	–	1
	Type D	I = 1/500	240	–	–	–
- 6	Type D	I = 1/240	276	–	–	2
- 7	Type D	I = 1/250	245	–	–	1
	Type D	I = 1/200	160	1	–	1
	Type B		360			
Sub-Total	Type C		230			
	Type D		2,694			
Total			3,284	10	4	11

Tract D

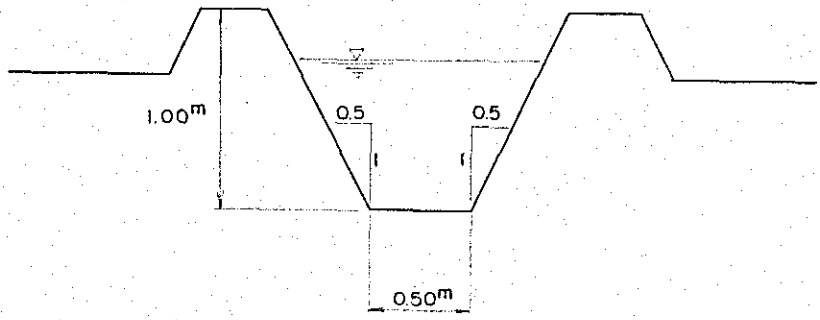
Name of Canal	Type	Grade	Length	Drop	Dis. Work	Culvert
			m	Nos.	Nos.	Nos.
IC. D - 1	Type B	I = 1/300	380	–	2	2
- 2	Type D	I = 1/230	633	–	–	2
- 3	Type D	I = 1/200	629	–	–	2
- 4	Type D	I = 1/200	655	3	–	4
Sub-Total	Type B		380			
	Type D		1,917			
Total			2,297	3	2	10

Irrigation Canals and Related Structures



3-4 Drainage Canals and Related Structures

Drainage canal along the proposed roads is designed as illustrated below.



Drainage Canal and Related Structures

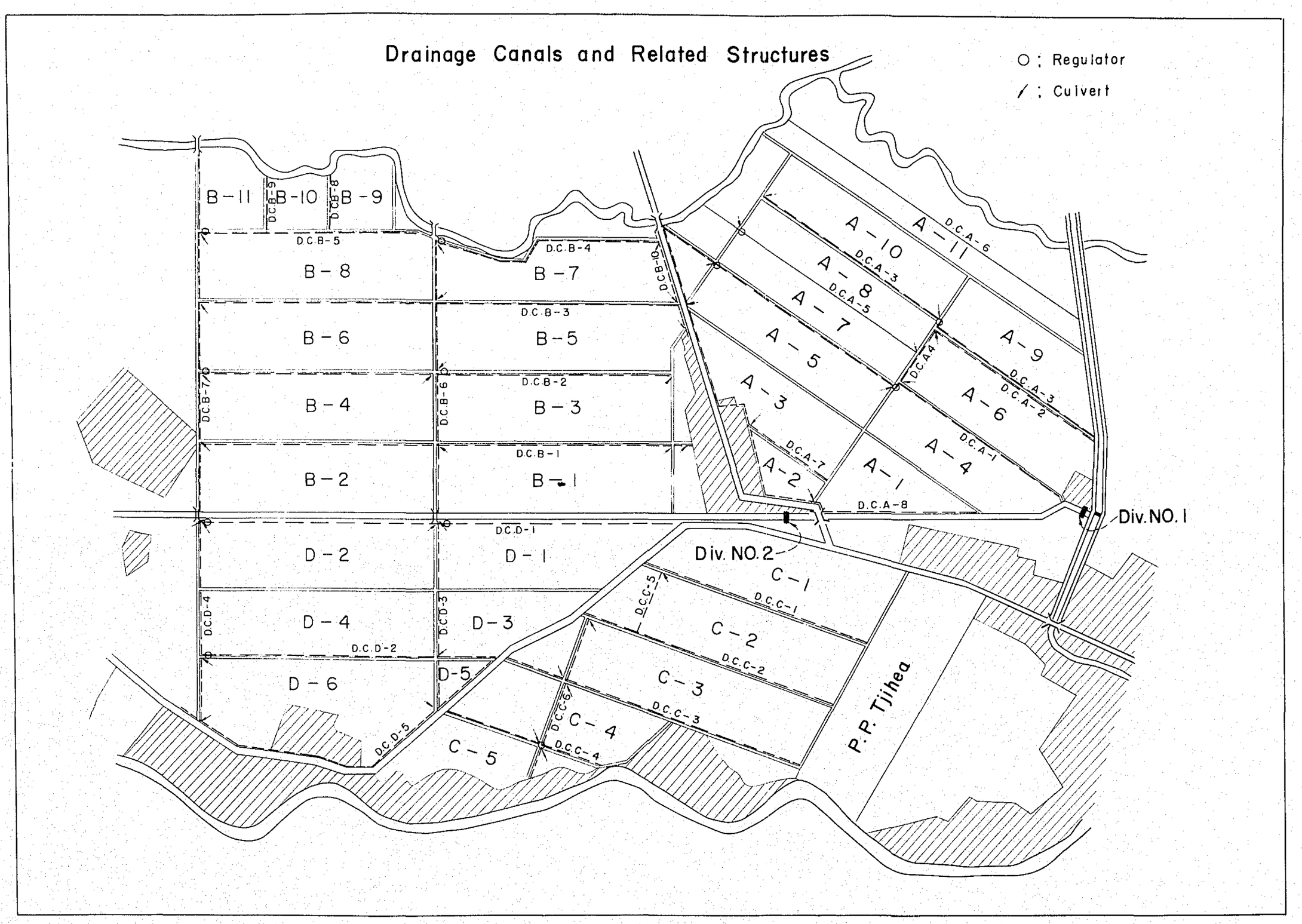
Item	Unit	Tract A	Tract B	Tract C	Tract D	Total
Canal length	m	3,718	4,260	1,842	2,392	12,212
Regulator	Nos.	4	4	1	3	12
Culvert	Nos.	10	15	6	8	39

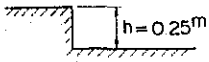
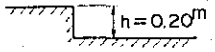
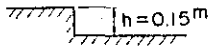
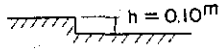
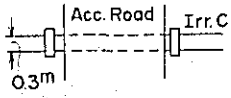
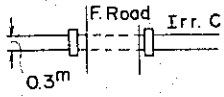
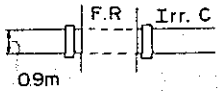
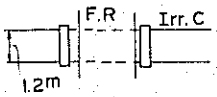
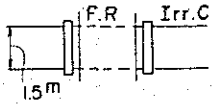
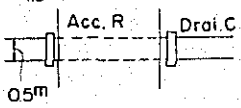
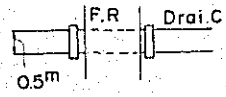
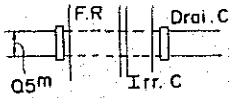
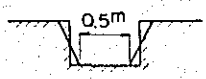
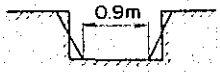
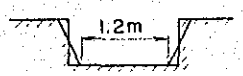
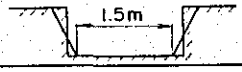
Canal section is the same in each Tract.

Break-down of Drainage Canals and Related Structures

Tract	Name of Canal	Length	Regulator	Culvert
		m	Nos.	Nos.
A	DC A - 1	720	2	2
	- 2	310	–	1
	- 3	655	1	2
	- 4	100	–	–
	- 5	402	1	2
	- 6	560	–	–
	- 7	158	–	–
	- 8	813	–	3
	Sub-Total	3,718	4	10
B	DC. B - 1	765	–	2
	- 2	730	–	2
	- 3	753	–	–
	- 4	376	–	–
	- 5	347	–	–
	- 6	419	2	4
	- 7	555	2	4
	- 8	80	–	–
	- 9	85	–	–
	- 10	150	–	3
	Sub-Total	4,260	4	15
C	DC. C - 1	343	–	–
	- 2	393	–	–
	- 3	463	–	1
	- 4	281	–	1
	- 5	100	–	1
	- 6	262	1	3
	Sub-Total	1,842	1	6
D	DC. D - 1	753	–	2
	- 2	467	–	0
	- 3	306	1	2
	- 4	314	2	2
	- 5	552	–	2
	Sub-Total	2,392	3	8
	Total	12,212	12	39

Drainage Canals and Related Structures

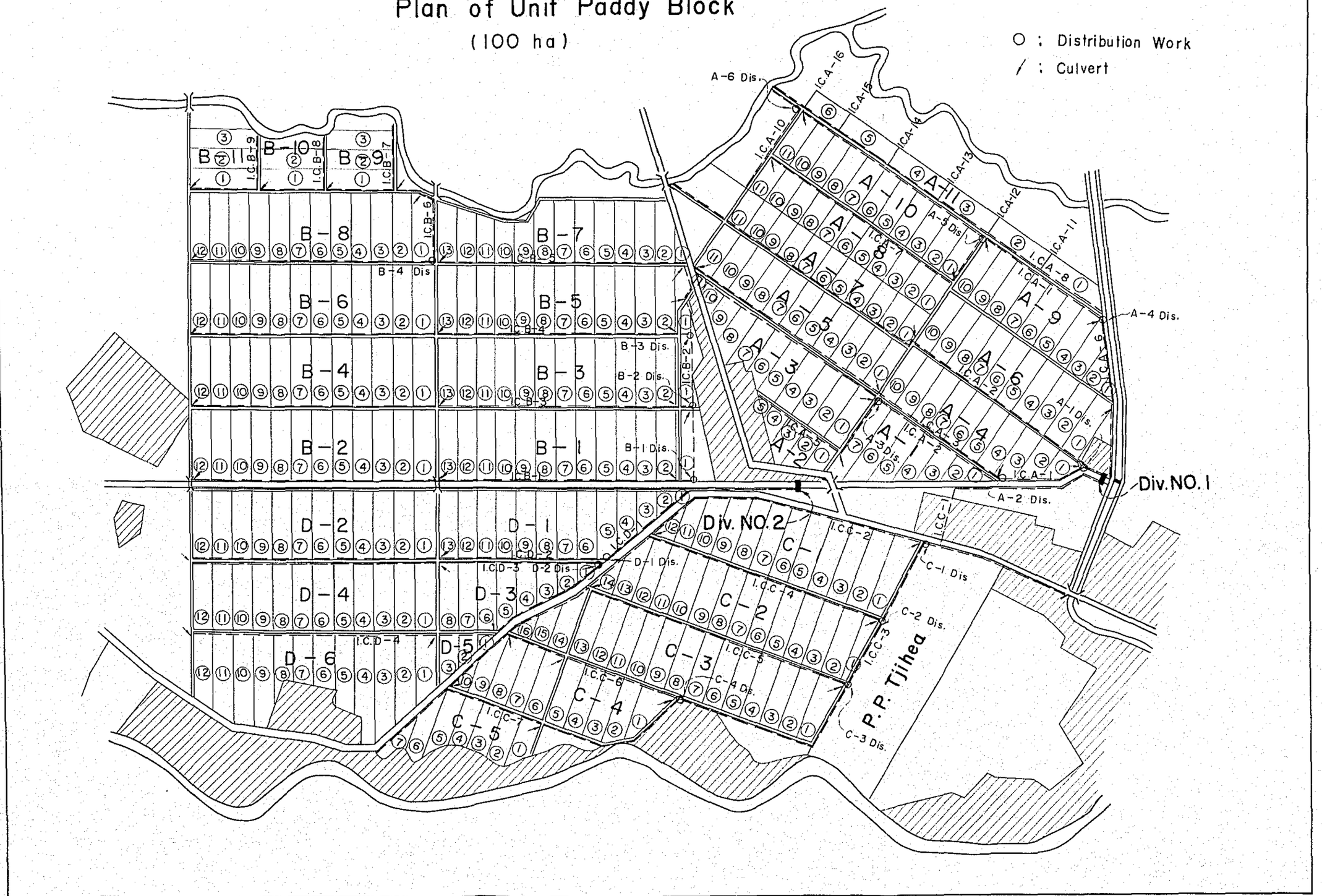


	Item	Sketch	Number				
			Tract A	Tract B	Tract C	Tract D	Total
Drop	Type A		2	–	–	–	2
	Type B		3	5	6	1	15
	Type C		2	2	4	1	9
	Type D		1	6	–	1	8
Culvert	Type A		–	10	–	6	16
	Type B		13	10	11	3	37
	Type C		2	2	–	–	4
	Type D		–	–	–	1	1
	Type E		–	1	–	–	1
	Type F		–	1	–	4	5
	Type G		8	7	3	2	20
	Type H		2	7	3	2	14
F. B. Weir	Type A		13	9	7	4	33
	Type B		6	4	1	4	15
	Type C		1	1	2	–	4
	Type D		–	–	–	1	1
	Type E		–	2	–	–	2

3 - 5 Field Elevation and Earthwork Quantity for Land Leveling

Plan of Unit Paddy Block

(100 ha)



Bill of Field Elevation and Earthwork Quantity for Leveling

Tract	Name of Block	Elevation (m)	Earthwork Quantity for Leveling (m³)	Remarks
A	A-1 - 1	264.88	14.90	
	- 2	264.68	47.78	
	- 3	264.47	80.66	
	- 4	264.32	108.76	
	- 5	264.16	136.85	
	- 6	264.03	150.96	
	- 7	263.89	165.07	
	Sub-Total		704.98	
	A-2 - 1	263.48	42.04	
	- 2	263.30	69.04	
	- 3	263.18	38.27	
	- 4	262.97	39.12	
	- 5	262.78	4.42	
	Sub-Total		192.89	
	A-3 - 1	263.77	152.50	
	- 2	263.61	151.28	
	- 3	263.46	150.02	
	- 4	263.31	148.76	
	- 5	263.14	164.93	
	- 6	262.96	181.09	
	- 7	262.82	165.73	
	- 8	262.68	150.37	
	- 9	262.57	126.06	
	- 10	262.46	101.75	
	- 11	262.35	77.45	
	Sub-Total		1,569.94	
	A-4 - 1	265.58	67.73	
	- 2	265.33	72.04	
	- 3	265.20	47.64	
	- 4	265.03	171.51	
	- 5	264.89	84.69	
	- 6	264.71	45.28	
	- 7	264.58	72.68	
	- 8	264.42	75.67	
	- 9	264.23	90.48	
	- 10	264.05	57.06	
	Sub-Total		784.78	
	A-5 - 1	263.87	107.63	
	- 2	263.71	105.20	
	- 3	263.58	106.49	

Tract	Name of Block	Elevation (m)	Earthwork Quantity for Leveling (m³)	Remarks
A	A-5 - 4	263.42	170.61	
	- 5	263.26	114.31	
	- 6	263.16	72.35	
	- 7	263.09	96.86	
	- 8	262.91	131.42	
	- 9	262.68	122.35	
	- 10	262.44	148.41	
	- 11	262.23	335.81	
	Sub-Total		1,511.44	
	A-6 - 1	265.66	60.29	
	- 2	265.53	63.76	
	- 3	265.40	67.23	
	- 4	265.26	86.04	
	- 5	265.12	104.84	
	- 6	264.96	136.40	
	- 7	264.80	167.96	
	- 8	264.64	199.51	
	- 9	264.47	190.40	
	- 10	274.30	181.28	
	Sub-Total		1,257.71	
	A-7 - 1	263.69	111.90	
	- 2	263.39	81.17	
	- 3	263.00	93.19	
	- 4	262.69	91.61	
	- 5	262.45	101.64	
	- 6	272.28	96.46	
	- 7	272.16	111.16	
	- 8	262.03	135.85	
	- 9	261.76	83.24	
	- 10	261.57	38.79	
	- 11	261.46	76.77	
	Sub-Total		1,026.78	
	A-8 - 1	264.06	87.79	
	- 2	263.71	124.88	
	- 3	263.38	188.82	
	- 4	263.22	278.78	
	- 5	263.03	233.86	
	- 6	262.84	232.81	
	- 7	262.78	260.57	
	- 8	262.80	251.69	
	- 9	262.52	315.86	
	- 10	262.58	325.88	

Tract	Name of Block		Elevation	Earthwork Quantity for Level-ing	Re-marks
A	A-8	- 11	262.45	221.90	
	Sub-Total			2,522.84	
	A-9	- 1	265.70	0.0	
		- 2	265.60	55.08	
		- 3	265.53	68.01	
		- 4	265.45	80.93	
		- 5	265.33	58.24	
		- 6	265.23	74.57	
		- 7	265.11	74.57	
		- 8	265.00	112.11	
		- 9	264.84	97.44	
		- 10	264.69	108.67	
	Sub-Total		264.50	152.45	
	A-10	- 1	264.50	152.45	
		- 2	264.37	118.65	
		- 3	264.25	141.30	
		- 4	263.97	200.28	
		- 5	263.97	167.76	
		- 6	263.87	225.55	
		- 7	263.79	208.32	
		- 8	263.69	159.77	
		- 9	263.54	135.26	
		- 10	263.39	125.84	
		- 11	263.04	280.01	
	Sub-Total			1,915.19	
	A-11	- 1	265.32	209.99	
		- 2	264.85	144.38	
		- 3	264.44	189.34	
		- 4	264.13	147.12	
		- 5	263.83	103.18	
		- 6	263.35	139.70	
	Sub-Total			933.71	
	Total			14,176.66	
B	B-1	- 1	262.30	145.96	
		- 2	262.14	99.72	
		- 3	262.14	114.86	
		- 4	261.96	89.60	
		- 5	261.80	96.00	
		- 6	261.62	84.62	
		- 7	261.48	109.70	
		- 8	261.31	46.55	
		- 9	261.13	76.95	
B	B-1	- 10	260.99	69.91	
		- 11	260.85	104.66	
		- 12	260.70	133.13	
		- 13	260.58	127.45	
	Sub-Total			1,299.11	
	B-2	- 1	260.48	132.62	
		- 2	260.35	108.05	
		- 3	260.30	254.40	
		- 4	260.09	103.39	
		- 5	260.00	122.64	
		- 6	259.88	101.15	
		- 7	259.76	146.36	
		- 8	259.64	128.56	
		- 9	259.49	124.51	
		- 10	259.42	68.26	
		- 11	259.29	121.17	
		- 12	259.10	91.38	
	Sub-Total			1,502.49	
	B-3	- 1	262.36	14.45	
		- 2	262.24	54.04	
		- 3	262.11	93.63	
		- 4	261.94	104.81	
		- 5	261.77	115.97	
		- 6	261.62	90.67	
		- 7	261.46	65.37	
		- 8	261.27	81.68	
		- 9	261.09	97.99	
		- 10	260.94	101.43	
		- 11	260.78	104.87	
		- 12	260.60	78.84	
		- 13	260.43	52.80	
	Sub-Total			1,056.55	
	B-4	- 1	260.30	96.10	
		- 2	260.16	157.72	
		- 3	259.97	185.25	
		- 4	259.78	212.77	
		- 5	259.66	190.96	
		- 6	259.54	169.15	
		- 7	259.38	197.71	
		- 8	259.22	226.27	
		- 9	259.09	304.87	
		- 10	258.96	383.48	
		- 11	258.81	346.47	
		- 12	258.67	309.46	
	Sub-Total			2,780.21	

Tract	Name of Block		Elevation	Earthwork Quantity for Level-ing	Re-marks
B	B-5	- 1	262.18	106.26	
		- 2	262.04	134.88	
		- 3	261.83	205.57	
		- 4	261.62	215.02	
		- 5	261.51	205.77	
		- 6	261.38	217.34	
		- 7	261.22	239.69	
		- 8	261.11	191.82	
		- 9	260.92	171.43	
		- 10	260.74	136.17	
		- 11	260.58	141.43	
		- 12	260.37	182.02	
		- 13	260.18	146.42	
	Sub-Total			2,293.82	
	B-6	- 1	260.01	181.13	
		- 2	259.93	214.88	
		- 3	259.74	181.08	
		- 4	259.57	93.80	
		- 5	259.38	96.65	
		- 6	259.18	130.45	
		- 7	259.00	161.60	
		- 8	258.75	166.98	
		- 9	258.60	191.33	
		- 10	258.41	155.50	
		- 11	258.19	179.31	
		- 12	258.00	189.76	
	Sub-Total			1,944.47	
	B-7	- 1	261.90	55.44	
		- 2	261.56	207.55	
		- 3	261.22	359.56	
		- 4	260.95	289.83	
		- 5	260.68	220.10	
		- 6	260.57	239.14	
		- 7	260.47	258.17	
		- 8	260.31	252.60	
		- 9	260.15	247.02	
		- 10	260.09	260.40	
		- 11	260.03	273.79	
		- 12	259.84	321.17	
		- 13	259.66	368.55	
	Sub-Total			3,353.32	
	B-8	- 1	259.44	270.43	
		- 2	259.29	208.92	
		- 3	259.19	163.52	
		- 4	259.09	118.12	
		- 5	258.95	149.97	
		- 6	258.82	181.82	
		- 7	258.70	147.68	
		- 8	258.59	113.53	
		- 9	258.41	117.79	
		- 10	258.24	122.05	
		- 11	258.13	111.99	
		- 12	258.02	101.92	
	Sub-Total			1,807.74	
	B-9	- 1	258.87	183.96	
		- 2	258.73	141.12	
		- 3	258.57	134.87	
	Sub-Total			459.95	
	B-10	- 1	258.59	179.36	
		- 2	258.40	219.60	
	Sub-Total			398.96	
	B-11	- 1	257.94	224.86	
		- 2	257.88	230.73	
		- 3	257.54	345.01	
	Sub-Total			800.6	
	Total			17,697.22	
C	C-1	- 1	264.11	15.36	
		- 2	263.96	133.10	
		- 3	263.80	136.67	
		- 4	263.63	95.44	
		- 5	263.43	158.02	
		- 6	263.27	234.63	
		- 7	263.05	229.57	
		- 8	262.83	221.10	
		- 9	262.72	211.08	
		- 10	262.63	123.84	
		- 11	262.49	105.02	
		- 12	262.35	37.69	
	Sub-Total			1,701.52	
	C-2	- 1	263.57	64.23	
		- 2	263.45	103.88	
		- 3	263.32	143.52	
		- 4	263.02	179.37	
		- 5	262.72	215.21	

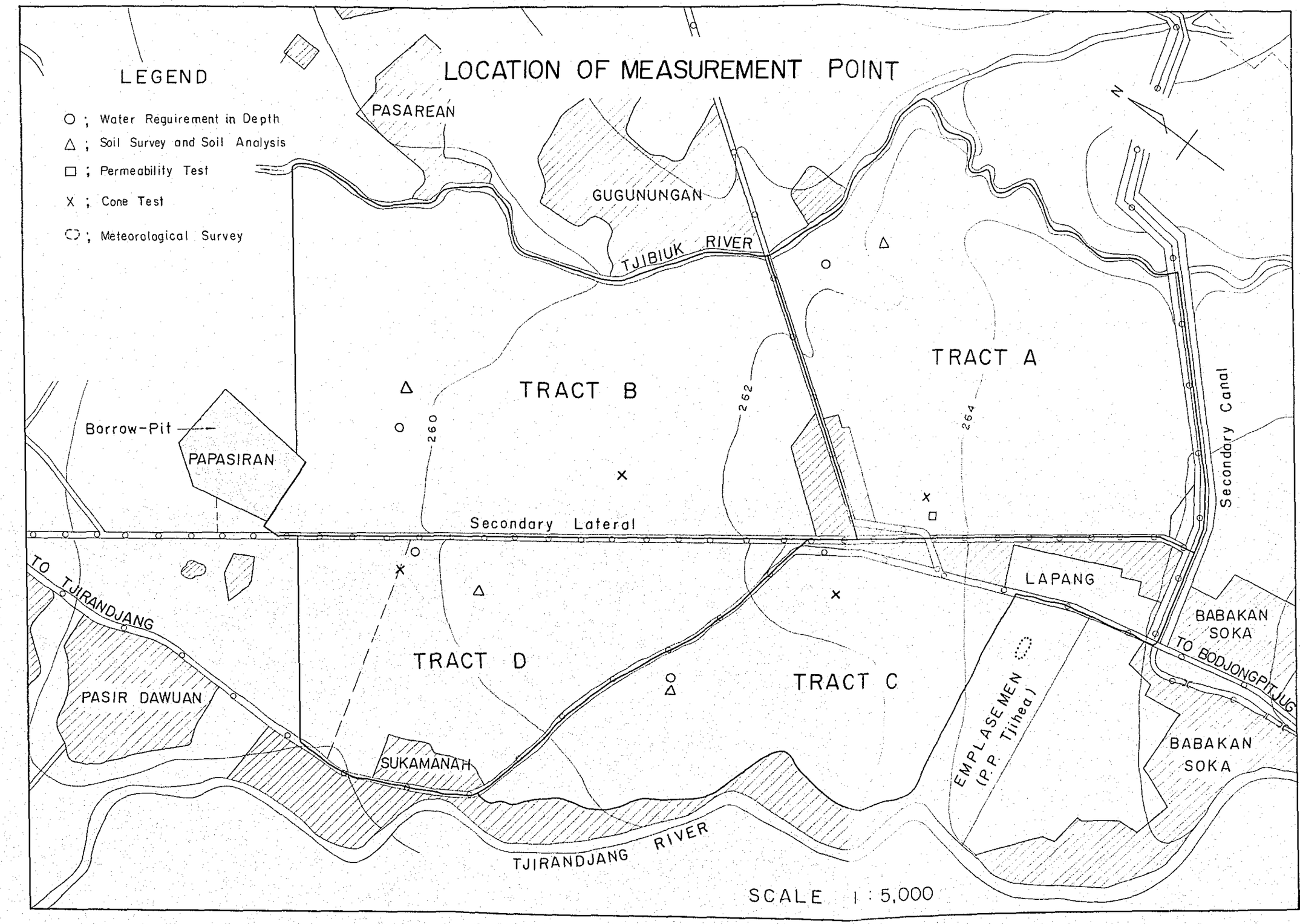
Tract	Name of Block	Elevation	Earthwork Quantity for Leveling	Remarks
C	C-2 - 6	262.43	250.15	
	- 7	262.13	285.09	
	- 8	261.98	345.64	
	- 9	261.83	406.18	
	- 10	261.84	356.98	
	- 11	261.85	307.78	
	- 12	261.85	187.74	
	- 13	261.79	95.61	
	- 14	261.67	29.02	
	Sub-Total		2,970.40	
	C-3 - 1	263.03	113.54	
	- 2	262.89	214.10	
	- 3	262.70	243.12	
	- 4	262.38	216.57	
	- 5	261.96	224.27	
	- 6	261.64	89.12	
	- 7	261.48	47.64	
	- 8	261.39	47.13	
	- 9	261.34	52.75	
	- 10	261.32	87.54	
	- 11	261.33	160.99	
	- 12	261.36	147.53	
	- 13	261.36	146.22	
	- 14	261.24	94.26	
	- 15	261.11	35.70	
	- 16	261.02	23.09	
	Sub-Total		1,943.57	
	C-4 - 1	261.25	111.98	
	- 2	261.11	122.58	
	- 3	261.09	74.01	
	- 4	261.03	30.29	
	- 5	260.96	78.36	
	- 6	260.87	98.23	
	- 7	260.75	113.23	
	- 8	260.63	123.65	
	- 9	260.52	130.52	
	- 10	260.27	39.46	
	Sub-Total		922.31	
	C-5 - 1	260.64	55.03	
	- 2	260.46	85.61	
	- 3	260.35	76.31	
	- 4	260.11	194.18	
	- 5	259.92	107.93	
	- 6	259.71	178.86	
C	C-5 - 7	259.35	112.34	
	Sub-Total		8,810.26	
	Total		8,348.06	
D	D-1 - 1	262.14	0.00	
	- 2	262.12	83.77	
	- 3	261.95	16.30	
	- 4	261.83	94.92	
	- 5	261.70	91.01	
	- 6	261.60	103.19	
	- 7	261.44	153.53	
	- 8	261.28	52.75	
	- 9	261.17	46.24	
	- 10	261.01	69.90	
	- 11	260.89	63.36	
	- 12	260.70	105.86	
	- 13	260.63	51.09	
	Sub-Total		931.92	
	D-2 - 1	260.46	67.21	
	- 2	260.34	61.14	
	- 3	260.23	115.07	
	- 4	260.08	75.84	
	- 5	260.08	75.84	
	- 6	259.99	94.64	
	- 7	259.68	64.26	
	- 8	259.63	138.86	
	- 9	259.55	154.55	
	- 10	259.45	237.82	
	- 11	259.19	111.71	
	- 12	259.03	119.23	
	Sub-Total		1,326.59	
	D-3 - 1	261.57	12.80	
	- 2	261.45	50.40	
	- 3	261.27	33.19	
	- 4	261.09	74.34	
	- 5	260.97	38.36	
	- 6	260.86	80.11	
	- 7	260.73	72.07	
	- 8	260.57	73.38	
	Sub-Total		434.65	
	D-4 - 1	260.39	64.47	
	- 2	260.21	83.55	
	- 3	260.10	100.37	
	- 4	259.95	113.68	
	- 5	259.77	176.68	

Tract	Name of Block		Elevation	Earthwork Quantity for Level-ing	Re-marks
D	D-4	- 6	259.71	131.88	
		- 7	259.58	143.21	
		- 8	259.43	132.49	
		- 9	259.28	174.47	
		- 10	259.14	120.29	
		- 11	258.96	81.49	
		- 12	258.76	148.75	
	Sub-Total			1,471.33	
	D-5	- 1	260.69	12.93	
		- 2	260.58	40.01	
		- 3	260.35	96.99	
	Sub-Total			149.93	

Tract	Name of Block		Elevation	Earthwork Quantity for Level-ing	Re-marks
D	D-6	- 1	260.10	225.68	
		- 2	259.85	354.36	
		- 3	259.58	406.59	
		- 4	259.31	458.81	
		- 5	259.24	343.99	
		- 6	259.17	229.16	
		- 7	258.99	318.96	
		- 8	258.80	408.76	
		- 9	258.65	501.01	
		- 10	258.50	593.25	
		- 11	258.41	442.88	
		- 12	258.32	292.51	
	Sub-Total			4,575.96	
	Total			8,890.38	

4. SURVEY

4 - 1 Hydrological Survey


LEGEND
○ ; Water Requirement in Depth
△ ; Soil Survey and Soil Analysis
□ ; Permeability Test
X ; Cone Test
⬭ ; Meteorological Survey
LOCATION OF MEASUREMENT POINT
PASAREAN
GUGUNUNGAN
TJIBIUK RIVER
TRACT A
TRACT B
TRACT C
TRACT D
260
262
264
Borrow-Pit
PAPASIRAN
Secondary Lateral
Secondary Canal
TO TJIRANDJANG
PASIR DAWUAN
SUKAMANAH
TJIRANDJANG RIVER
LAPANG
BABAKAN SOKA
TO BODJONGPITJUG
EMPLASEMEN (P.P. Tjihea)
N
SCALE 1 : 5,000

(1) Rainfall and Evaporation

Rainfall and evaporation had been surveyed for 38 days (Nov. 8 - Dec. 15) by a rain gauge and a evaporation pan set at P.P. Tjihea; The rain gauge of galvanized iron is 60 cm high and its receiving diameter is 20 cm and the evaporation pan of galvanized iron is 10 cm high and 20 cm in diameter. According to this survery, mean daily rainfall was 12.2 mm and maximum daily rainfall was 100.4 mm.

Mean daily rainfalls at P.P. Tjihea in 1961/69 are given in the table below.

	1961	1962	1963	1964	1965	1966	1967	1968	1969	Mean
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
Nov.	4.8	4.8	27.4	3.6	9.9	11.4	7.6	3.6	11.9	9.4
Dec.	10.4	10.7	8.7	6.7	9.7	7.7	12.9	6.7	14.4	9.8

Mean daily rainfall survery by the team shows slightly larger than above ones.

Mean daily evaporation was 3.2 mm.

The survey data are attached:

Data of Rainfall and Evaporation

Place ; P.P. Tjihea

Implement ; Rain-Gauge (Dia. 20cm, Height 60cm) Evaporimeter Dia. 20cm Depth 10cm

Date	Time	Weather	Rain fall	Evapo-ration	Re-marks	Date	Time	Weather	Rain fall	Evapo-ration	Re-marks
			mm	mm					mm	mm	
Nov. 8	9:10	Fine	0.4	-		Nov. 27		-	-	-	
9	9:10	"	0.6	2.9		28		-	-	-	
10	8:50	"	0.0	3.6		29		-	-	-	
11	9:00	"	44.8	-		30		-	-	-	
12	8:45	"	0.0	2.6		Dec. 1		--	-	-	
13	9:00	"	3.4	3.4		2		-	-	-	
14	8:30	"	6.8	3.6		3	9:10	Rainy	130.8	-	7 days
15			-	-		4		-	-	-	
16	9:00	Fine	41.4	-	2 days	5	8:45	Fine	2.0	6.5	2 days
17	8:50	"	22.1	3.3		6		-	-	-	
18	8:30	"	0.0	3.0		7	8:30	Fine	1.6	6.1	2 days
19	8:30		0.0	3.3		8	8:40	"	0.1	4.1	
20			-	-		9	9:00	"	1.4	3.0	
21	9:00	Fine	5.8	6.0	2 days	10	9:00	"	0.0	4.1	
22			-	-		11	9:00	"	0.0	4.0	
23	8:50	Fine	14.1	8.1	2 days	12	9:00	"	36.4	-	
24	8:40	"	38.7	-		13	9:00	"	0.0	3.8	
25	8:45	"	100.4	-		14	9:00	"	0.0	3.7	
26	8:25	"	11.7	3.5		15	9:00	"	0.0	3.6	
						Total			462.5	82.2	

(2) Wind

By an anemometer set at P.P. Tjihea, wind direction and velocity had been surveyed for 40 days. Mean wind velocity was 0.25 m/sec in November and 0.94 m/sec in December. Wind direction was not always constant during the survey but almost west and south-west.

The survey data are shown in the following tables:

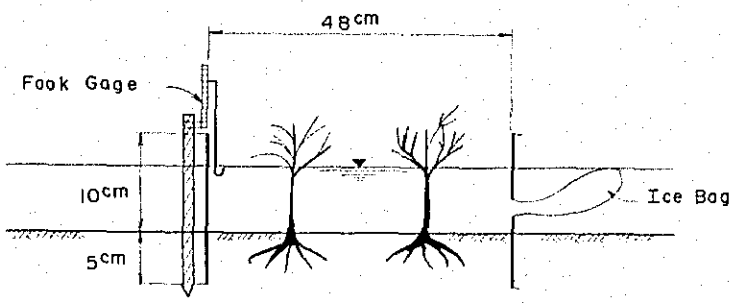
Data of Direction and Velocity of Wind

Place : P.P. Tjihea
Implement : Biram's Anemometer

Date		Time	Weather	Wind Direction	Wind Velocity (m/s)				Remarks
					1	2	3	Mean Velocity	
Nov.	9	12 : 00	Fine	SE	0.95	0.70	1.12	0.92	
	9	16 : 00	"		0.87	0.40	1.07	0.78	
	12	8 : 50	"		0.83	0.78	0.88	0.83	
	12	16 : 15	"		0	0	0	0	
	13	9 : 00	"		0	0	0	0	
	13	16 : 20	"	E	0.83	0.67	0.75	0.75	
	14	8 : 30	"		0	0	0	0	
	14	16 : 10	"		0	0	0	0	
	16	9 : 00	"		0	0	0	0	
	16	16 : 00	"		0	0	0	0	
	17	9 : 00	"	W	0.07	0.10	0.04	0.07	
	18	8 : 30	"	W	0.07	0.06	0.08	0.07	
	18	15 : 15	Cloudy	E	0.17	0.33	0.25	0.25	
	21	8 : 30	Fine	W.N.W.	0.07	0.05	0.09	0.07	
	21	16 : 00	"	E	0.08	0.06	0.10	0.08	
Dec.	5	8 : 45	"	S.W.	1.40	2.07	1.75	1.74	
	5	16 : 10	"	S.W.	1.08	0.82	1.67	1.19	
	7	8 : 30	"		0	0	0	0	
	8	8 : 30	"	S.W.	1.33	1.45	1.21	1.33	
	8	16 : 00	"	W.	0.33	0.24	0.42	0.33	28° C
	9	8 : 30	"	S.W.	0.97	1.03	0.91	0.97	
	9	8 : 30	"	S.W.	0.93	0.99	0.87	0.93	28.5° C
	10	9 : 00	"	S.W.	1.05	0.95	1.15	1.05	Noon : 31° C

(3) Water Requirement in Depth

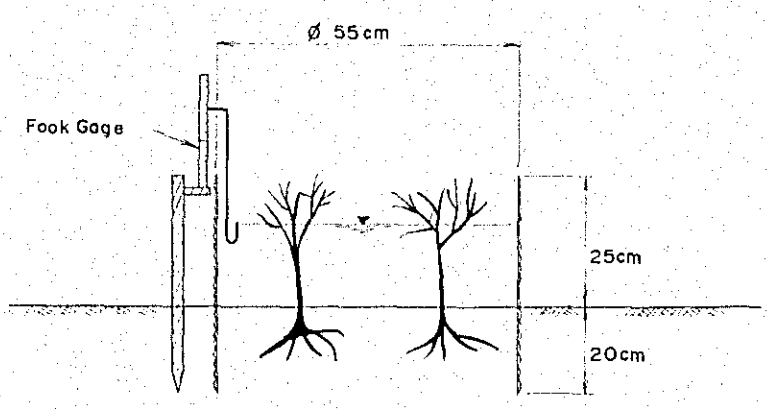
On November 17, it was begun to measure water requirement in depth by use of 2 devices, N Model, at Tract C in the Pilot Farm, as illustrated.



Record obtained is given in Table below.

Date	Measurement by Hook Gage	Water Requirement in Depth
17, Nov.	134 mm	- mm
18, Nov.	84	50
19, Nov.	-	-

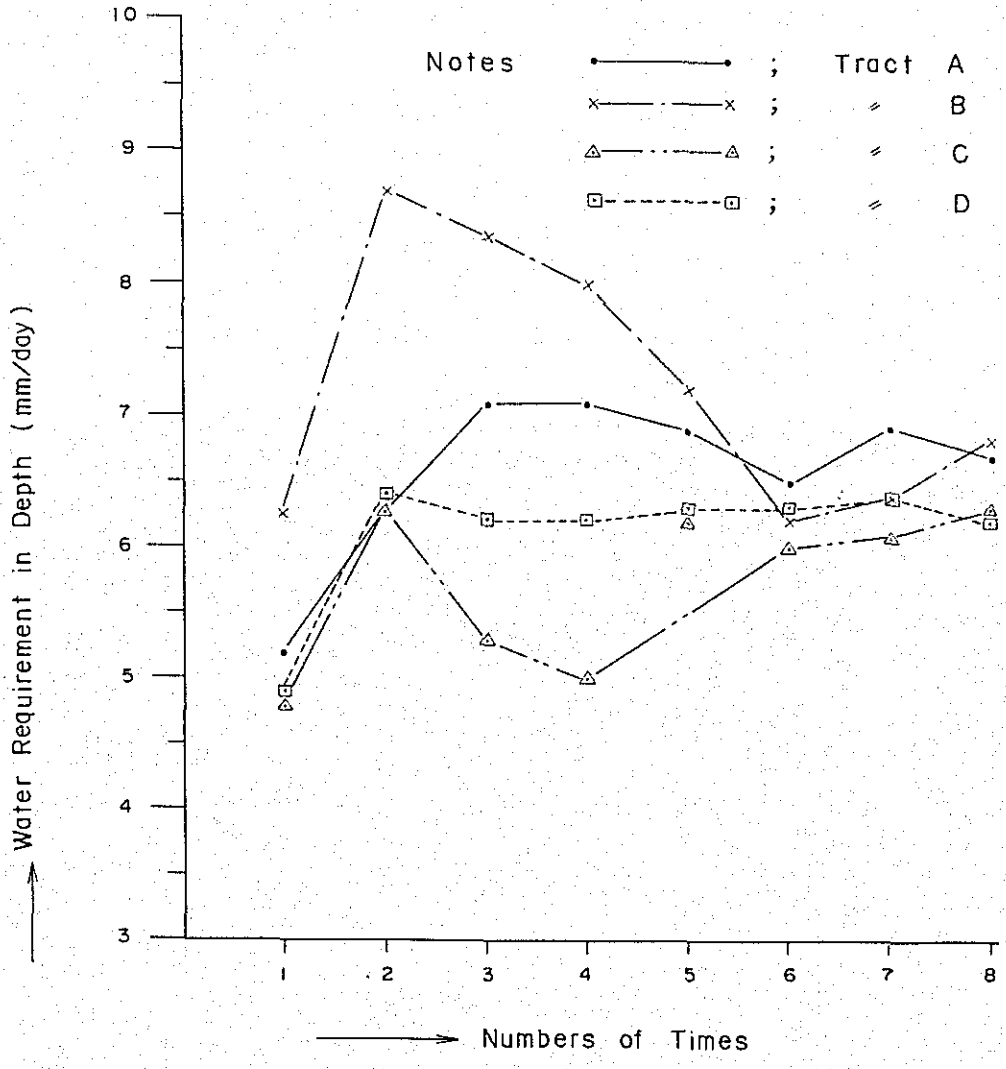
As after 2 day's survey, no water was found in the devices, it could not continue to survey. It may be concluded that seepage under borders was too much to survey by N Model device. Therefore, it was required to have another device and plots where seepage did not exceed. On December 7, half cut drum cans, 55 cm in diameter and 45 cm in length were set at selected paddy plots in Tract A, B, C, and D so that their bottoms were driven into 20 cm holding 4 or 5 stumps of rice inside. (see illustration)



According to the records from Dec. 7 to 14. mean water requirement in depth is shown in Table below.

Tract A	6.3 mm
Tract B	7.3
Tract C	5.8
Tract D	6.1
Mean	6.5

Water Requirement in Depth



Data of Water Requirement in Depth

Place ; Tract A

Implement ; Drum Can Dia. 55 cm, Height 45 cm
Built-in-Depth 20 cm

Date		Weather		Time	Measurement by Hook-Gauge	Water Requirement in Depth	Remarks	
Dec.	5	Cloudy	B.	15 : 30	131.5 mm	5.2 mm	Rainfall	1.6 mm
	7	"	E.	11 : 30	123.5			
	7	"	B.	11 : 30	123.5	6.3	Rainfall	1.3
	8	"	E.	15 : 30	117.5			
	8	"	B.	15 : 30	117.5	7.1	Rainfall	0.2
	9	Fine	E.	15 : 10	110.8			
	9	"	B.	15 : 10	110.8	7.1	Rainfall	0.0
	10	Cloudy	E.	14 : 40	103.8			
	10	"	B.	14 : 40	103.8	6.9	Rainfall	0.0
	11	Fine	E.	14 : 40	96.9			
	11	"	B.	14 : 40	96.9	6.5	Rainfall	36.4
	12	Cloudy	E.	14 : 00	126.9			
	12	"	B.	14 : 00	126.9	6.9	Rainfall	0.0
	13	Fine	E.	14 : 30	119.9			
	13	"	B.	14 : 30	119.9	6.7	Rainfall	0.0
	14	"	E.	14 : 30	113.2			

Place ; Tract B

Implement ; Drum Can Dia 55 cm, Height 45 cm
Built-in-Depth 20 cm

Date		Weather		Time	Measurement by Hook-Gauge	Water Requirement in Depth	Remarks	
Dec.	5	Cloudy	B.	15 : 10	134.8 mm	6.5 mm	Rainfall	1.6 mm
	7	"	E.	10 : 50	124.5			
	7	"	B.	10 : 50	124.5	8.7	Rainfall	1.3
	8	"	E.	15 : 10	115.5			
	8	"	B.	15 : 10	115.5	8.4	Rainfall	0.2
	9	Fine	E.	15 : 25	107.2			
	9	"	B.	15 : 25	107.2	8.0	Rainfall	0
	10	Cloudy	E.	15 : 25	99.2			
	10	"	B.	15 : 25	99.2	7.2	Rainfall	0
	11	Fine	E.	15 : 00	92.1			
	11	"	B.	15 : 00	92.1	6.2	Rainfall	36.4
	12	Cloudy	E.	14 : 20	122.5			
	12	"	B.	14 : 20	122.5	6.4	Rainfall	0
	13	Fine	E.	14 : 50	116.0			
	13	"	B.	14 : 50	116.0	6.8	Rainfall	0
	14	"	E.	14 : 50	109.2			

Place ; Tract C

Implement ; Drum Can Dia. 55 cm, Height 45 cm
Built-in-Depth 20 cm

Date	Weather	Time	Measurement by Hook-Gauge	Water Requirement in Depth	Remarks	
Dec. 5	Cloudy	B. 14 : 15	142.5 mm			
7	"	E. 9 : 00	135.5	4.8 mm	Rainfall	1.6 mm
7	"	B. 9 : 00	135.5			
8	"	E. 14 : 45	129.0	6.3	Rainfall	1.3
8	"	B. 14 : 45	129.0			
9	Fine	E. 15 : 40	123.7	5.3	Rainfall	0.2
9	"	B. 15 : 40	123.7			
10	Cloudy	E. 15 : 00	118.8	5.0	Rainfall	0
10	"	B. 15 : 00	118.8			
11	Fine	E. 16 : 00	112.3	6.2	Rainfall	0
11	"	B. 16 : 00	112.3			
12	Cloudy	E. 14 : 40	143.0	6.0	Rainfall	36.4
12	"	B. 14 : 40	143.0			
13	Fine	E. 15 : 10	136.8	6.1	Rainfall	0
13	"	B. 15 : 10	136.8			
14	"	E. 15 : 10	130.5	6.3	Rainfall	0

Place ; Tract D

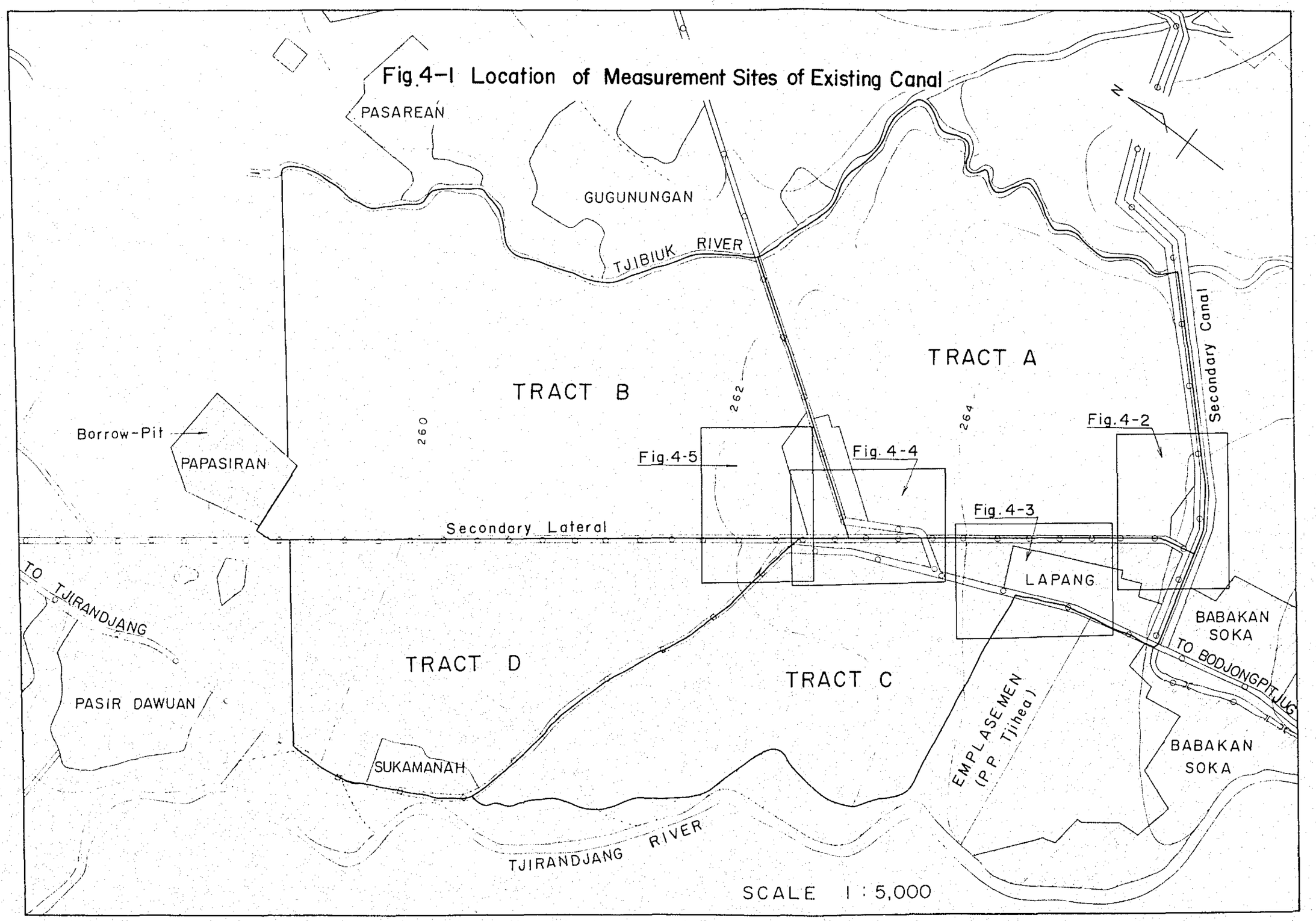
Implement ; Drum Can Dia. 55 cm, Height 45 cm
Built-in-Depth 20 cm

Date	Weather	Time	Measurement by Hook-Gauge	Water Requirement in Depth	Remarks	
Dec. 5	Cloudy	B. 14 : 50	126.5 mm			
7	"	E. 9 : 10	119.5	4.9 mm	Rainfall	1.6 mm
7	"	B. 9 : 10	119.5			
8	"	E. 15 : 00	112.8	6.4	Rainfall	1.3
8	"	B. 15 : 00	112.8			
9	Fine	E. 15 : 30	106.7	6.2	Rainfall	0.2
9	"	B. 15 : 30	106.7			
10	Cloudy	E. 15 : 20	100.5	6.2	Rainfall	0
10	"	B. 15 : 20	100.5			
11	Fine	E. 15 : 20	94.2	6.3	Rainfall	0
11	"	B. 15 : 20	94.2			
12	Cloudy	E. 14 : 30	124.5	6.3	Rainfall	36.4
12	"	B. 14 : 30	124.5			
13	Fine	E. 15 : 00	118.0	6.4	Rainfall	0
13	"	B. 15 : 00	118.0			
14	"	E. 15 : 00	111.8	6.2	Rainfall	0

(4) Capacity of Existing Canals

Capacity of existing canals in Pilot Farm being of earth and trapezoid section are surveyed as follows:

Fig.4-1 Location of Measurement Sites of Existing Canal



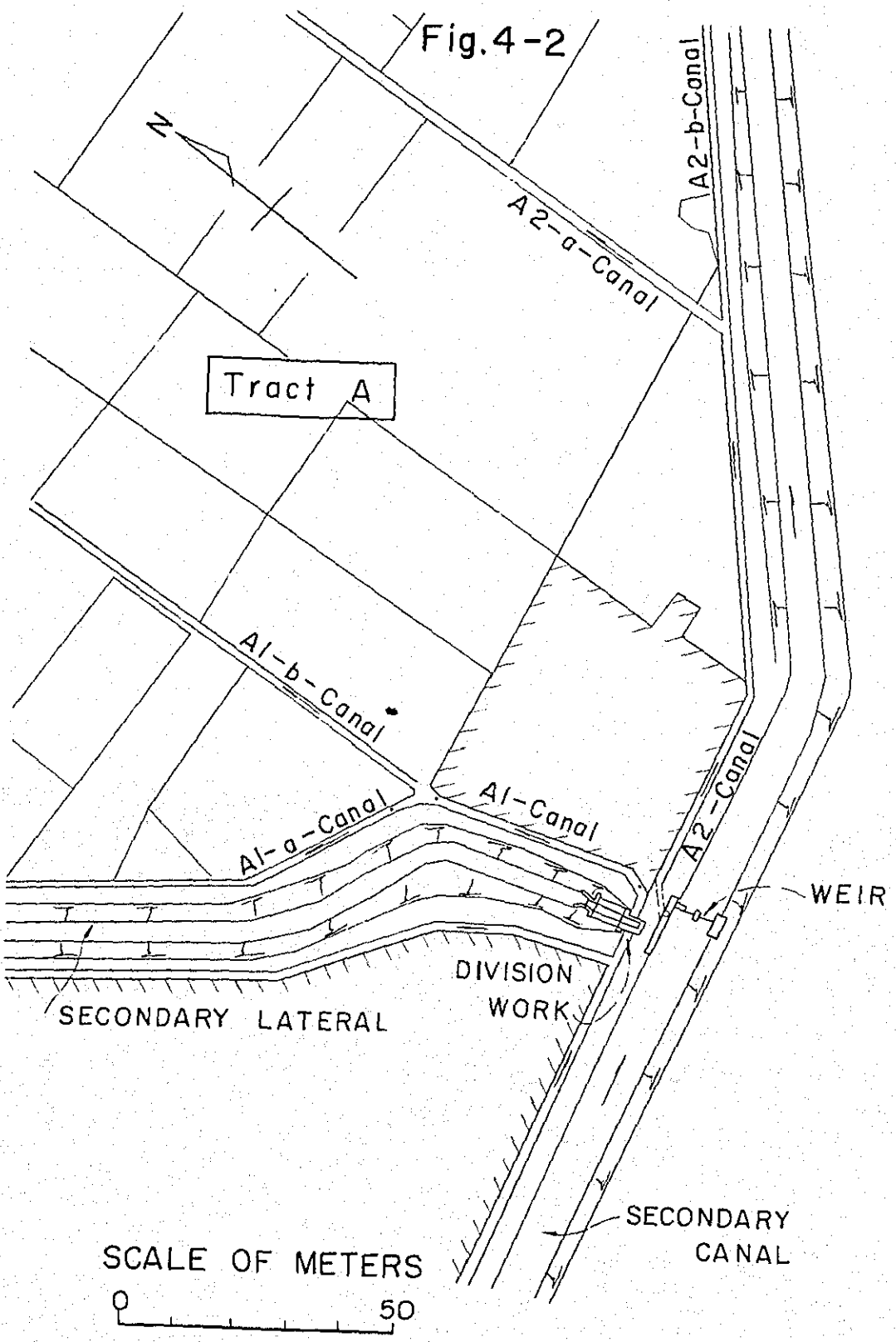


Fig.4-2
N
A2-b-Canal
A2-a-Canal
Tract A
A1-b-Canal
A1-Canal
A2-Canal
A1-a-Canal
WEIR
DIVISION
WORK
SECONDARY LATERAL
SECONDARY
CANAL
SCALE OF METERS
0
50

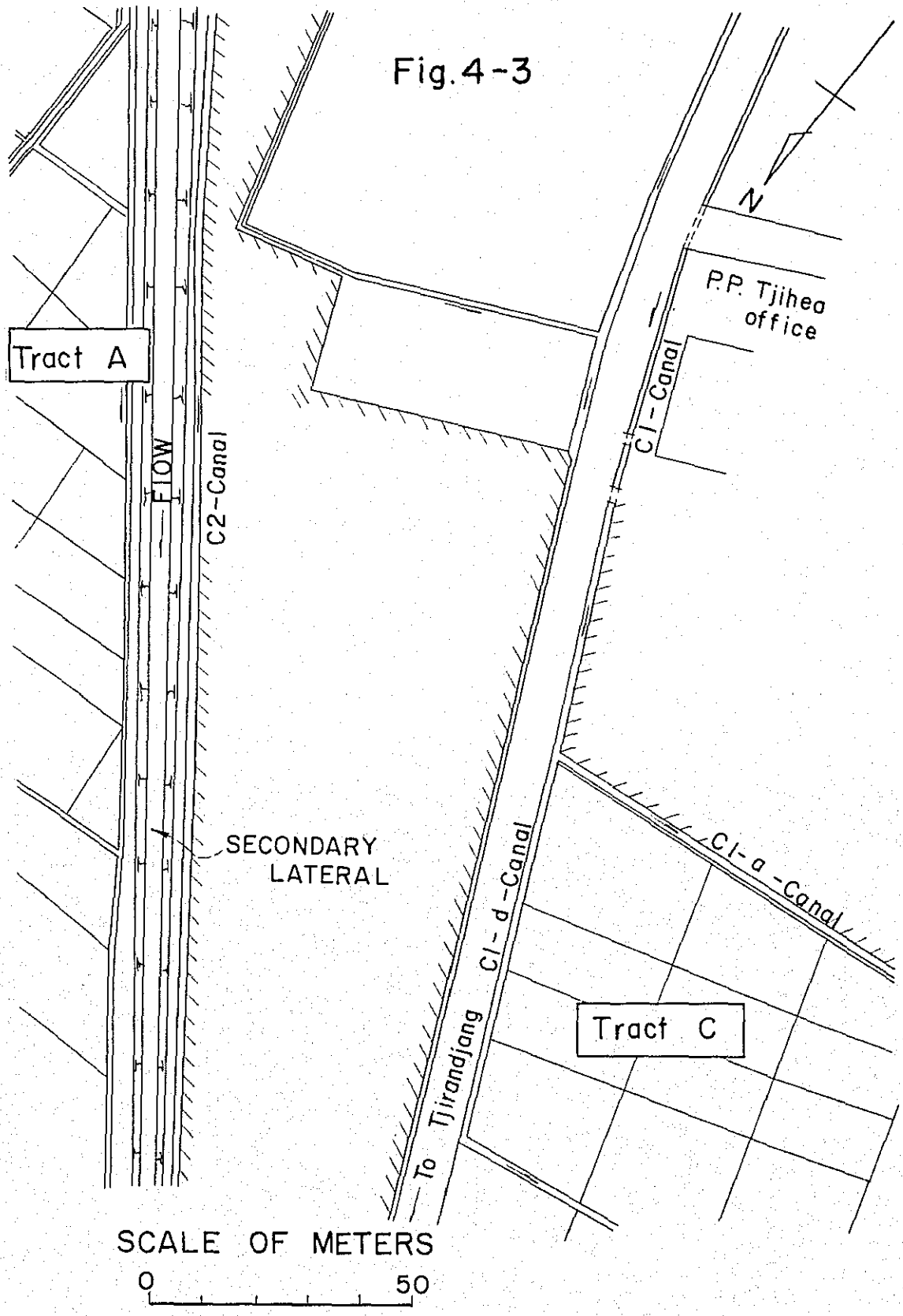
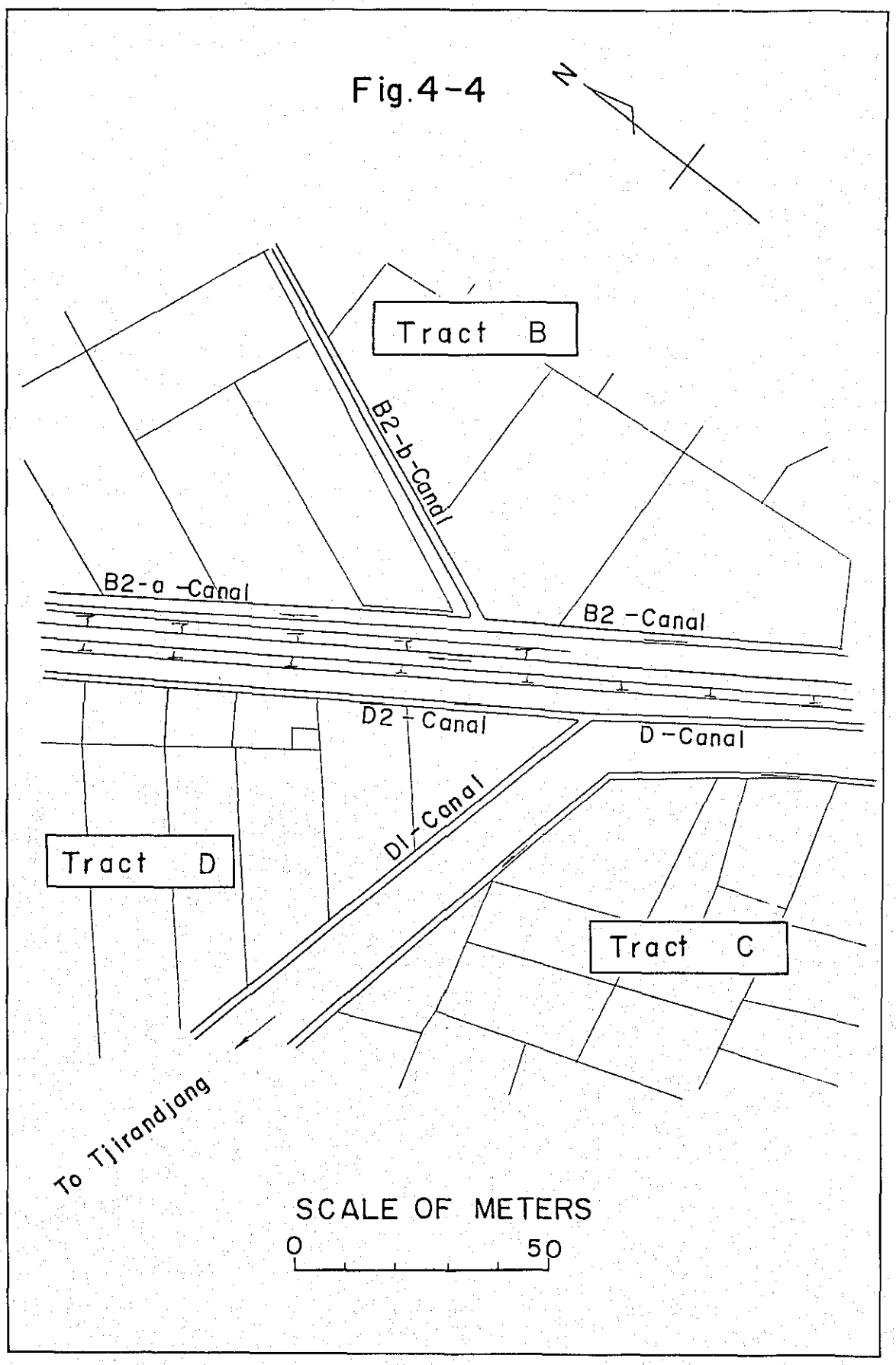


Fig. 4-3
Tract A
FLOW
C2-Canal
SECONDARY LATERAL
C1-Canal
P.P. Tjihea office
N
C1-a-Canal
C1-d-Canal
To Tjirandjang
Tract C
SCALE OF METERS
0
50

Fig.4-4


N
Tract B
B2-b-Canal
B2-a-Canal
B2-Canal
D2-Canal
D-Canal
D1-Canal
Tract D
Tract C
To Tjirandjang
SCALE OF METERS
0
50

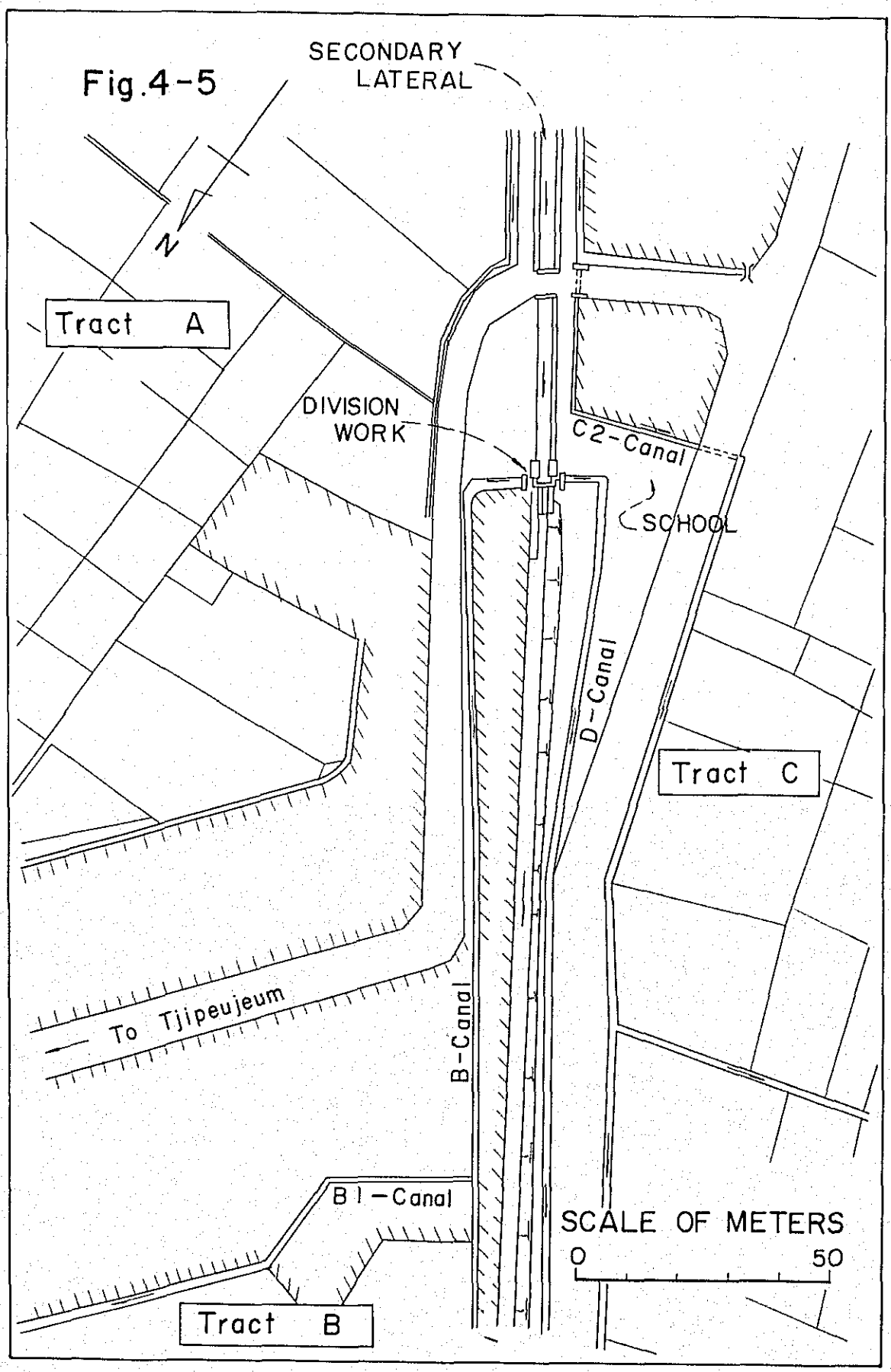
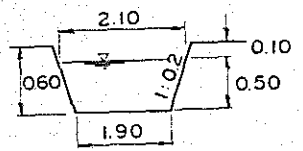
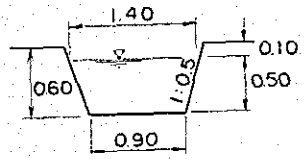
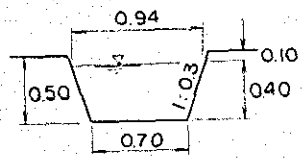
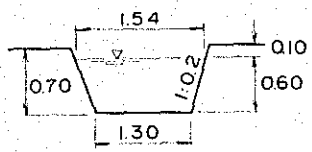
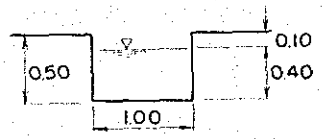
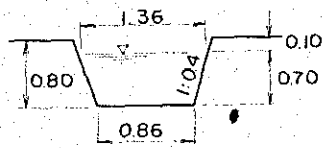
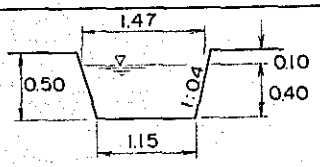
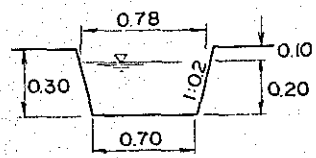
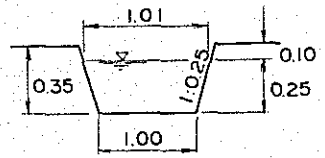
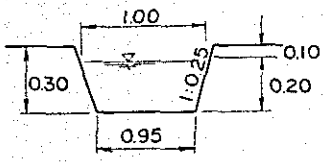
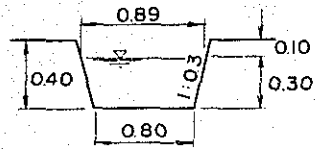
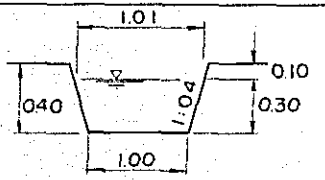
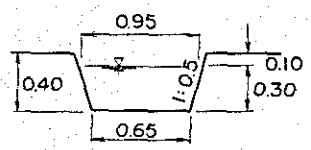
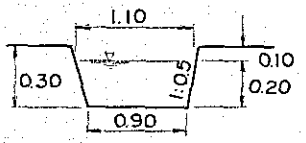
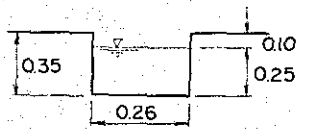
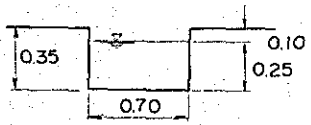
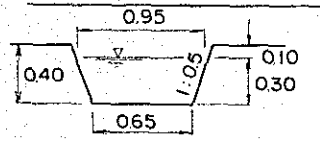
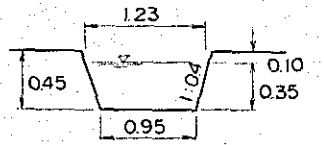
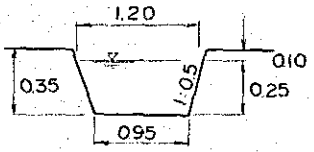


Fig.4-5
SECONDARY LATERAL
N
Tract A
DIVISION WORK
C2-Canal
SCHOOL
D-Canal
Tract C
To Tjipeujeum
B-Canal
B1-Canal
Tract B
SCALE OF METERS
0
50

Calculation of Existing Canal Capacity

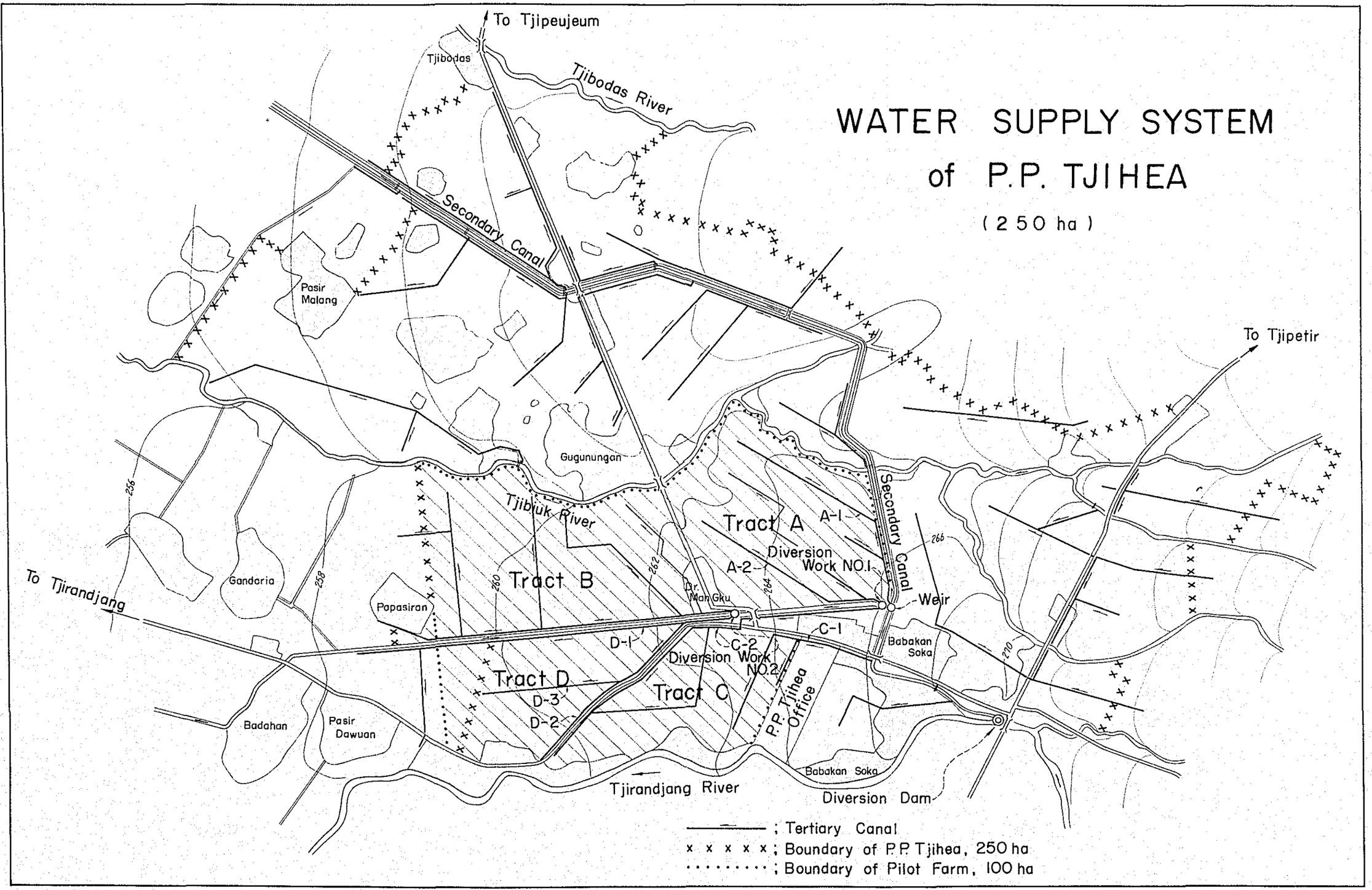
Tract	Name of Canal	Length L	Drop H	Grade Survey	Grade Calcu.	Section	Flow Area A	Wetted Perimeter P	Hydraulic Radius R=A/P	$R^{2/3}$	Velocity V	Discharge Q	Remarks
A	A_1	40	0.07	1/571	1/600		1.000	2.920	0.342	0.489	0.67	0.67	
	A_1 - a	50	0.10	1/500	1/500		0.575	2.018	0.245	0.433	0.65	0.37	
	A_1 - b	50	0.06	1/833	1/800		0.328	1.535	0.214	0.358	0.42	0.14	
	A_2	50	0.05	1/1,000	1/1,000		0.852	2.524	0.338	0.485	0.51	0.44	
	A_2 - a	50	0.08	1/625	1/600		0.400	1.800	0.222	0.367	0.50	0.20	
	A_2 - b	50	0.08	1/625	1/600		0.756	2.308	0.328	0.476	0.65	0.49	

Tract	Name of Canal	Length L	Drop H	Grade Survey	Grade Calcu.	Section	Flow Area A	Wetted Perimeter P	Hydraulic Radius R=A/P	$R^{2/3}$	Velocity V	Discharge Q	Remarks
B	B	50	0.10	$\frac{1}{500}$	$\frac{1}{500}$		0.524	2.012	0.260	0.407	0.61	0.32	
	B_1	50	0.04	$\frac{1}{1250}$	$\frac{1}{1250}$		0.148	1.108	0.134	0.262	0.25	0.04	
	B_2	90	0.18	$\frac{1}{500}$	$\frac{1}{500}$		0.266	1.515	0.175	0.313	0.47	0.12	
	B_2 - a	50	0.26	$\frac{1}{192}$	$\frac{1}{200}$		0.200	1.362	0.147	0.279	0.66	0.13	
	B_2 - b	50	0.08	$\frac{1}{625}$	$\frac{1}{600}$		0.267	1.426	0.187	0.327	0.45	0.12	
C	C_1	50	0.11	$\frac{1}{455}$	$\frac{1}{450}$		0.304	1.600	0.190	0.330	0.52	0.16	

Tract	Name of Canal	Length L	Drop H	Grade Survey	Grade Calcu.	Section	Flow Area A	Wetted Perimeter P	Hydraulic Radius R=A/P	$R^{2/3}$	Velocity V	Discharge Q	Remarks
C	C_1 - a	50	0.16	1/313	1/300		0.240	1.321	0.182	0.321	0.62	0.15	
	C_1 - b	50	0.18	1/278	1/300		0.200	1.347	0.148	0.280	0.54	0.11	
	C_2 (Concrete)	24	0.06	1/400	1/400		0.065	0.760	0.086	0.195	0.65	0.04	
	C_2 (Earth)	130	0.30	1/400	1/400		0.175	1.200	0.146	0.277	0.46	0.08	
D	D	50	0.17	1/294	1/300		0.240	1.321	0.182	0.321	0.62	0.15	
	D_1	50	0.09	1/556	1/550		0.382	1.704	0.224	0.369	0.52	0.20	
	D_2	50	0.15	1/333	1/350		0.269	1.509	0.178	0.316	0.56	0.15	

WATER SUPPLY SYSTEM of P.P. TJIHEA

(250 ha)



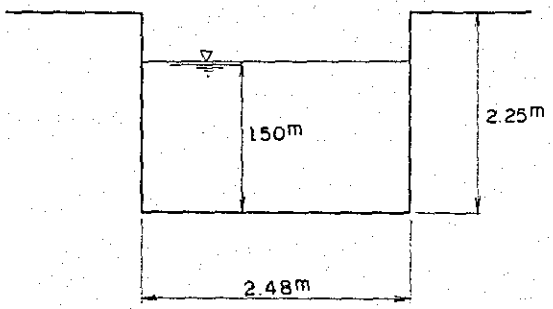
(5) Water Supply System

The existing water supply system of P.P. Tjihea 250 ha is in the following illustration.

(6) Hydrometry of Main Canal

The main canal which is 17 km in length and originates from the Tjisokan diversion dam flows along the south boundary of the Project Area. The main canal of trapezoid earth has many drops as topographical conditions steepen and aqueducts built across the rivers which flow into the Area. When the flow was estimated in the maximum, discharge of the main canal was measured by a current meter, Price type, at the aqueduct in Sukarama which was situated at 3.5 km downstream from Tjisokan diversion dam.

Section of Aqueduct in Sukarama



Flow Area $A = 1.50 \times 2.48 = 3.72\ m^2$

Number of Rotations

$$N = \frac{165 + 155 + 160}{3} \times \frac{1}{60} = 2.67\ r/sec$$

Mean Velocity $V_m = 0.716 \times N - 0.013$

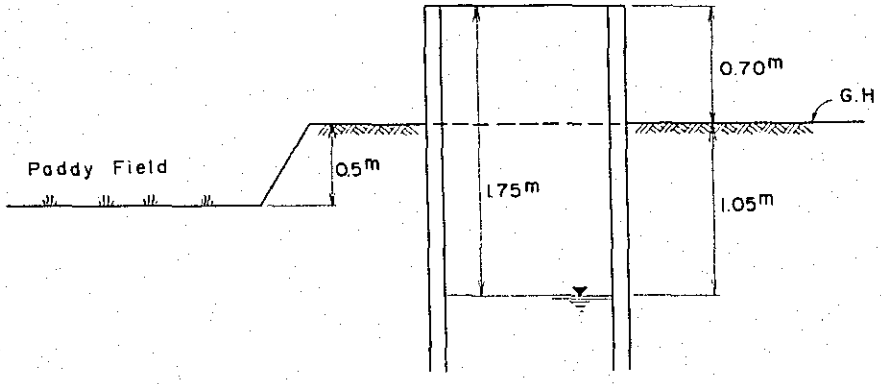
$= 0.716 \times 2.67 - 0.013 = 1.90\ m/sec$

Discharge $Q = A \times V_m = 3.72 \times 1.90 = 7.0\ m^3/sec$

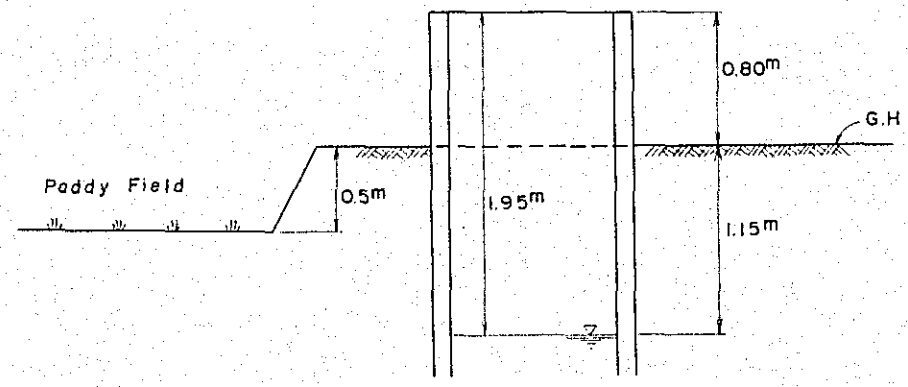
(7) Ground Water Level

In surveying ground water level, wells situated along the Provincial Road between Tract A and B were selected. Ground water level was recorded as illustrated below.

Tract A



Tract B



4 - 2 Soil Survey and Soil Analysis

(1) Soil Analysis

Soil test was performed for the purpose of finding how much fertilizer and other element indispensable for plant growing was contained in the soil of the Area. As there was no difference among Tracts, soil sampled in 20 cm. depth at Tract A was tested by using FHK Portable Soil Tester. Analysis is given in the following Table.

Data of Soil Analysis

Place ; Tract A

Item	Result
Phosphoric Acid	1.0 mg/Soil 100 g
Lime	0.15 %
Alumina	5 mg/Soil 100 g
Magnesia	20 mg/Soil 100 g
Manganese	10 p.p.m.
Ratio of Silica-Alumina	Silicious Soil
Ferrous	Little
Ferric	Little
Kalium	3 mg/Soil 100 g
Ammonia Nitrogen	2.5 mg/Soil 100 g
Salts	0.05 %

(2) Soil Survey

a) Mechanical Analysis and Permeability Test

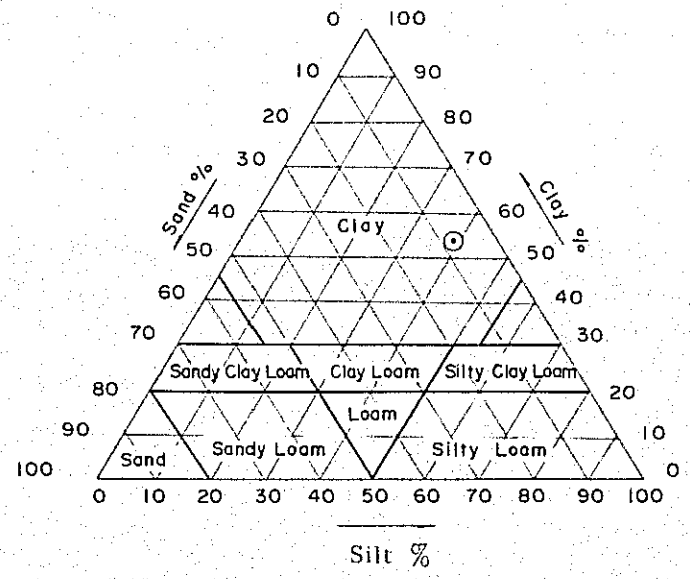
Soil Survey and Test were carried out in order to clarify soil condition in the Project Area on the following iterms ; Mechanical Analysis, Specific Gravity Test , Moisture Content and Permeability Test.

Test : As is became clear that soil is homogeneous in each Tract, soil sampled at Tract A and B was analyzed and tested. Soil Survey is shown as follows:

		Tract A	Tract B	Average Valve
Gravel	%	0	0	0
Sand	%	7.0	8.0	7.5
Silt	%	42.0	36.0	39.0
Clay	%	51.0	56.0	53.5
Specific Gravity		2.5	2.5	2.5
Air-Dry Condition	%	49.2	45.1	47.2
Dry Condition	%	67.9	66.7	67.3
Coeffient of Permeability	cm/sec	8.95×10^{-8}	-	8.95×10^{-8}

Then the soil sampled can be classified as Triangular Diagram Method.

Triangular Diagram of Soil



The soil at the Project Area was proved to be Heavy Clay Soil : Colloid is contained 30 % in soil at Tract A and 40% at Tract B, averaging 38 %.

Generally, Heavy Clay Soil is defined to be included more than 60% cly. It is also acid, less corrosive and low productive.

Permeability Test was carried out by a Portable Falling - Head Permeameter which is for the use of poor Permeability soil. The disturbed soil was sampled in 0.2 - 0.5 m. depth at Tract A.

Results of test are given the following table. Coefficient of Permeability shows 8.95×10^{-8} cm/sec in average.

Data Sheet of Mechanical Analysis of Soil

Place Tract A Date 12, Dec. 1970

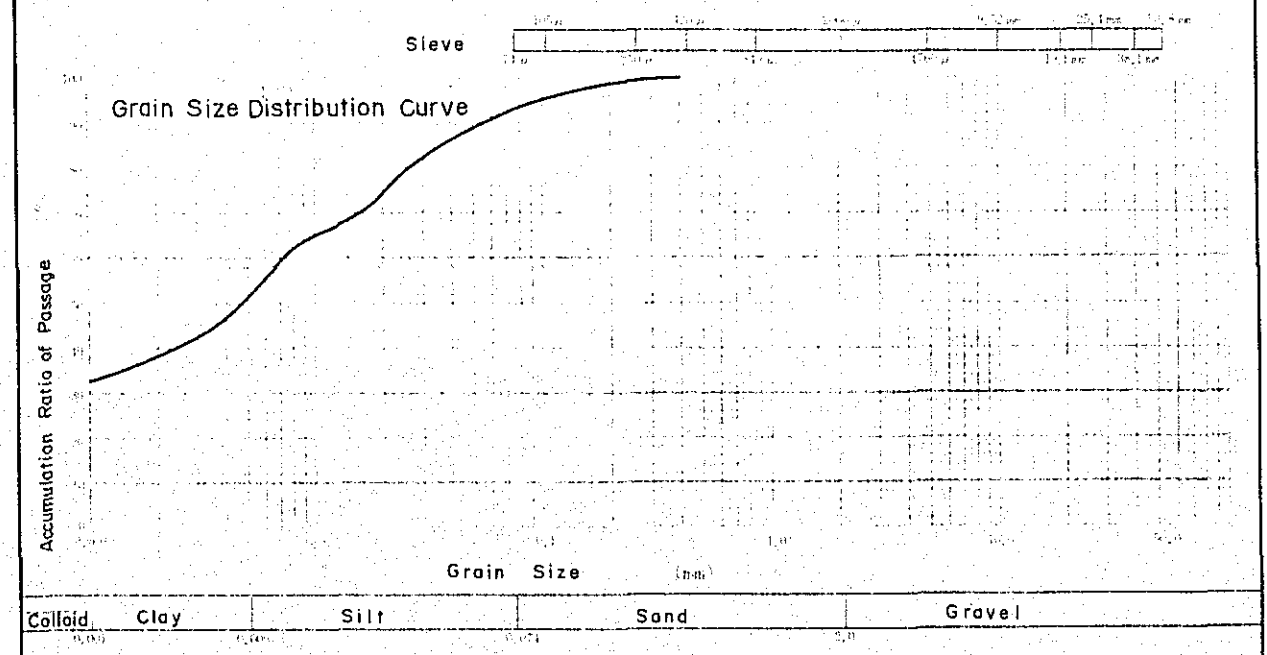
Measurement

Sample No & Depth : No. 1 (0 m ~ 0.2 m) Specific Gravity 2.50

Sieve													
Grain mm		50.8	38.1	25.4	19.1	9.52	4.76	2.00	0.84	0.42	0.25	0.105	0.074
% in Weight	%												
	mm												
	%												

Sample No & Depth No. m ~ m Specific Gravity

Sieve													
Grain mm		50.8	38.1	25.4	19.1	9.52	4.76	2.00	0.84	0.42	0.25	0.105	0.074
% in Weight	%												
	mm												
	%												



Sample No, Depth	No. 1 0 m ~ 0.2 m	No. m ~ m	Sample No, Depth	No. m ~ m	No. m ~ m
4.76mm↑ Grain	0 %	%	Maximum Grain Size	mm	mm
4.76 ~ 2 mm Grain	0 %	%	60 % Grain Size	mm	mm
2 ~ 0.42 mm Grain	0 %	%	30 % Grain Size	mm	mm
0.42 ~ 0.074mm Grain	7 %	%	10 % Grain Size	mm	mm
0.074 ~ 0.005mm Silt	42 %	%	Coefficient of Uniformity		
0.005mm > Clay	18 %	%	Coefficient of Curvature		
0.001mm > Colloid	33 %	%	Degree of Dispersion		
2000μ Sieve,% in Weight	%	%			
420μ Sieve,% in Weight	%	%			
74μ Sieve,% in Weight	%	%			

Data Sheet of Mechanical Analysis of Soil

Place Tract B Date 12, Dec. 1970

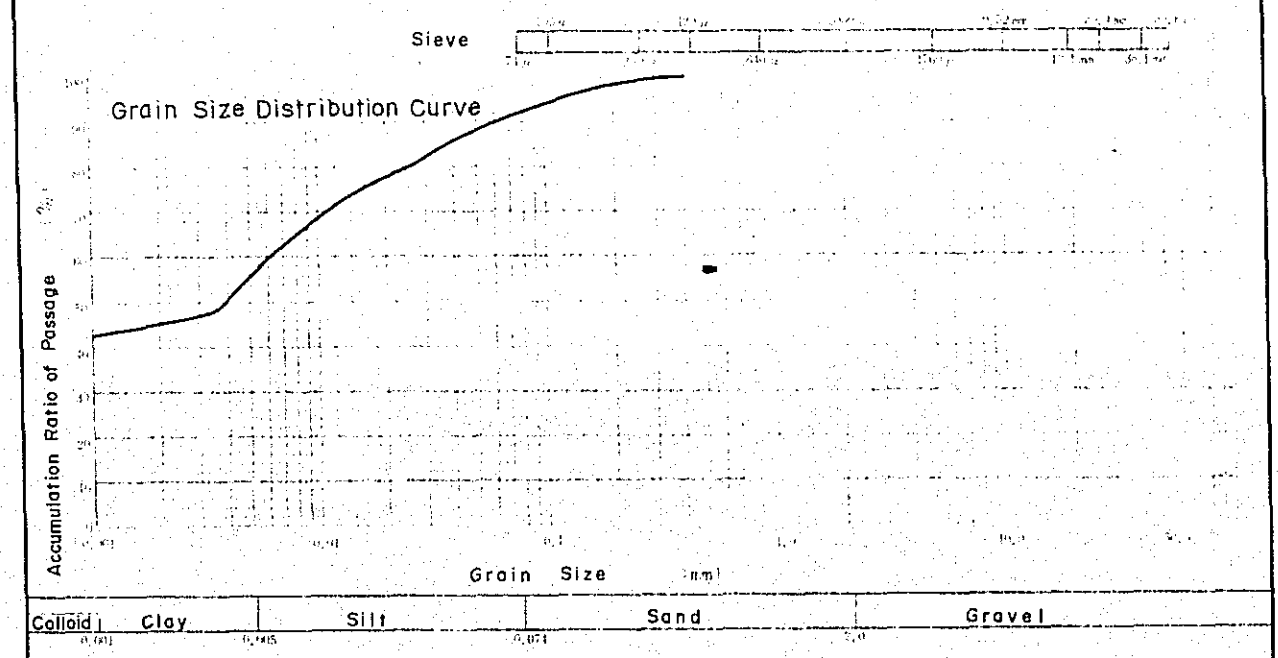
Measurement

Sample No & Depth No. 1 0 m ~ 0.2 m Specific Gravity 2.50

Sieve												
Grain mm	50.8	38.1	25.4	19.1	9.52	4.76	2.00	0.84	0.42	0.25	0.105	0.074
% in Weight												

Sample No & Depth No. m ~ m Specific Gravity

Sieve												
Grain mm	50.8	38.1	25.4	19.1	9.52	4.76	2.00	0.84	0.42	0.25	0.105	0.074
% in Weight												



Sample No, Depth	No. 1 0 m ~ 0.2 m	No. m ~ m	Sample No, Depth	No. m ~ m	No. m ~ m
4.76mm < Grain	0 %	%	Maximum Grain Size	mm	mm
4.76 ~ 2 mm Grain	0 %	%	60 % Grain Size	mm	mm
2 ~ 0.42 mm Grain	0 %	%	30 % Grain Size	mm	mm
0.42 ~ 0.074mm Grain	8 %	%	10 % Grain Size	mm	mm
0.074 ~ 0.005mm Silt	36 %	%	Coefficient of Uniformity		
0.005mm > Clay	13 %	%	Coefficient of Curveture		
0.001mm > Colloid	43 %	%	Degree of Dispersion		
2000μ Sieve % in Weight	%	%			
420μ Sieve % in Weight	%	%			
74μ Sieve % in Weight	%	%			

Data Sheet of Specific Gravity of Soil

Place Tract A and B Date 11 Dec. 1970

Sample · No.

Test No.		Tract A	Tract B	3	4
Pycnometer No.		1	37		
Weight of Pycnometer W_f g		47	42		
(Pycnometer + Distilled Water) W_a' g		145.0	142.0		
Temperature of Wa' T' °C		21.5°	21.5°		
(Pycnometer + Dry Soil (or Wet Soil) + Distilled Water) Weight W_b g		154.0	151.0		
W_b Temperature of Wb T°C		21.5°	21.5°		
Weight of Dry Soil in Pycnometer W_s g	Vessel No.				
	※(Vessel + Dry soil) Weight g				
	※Weight of Vessel				
※ In case of wet soil	W_s g	15.0	15.0		
① Specific Gravity of T°C Water (GT) / Specific Gravity of T°C Water (GT')		= 0.9991	= 0.9991	=	=
$W_a - W_f$ g		98.0	100.0		
② $\frac{G_t}{G_t'} \times (W_a' - W_f)$ g		97.91	99.91		
(Pycnometer + Distilled Water) Converted Weight on T°C g		144.91	141.91		
$W_s + (W_a - W_b)$ g		6.0	6.0		
Specific Gravity on T°C $(T/T°C) = \frac{W_s}{W_s + (W_a - W_b)}$		2.50	2.5		
③ Coefficient of Revision K		0.9991	0.9991		
Specific Gravity on 15° C (T/15°C) = K x (T/T°C)		2.50	2.50		
		(T/15°C) =			

:

Data Sheet of Moisture Ratio of Soil

$$\frac{WW(\text{Wet Soil+Vessel) Weight} - DW(\text{Dry Soil+Vessel) Weight}}{DW(\text{Dry Soil+Vessel) Weight} - TW(\text{Vessel Weight})} \times 100 = \frac{Ww(\text{Water Weight in Sample})}{Ws(\text{Dry Soil Weight})} \times 100 =$$ Moisture Ratio, %

Date and Sample No.	Measurement	Moisture Ratio, %	Date and Sample No.	Measurement	Moisture Ratio, %
11. Dec.'70 Tract A Paddy Field Soil (0~0.2m)	No. 1 WW 202.0 DW 164.0 DW 164.0 TW 108.0 Ww 38.0 Ws 56.0	Dry Condition 67.9	11. Dec.'70 Tract A Paddy Field Soil (0~0.2m)	No. 1 WW 202.0 DW 171.0 DW 171.0 TW 108.0 Ww 31.0.0 Ws 63.0	Air-Dry Condition 49.2
11. Dec.'70 Tract B Paddy Field Soil (0~0.2m)	No. 2 WW 239.0 DW 185.0 DW 185.0 TW 104.0 Ww 54.0 Ws 81.0	Dry Condition 66.7	11. Dec.'70 Tract B Paddy Field Soil (0~0.2m)	No. 2 WW 239.0 DW 197.0 DW 197.0 TW 104.0 Ww 42.0 Ws 93.0	Air-Dry Condition 45.1
	No. WW DW DW TW Ww Ws			No. WW DW DW TW Ww Ws	
	No. WW DW DW TW Ww Ws			No. WW DW DW TW Ww Ws	
	No. WW DW DW TW Ww Ws			No. WW DW DW TW Ww Ws	
	No. WW DW DW TW Ww Ws			No. WW DW DW TW Ww Ws	
	No. WW DW DW TW Ww Ws			No. WW DW DW TW Ww Ws	
	No. WW DW DW TW Ww Ws			No. WW DW DW TW Ww Ws	
	No. WW DW DW TW Ww Ws			No. WW DW DW TW Ww Ws	
	No. WW DW DW TW Ww Ws			No. WW DW DW TW Ww Ws	

Data Sheet of Permeability Test of Soil

Place Tract A Date 20, Dec., '70

Sample No & Depth No. 1 (0.20 m ~ 0.30 m)

Implement No. Vessel No. Sample Condition : Disturbed Sample

Dia of Glass Pipe cm	2.12	Condition of Sample	Before Test	After Test
Area of Pipe Section a	3.53	(Vessel+Sample) Weight W' g	255.0	
Dia. of Sample cm	10.00	Weight of Sample $W_0 = W' - W_v$ g	145.0	
Permeability Area A cm²	78.50	Wet Density $\gamma_t = W_0/V$ g	1.53	
Length of Sample L cm	12.70	Degree of Saturation S_r %		
Volume of Sample $V = AL$ cm³	95.02	Moisture Ratio w %	72.2	
Weight of Vessel W_v g	110.0	Dry Density $\gamma_d = \gamma_t/(1+\frac{w}{100})$ g/cm³	0.89	
Specific Gravity G	2.5	Void Ratio e		

Test No.		1	2	3
	Time Started t_1	11h 55min	18h 05min	8h 30min
	Time Completed t_2	18h 05min	8h 30min	16h 30min
	$t_2 - t_1$ sec	22.200	51.900	28.800
Constant-head Permeability Test Method	Head h cm			
	A · t_1 t_2			
	L h			
	Permeability Volume Q cm³			
	Q A $t_2 - t_1$			
	$k_T = \frac{L}{t} \cdot \frac{Q}{A} \cdot \frac{1}{h}$ cm/sec			
Falling-head Permeability Test Method	Head at t1 h_1 cm	197.5	196.4	194.9
	Head at t2 h_2 cm	196.4	194.9	194.1
	h_1 / h_2	1.006	1.008	1.004
	$\log_{10}(h_1/h_2)$	2.60×10^{-3}	3.46×10^{-3}	1.73×10^{-3}
	a · L	44.83	44.83	44.83
	aL / A	5.71×10^{-1}	5.71×10^{-1}	5.71×10^{-1}
	$2.3 \cdot (t_2 - t_1)$	1.04×10^{-4}	4.43×10^{-5}	7.99×10^{-5}
	$k_T = \frac{aL}{A} \cdot \frac{2.3}{t_2 - t_1} \cdot \log_{10}\frac{h_1}{h_2}$ cm/sec	1.54×10^{-7}	8.75×10^{-8}	7.89×10^{-8}
Water Temperature T °C		22°	22°	22°
	μ_T / μ_{15}	0.839	0.839	0.839
	$k_{15} = k_T \frac{\mu_T}{\mu_{15}}$	1.29×10^{-7}	7.34×10^{-8}	6.62×10^{-8}
Average Value	k_{15} cm/sec	8.95×10^{-8}		

Moisture Ratio Before Test

No. 3

W_a 242.0 W_b 185.0

W_b 185.0 W_c 106.0

W_w 57.0 W_s 79.0

w = 72.2 %

No.

W_a W_b

W_b W_c

W_w W_s

w = %

Moisture Ratio w = 72.2 %

Moisture Ratio after Test

No.

W_a W_b

W_b W_c

W_w W_s

w = %

No.

W_a W_b

W_b W_c

W_w W_s

w = %

Moisture Ratio w = %

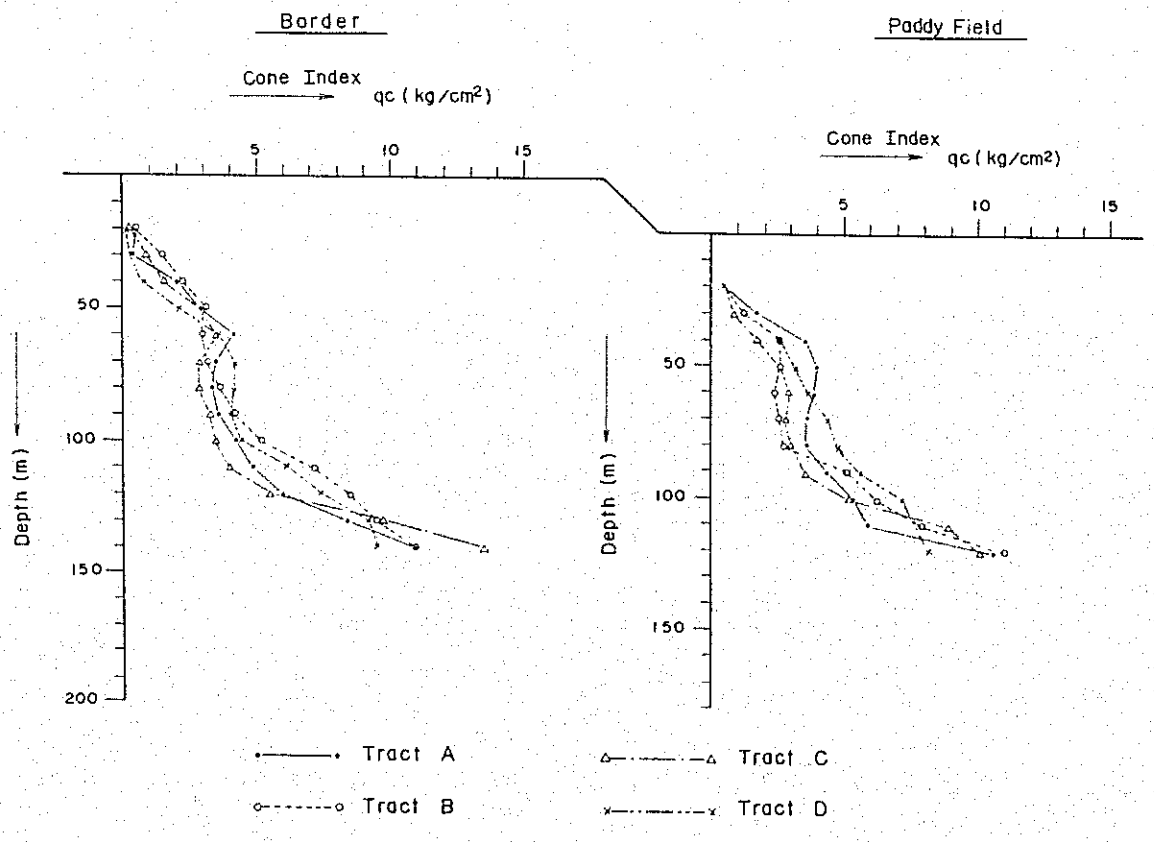
b) Bearing Capacity Test

As bearing capacity test is essential of design for roads, cone penetrometer test, static penetration test, was carried out at borders and paddies in Tract A, B, C and D according to the following measure.

Cone Pentrometer

cone bottom section	.....	6.4 cm^2
point angle	.....	30 ^oC
Pentrating Speed	.....	1.0 cm/sec
Measuring Point	.....	10 cm intervals

These tests indicate that solid portion is in limited on surface of border, 20 cm thickness and there is no difference among Tracts.



Measurement of Cone Test

Date ; 18, Dec., '70

Place ; Tract A, Border

Implement ; Cone-penetrometer Angle of Cone 30°

Section Area of Cone 6.4 cm^2

Depth (cm)	Measurement by Dial Gauge 1	2	3	Mean	Cone Index qc (kg/cm^2)	Remarks
10						Coefficient of Change = 0.0844
20	9	5		7	0.59	
30	5	4		5	0.42	
40	27	23		25	2.11	
50	36	34		35	2.95	
60	50	50		50	4.22	
70	40	44		42	3.54	
80	40	40		40	3.38	
90	42	44		43	3.63	
100	50	49		50	4.22	
110	55	60		58	4.90	
120	68	72		70	5.91	
130	100	100		100	8.44	
140	130	130		130	10.97	
150						
160						
170						

Date ; 18, Dec., '70

Place ; Tract A, Paddy Field

Implement ; Cone-penetrometer Angle of Cone 30°

Section Area of Cone 6.4 cm^2

Depth (cm)	Measurement by Dial Gauge 1	2	3	Mean	Cone Index qc (kg/cm^2)	Remarks
10						Coefficient of Change = 0.0844
20	10	0		5	0.42	
30	29	10		20	1.69	
40	44	40		42	3.54	
50	48	45		47	3.97	
60	44	45		45	3.80	
70	40	44		42	3.54	
80	42	42		42	3.54	
90	50	52		51	4.30	
100	65	60		63	5.32	
110	70	68		69	5.82	
120	130	120		125	10.55	
130						
140						
150						
160						
170						

Date ; 18, Dec., '70

Place ; Tract B, Border

Implement ; Cone-penetrometer Angle of Cone 30°

Section Area of Cone 6.4 cm^2

Depth (cm)	Measurement by Dial Gauge 1	2	3	Mean	Cone Index qc (kg/cm^2)	Remarks
10						Coefficient of Change = 0.0844
20	10	2		6	0.51	
30	28	3		15.5	1.31	
40	30	22		26	2.19	
50	40	33		36.5	3.08	
60	35	35		35	2.95	
70	33	42		37.5	3.17	
80	36	50		43	3.63	
90	36	65		50.5	4.26	
100	50	72		61	5.15	
110	80	90		85	7.17	
120	96	105		101	8.52	
130	110	115		113	9.54	
140	130	130		130	10.97	
150						
160						
170						

Date ; 18, Dec., '70

Place ; Tract B, Paddy Field

Implement ; Cone-penetrometer Angle of Cone 30°

Section Area of Cone 6.4 cm^2

Depth (cm)	Measurement by Dial Gauge 1	2	3	Mean	Cone Index qc (kg/cm^2)	Remarks
10						Coefficient of Change = 0.0844
20	3	5		4	0.34	
30	15	12		14	1.18	
40	30	29		30	2.53	
50	30	30		30	2.53	
60	28	27		28	2.36	
70	30	30		30	2.53	
80	34	30		32	2.70	
90	58	62		60	5.06	
100	70	75		73	6.16	
110	85	100		93	7.85	
120	130	130		130	10.97	
130						
140						
150						
160						
170						

Date ; 18, Dec., '70

Place ; Tract C Border

Implement ; Cone-penetrometer Angle of Cone 30^{o}

Section Area of Cone 6.4 cm^2

Depth (cm)	Measurement by Dial Gauge 1	2	3	Mean	Cone Index qc (kg/cm^2)	Remarks
10						Coefficient of Change = 0.0844
20	5	3		4.0	0.34	
30	10	12		11.0	0.93	
40	15	20		17.5	1.48	
50	30	40		35.0	2.95	
60	36	45		40.5	3.42	
70	30	38		34.0	2.87	
80	31	35		33.0	2.79	
90	40	38		39.0	3.29	
100	40	41		40.5	3.42	
110	45	50		47.5	4.01	
120	60	70		65	5.49	
130	100	130		115	9.71	
140		160		160	13.50	
150						
160						
170						

Date ; 18, Dec., '70

Place ; Tract C. Paddy Field

Implement ; Cone-penetrometer Angle of Cone 30^{o}

Section Area of Cone 6.4 cm^2

Depth (cm)	Measurement by Dial Gauge 1	2	3	Mean	Cone Index qc (kg/cm^2)	Remarks
10						Coefficient of Change = 0.0844
20	5	5		5.0	0.42	
30	8	10		9.0	0.76	
40	10	30		20.0	1.69	
50	23	36		29.5	2.49	
60	33	34		33.5	2.83	
70	34	30		32.0	2.70	
80	39	32		35.5	3.00	
90	47	35		41.0	3.46	
100	70	50		60.0	5.06	
110	110	100		105.0	8.86	
120		120		120.0	10.13	
130						
140						
150						
160						
170						

Date ; 7, Dec., '70

Place ; Tract D. Border

Implement ; Cone-penetrometer Angle of Cone 30°

Section Area of Cone 6.4 cm^2

Depth (cm)	Measurement by Dial Gauge 1	2	3	Mean	Cone Index qc (kg/cm^2)	Remarks
10						Coefficient of Change = 0.0844
20	3	5	2	3	0.25	
30	5	8	4	4	0.34	
40	10	10	8	9	0.76	
50	30	22	22	25	2.11	
60	44	35	48	42	3.54	
70	55	40	55	50	4.22	
80	60	42	43	49	4.14	
90	52	40	52	48	4.05	
100	50	40	66	52	4.39	
110	55	64	100	73	6.16	
120	70	70	120	87	7.34	
130	90	90	144	108	9.12	
140	85	100	150	112	9.45	
150	120	120		120	10.13	
160						
170						

Date ; 7, Dec., '70

Place ; Tract D., Paddy Field

Implement ; Cone-penetrometer Angle of Cone 30°

Section Area of Cone 6.4 cm^2

Depth (cm)	Measurement by Dial Gauge 1	2	3	Mean	Cone Index qc (kg/cm^2)	Remarks
10						Coefficient of Change = 0.0844
20	6	5		6	0.51	
30	12	16		14	1.18	
40	30	29		30	2.53	
50	35	38		37	3.12	
60	41	45		43	3.63	
70	44	58		51	4.30	
80	49	62		56	4.73	
90	52	80		66	5.57	
100	70	100		85	7.17	
110	70	110		90	7.60	
120	74	120		97	8.19	
130	90	140		115	9.71	
140	140			140	11.82	
150						
160						
170						

The mean cone indexes at the paddy field and border in Tract A, B, C and D are shown as follows;

Depth (cm)	Border Tract				Mean	Paddy Field Tract				Mean	Mean
	A	B	C	D		A	B	C	D		
	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	-	-	-	-	-	kg/cm^2
10	0	0	0	0	0						0
20	0.59	0.51	0.34	0.25	0.42	-	-	-	-	-	0.42
						kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	
30	0.42	1.31	0.93	0.34	0.75	0	0	0	0	0	0.75
40	2.11	2.19	1.48	0.76	1.64	0.42	0.34	0.42	0.51	0.42	1.03
50	2.95	3.08	2.95	2.11	2.77	1.69	1.18	0.76	1.18	1.20	1.99
60	4.22	2.95	3.42	3.54	3.53	3.54	2.53	1.69	2.53	2.57	3.05
70	3.54	3.17	2.87	4.22	3.45	3.97	2.53	2.49	3.12	3.03	3.24
80	3.38	3.63	2.79	4.14	3.49	3.80	2.36	2.83	3.63	3.16	3.33
90	3.63	4.26	3.29	4.05	3.81	3.54	2.53	2.70	4.30	3.27	3.54
100	4.22	5.15	3.42	4.39	4.30	3.54	2.70	3.00	4.73	3.49	3.90
110	4.90	7.17	4.01	6.16	5.56	4.30	5.06	3.46	5.57	4.60	5.08
120	5.91	8.52	5.49	7.34	6.82	5.32	6.16	5.06	7.17	5.93	6.38
130	8.44	9.54	9.71	9.12	9.20	5.82	7.85	8.86	7.60	7.53	8.37
140	10.97	10.97	13.50	9.45	11.22	10.55	10.97	10.13	8.19	9.96	10.59

The standards prepared with the average values of cone index to decide the possibility for working rravel of the farm machineries are as follows:

(i) Working travel in plowing and hervesting standard of easiness for working travel in straight line.

For no-load travel or rotar-vator plowing

Average of qc at the depth of 0 - 15 cm (kg/cm^2)	Wheel tractor	Average of qc at the depth of 0 - 15 cm (kg/cm^2)	Wheel and crawler tractor fitted with girdless
> 4	easy	> 3	easy
4 - 3	possible	3 - 2	possible
3 - 2	difficult	2 - 1	difficult
2 <	impossible	1 <	impossible

Harvesting travel

Average of qc at the depth of 0 - 15 cm (kg/cm^2)	Semi-crawler combine
> 3	easy
3 - 2.5	possible
2.5 - 1	difficult
1 <	impossible or very difficult

(ii) Working travel in puddling

Where wheel tractor is used for puddling it is fitted with paddy field wheels, basket wheels or girdles. The satisfactory cone index in this case is 3 kg/cm^2 in the average of those in a range of 10 cm immediately below the surface soil layer.

According to the standards on travelling of farm machinery, cone index at the depth of 0 - 15 cm is required to be more than 3.0 kg/cm^2. Cone index of Pilot Farm shows less than 3.0 kg/cm^2 and it is impossible to use farm machineries under pre sent circumstances: Permeability of the soil in this area is n x 10^{-8} cm/sec and the drainage condition is poor. Therefore, in order to achieve improvement of permeability of soil layer and strengthening of bearing capacity of the field, underdrainage has to be planned.

Bearing capacity of foundation can be calculated from cone index. Between allowable capacity and cone index in clay soil (internal friction angle $\phi = 0^o$), there is the following relation:

$$q_a = \frac{1}{3} q_d = \frac{1}{3} (3.8 \times q_c + \gamma \times D)$$

Where, q_a ; Allowable Bearing Capacity (t/m^2)
q_d : Ultimate Bearing Capacity (t/m^2)
q_c ; Cone Index (kg/cm^2)
γ ; Unit Weight of Soil (t/m^3)
D ; Depth (m)

From the above formula, allowable bearing capacity are given as follows:

Depth D (m)	Cone Index q_c (kg/cm^2)	Allowable Bearing Capacity q_a (t/m^2)
10	0.00	0.05
20	0.42	0.63
30	1.20	1.67
40	2.57	3.46
50	3.03	4.09
60	3.16	4.31
70	3.27	4.50
80	3.49	4.83
90	4.60	6.29
100	5.93	8.02
110	7.53	10.10
120	9.96	13.23

(3) Survey of Borrow - Pit

After investigations and tests it became clear that soil in the Project Area is unsuitable for road embankment, because of poor permeasbility and extremely low bearing capacity. So as to get hills scattered in the Area were investigated.

The hill at the Papasiran village of about 10 m. in height and 12,780 m^2, neighborring to Pilot Farm was adopted as Borro - Pit for road embankment for following reasons:

(1) This Borrow - Pit situated adjacent to Tract B.

(2) By utilizing the proposed access road running near Borrow - Pit, banking material can be easily carried to each tract.

(3) Borrow - Pit consists of gravel, sand and rocks exposed at some portions which are suitable for embankment materials.

Proposed Access and Farm Roads need embankment materials shown as below.

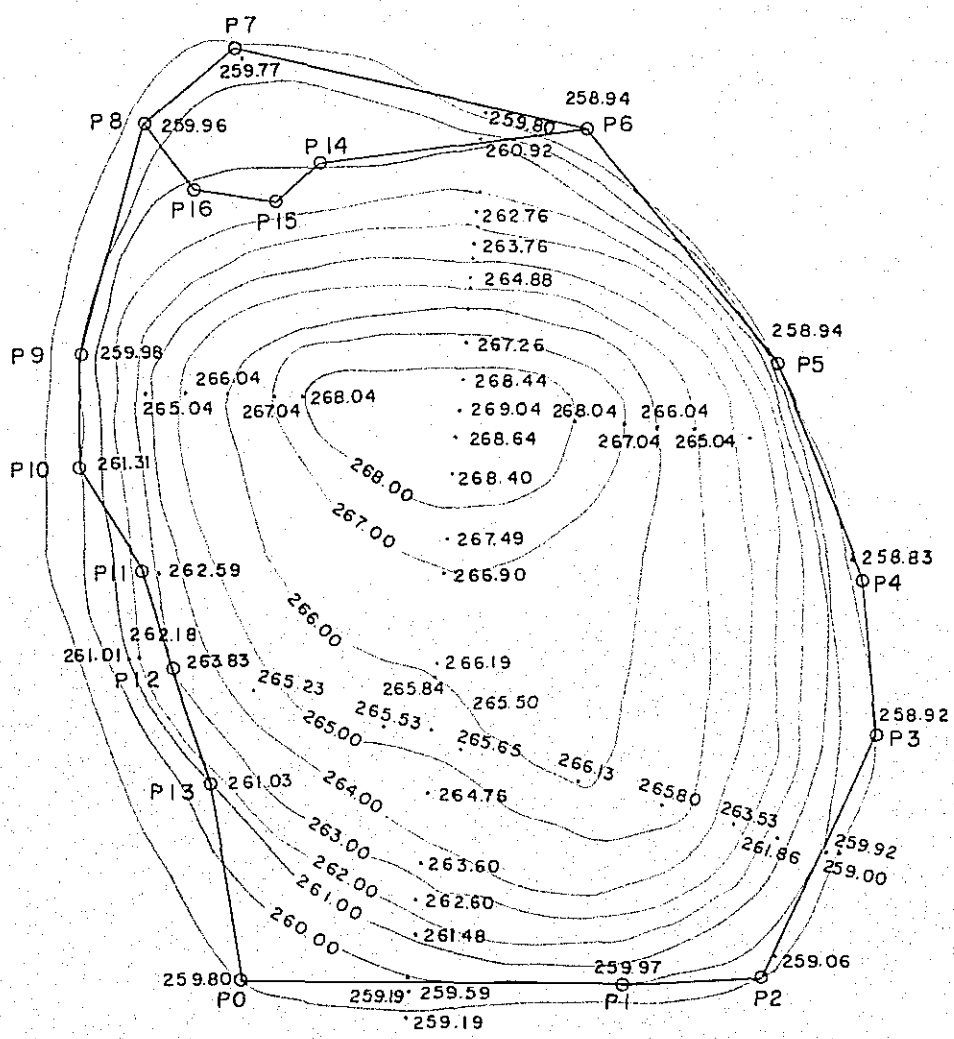
	Width	Extention	Volum
Access Road	4.0	1.6	7,036
Farm Road	2.0	11.1	17,582
Total			24,618

By traverse surveying and leveling it was confirmed that volume of material for road embankment amounted to about 70,000 m. : this volume shows three times as much as proposed one.

The results are shown as follows.

Calculation of Borrow - Pit Volume

Elevation	h (m)	Area (m^2)	Mean Area (m^2)	Volume (m^3)
EL				
259.00	0	670	0	0
260.00	1.00	1,430	1,050	1,050
261.00	1.00	3,320	2,375	2,375
262.00	1.00	5,250	4,285	4,285
263.00	1.00	6,910	6,080	6,080
264.00	1.00	6,870	6,890	6,890
265.00	1.00	8,290	7,580	7,580
266.00	1.00	9,460	8,875	8,875
267.00	1.00	10,640	10,050	10,050
268.00	1.00	12,070	11,355	11,355
269.00	1.00	12,780	12,425	12,425
				70,695 m^3


P7
259.77
P8
259.96
P14
260.92
P16
P15
P6
258.94
259.80
262.76
263.76
264.88
P9
259.98
266.04
265.04
267.04
268.04
267.26
268.44
269.04
268.04
266.04
268.64
267.04
265.04
P10
261.31
268.00
268.40
267.00
267.49
266.90
P5
258.94
P11
262.59
266.00
266.19
262.18
261.01
263.83
P12
265.23
265.84
265.50
265.53
265.00
265.65
266.13
P4
258.83
P3
258.92
P13
261.03
264.00
264.76
26580
263.53
261.86
259.92
259.00
263.00
263.60
262.00
262.60
261.00
261.48
260.00
259.97
259.06
259.80
P0
259.19
259.59
P1
P2
259.19

SCALE= 1 :1,000

Sta	Distrance	Angle			Remarks
P_0	m	99°	36'	28"	(n - 2) x 180
	57.10				
P_1		177°	30'	06"	= (14 - 2) x 180°
	20.92				= 2,160°
P_2		116°	56'	12"	
	41.70				
P_3		150°	18'	09"	
	23.65				
P_4		163°	52'	13"	
	35.25				
P_5		161°	38'	32"	
	45.62				
P_6		142°	08'	01"	
	54.39				
P_7		127°	28'	09"	
	17.64				
P_8		145°	41'	20"	
	36.69				
P_9		163°	41'	27"	
	17.54				
P_{10}		148°	58'	18"	
	18.56				
P_{11}		194°	21'	40"	
	15.28				
P_{12}		179°	07'	14"	
	18.77				
P_{13}		188°	43'	06"	
	31.80				
Total		2,160°	00'	47"	

4 - 3 Surveying

(1) Detail Surveying in the Pilot Farm, 100ha

A detailed map for existing conditions of the Pilot Farm which consists of more than 2,100 paddy plots was finished by means of traverse survey, plane-table survey and leveling basing on 14 bench marks and 27 traverse points. As bench mark could not be found around the project area, temporary bench mark, B.M. No. 1 of 265.0 m above sea level was established in P.P. Tjihea. Every elevation shown in planning and drawings are come from this temporary elevation.

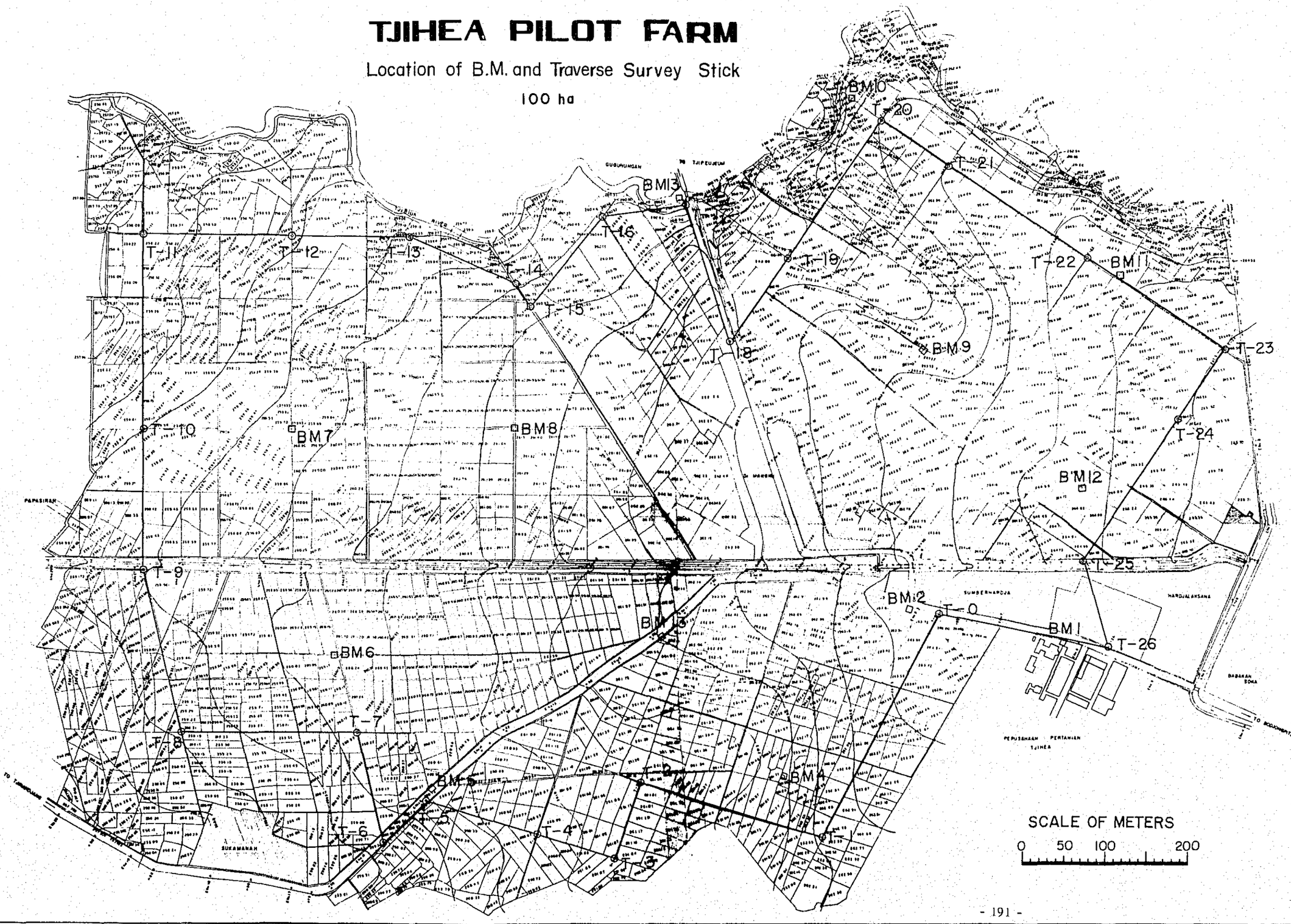
The surveying data are shown in the following table.

B.M. No	Elevation	B.M. No	Elevation
1	265.000 m	8	261.672 m
2	263.960	9	263.190
3	262.455	10	263.070
4	262.430	11	265.343
5	261.110	12	264.920
6	260.610	13	260.715
7	260.274		

TJIHEA PILOT FARM

Location of B.M. and Traverse Survey Stick

100 ha



Calculation of Traverse Survey

No	Distance	Angle	Revised Angle	Calculation	Azimuth Angle	Azimuth	cos α	sin α
T27	208.63	253° 33' 15"	253° 32' 22"	79° 34' 38" + 253° 32' 22" - 180°	153° 07' 00"	S 26° 58' 00" E	0.89193	0.45218
T26	108.30	62° 19' 26"	62° 18' 32"	153° 07' 00" + 62° 18' 32" - 180°	35° 25' 32"	N 35° 25' 32" E	0.81487	0.57963
T25	205.55	230° 25' 45"	230° 24' 52"	35° 25' 32" + 230° 24' 52" - 180°	85° 50' 24"	N 85° 50' 24" E	0.07251	0.99736
T24	102.65	179° 59' 55"	179° 59' 01"	85° 50' 24" + 179° 59' 01" - 180°	85° 49' 25"	N 85° 49' 25" E	0.07280	0.99734
T23	199.91	90° 00' 18"	89° 59' 24"	85° 49' 25" + 89° 59' 24" - 180°	355° 48' 49"	N 4° 11' 11" W	0.99733	0.07295
T22	201.90	179° 26' 34"	179° 25' 41"	355° 48' 49" + 179° 25' 41" - 180°	355° 14' 30"	N 4° 45' 30" W	0.99655	0.08294
T21	97.70	180° 44' 44"	180° 43' 50"	355° 14' 30" + 180° 43' 50" - 180°	355° 58' 20"	N 4° 01' 40" W	0.99752	0.07033
T20	201.05	90° 16' 57"	90° 16' 04"	355° 58' 20" + 90° 16' 04" - 180°	266° 14' 24"	S 86° 14' 24" W	0.06554	0.99784
T19	123.20	179° 48' 13"	179° 47' 19"	266° 14' 24" + 179° 47' 19" - 180°	266° 01' 43"	S 86° 01' 43" W	0.06917	0.99760
T18	175.39	307° 54' 05"	307° 53' 11"	266° 01' 43" + 307° 53' 11" - 180°	393° 54' 54"	N 33° 54' 54" E	0.82985	0.55798
T17	100.95	100° 08' 45"	100° 07' 51"	393° 54' 54" + 100° 07' 51" - 180°	314° 02' 45"	N 45° 57' 15" W	0.69528	0.71873
T16	139.53	136° 43' 40"	136° 42' 46"	314° 02' 45" + 136° 42' 46" - 180°	270° 45' 31"	N 89° 14' 29" W	0.01323	0.99991
T15	32.84	287° 52' 20"	287° 51' 26"	270° 45' 31" + 287° 51' 26" - 180°	378° 36' 57"	N 18° 36' 57" E	0.94767	0.31924
T14	141.15	146° 51' 35"	146° 50' 41"	378° 36' 57" + 146° 50' 41" - 180°	345° 27' 38"	N 14° 32' 22" W	0.96796	0.25108
T13	144.50	157° 07' 25"	157° 06' 31"	345° 27' 38" + 157° 06' 31" - 180°	322° 34' 09"	N 37° 25' 51" W	0.79406	0.60784
T12	178.25	179° 52' 10"	179° 51' 16"	322° 34' 09" + 179° 51' 16" - 180°	322° 25' 25"	N 37° 34' 35" W	0.79255	0.60980
T11	237.67	90° 03' 49"	90° 02' 56"	322° 25' 25" + 90° 02' 56" - 180°	232° 28' 21"	S 52° 28' 21" W	0.60915	0.79308
T10	170.84	179° 32' 05"	179° 31' 11"	232° 28' 21" + 179° 31' 11" - 180°	231° 59' 32"	S 51° 59' 32" W	0.61578	0.78792
T9	204.24	167° 10' 45"	167° 09' 52"	231° 59' 32" + 167° 09' 52" - 180°	219° 09' 24"	S 39° 09' 24" W	0.77540	0.63146
T8	212.39	102° 33' 10"	102° 32' 17"	219° 09' 24" + 102° 32' 17" - 180°	141° 41' 41"	S 38° 18' 19" E	0.78478	0.61978
T7	137.25	256° 45' 23"	256° 44' 29"	141° 41' 41" + 256° 44' 29" - 180°	218° 26' 10"	S 38° 26' 10" W	0.78333	0.62160
T6	73.00	59° 35' 40"	59° 35' 46"	218° 26' 10" + 59° 35' 46" - 180°	98° 01' 56"	S 81° 58' 04" E	0.13975	0.99019
T5	142.17	240° 48' 10"	240° 47' 16"	98° 01' 56" + 240° 47' 16" - 180°	158° 49' 12"	S 21° 10' 48" E	0.93243	0.36135
T4	99.00	180° 33' 20"	180° 32' 26"	158° 49' 12" + 180° 32' 26" - 180°	159° 21' 38"	S 20° 38' 22" E	0.93580	0.35252
T3	99.00	91° 29' 40"	91° 28' 46"	159° 21' 38" + 91° 28' 46" - 180°	70° 50' 24"	N 70° 50' 24" E	0.32817	0.94461
T2	228.32	267° 53' 40"	267° 52' 47"	70° 50' 24" + 267° 52' 47" - 180°	158° 43' 11"	S 21° 16' 49" E	0.93179	0.36298
T1	308.20	100° 52' 20"	100° 51' 27"	158° 43' 11" + 100° 51' 27" - 180°	79° 34' 38"	N 79° 34' 38" E	0.18094	0.98349
	4,273.58	4,500° 24' 09"	4,500° 00' 00"					

Latitude		Depature			Revised Latitude		Revised Latitude		Total Latitude		Total Deperture
N (+)	S (−)	E (+)	W (−)	±		±		±		±	
	186.08	94.34		−	186.07	+	94.37	−	0.00 186.07	+	0.00 94.37
88.25		62.77		+	88.25	+	62.79	−	97.82	+	157.16
14.90		205.01		+	14.91	+	205.04	−	82.91	+	362.20
7.47		102.38		+	7.48	+	102.40	−	75.43	+	464.60
199.37			14.58	+	199.38	−	14.55	+	123.95	+	450.05
201.20			16.75	+	201.21	−	16.72	+	325.16	+	433.33
97.46			6.87	+	97.47	−	6.86	+	422.63	+	426.47
	13.23		200.62	−	13.22	−	200.59	+	409.41	+	225.88
	8.52		122.90	−	8.51	−	122.88	+	400.90	+	103.00
145.55		97.86		+	145.56	+	97.89	+	546.46	+	200.89
70.19			72.56	+	70.20	−	72.55	+	616.66	+	128.34
1.85			139.52	+	1.85	−	139.50	+	618.51	−	11.16
31.12		10.48		+	31.13	+	10.48	+	649.64	−	0.68
136.63			35.44	+	136.64	−	35.42	+	786.28	−	36.10
114.74			87.83	+	114.75	−	87.81	+	901.03	−	123.91
141.27			108.70	+	141.28	−	108.68	+	1,042.31	−	232.59
	144.78		188.49	−	144.77	−	188.46	+	897.54	−	421.05
	105.20		134.61	−	105.17	−	134.59	+	792.37	−	555.64
	158.37		128.97	−	158.36	−	128.94	+	634.01	−	684.58
	166.68	131.64		−	166.67	+	131.67	+	467.34	−	552.91
	107.51		85.31	−	107.50	−	85.29	+	359.84	−	638.20
	10.20	72.28		−	10.20	+	72.29	+	349.64	−	565.91
	132.56	51.37		−	132.55	+	51.39	+	217.09	−	514.52
	92.64	34.90		−	92.63	+	34.92	+	124.46	−	479.60
32.49		93.52		+	32.49	+	93.54	+	156.95	−	386.06
	212.75	82.88		−	212.74	+	82.91	−	55.79	−	303.15
55.77		303.11		+	55.79	+	303.15		0.00		0.00
1,338.26	1,338.52	1,342.54	1,343.15		0		0				
	0.26		0.61								

(2) Main Canal

By profile leveling, stations at intervals of 100 m. were settled along the Main Canal within the Project Area which begins at the distribution work for Tjirandjang River and ends at the culvert of Tjibodas River. The canal length in the Area from the beginning station NO. 0 to station NO. 46 + 84.00 is 4,684 m.

Structures in the Main Canal are shown in Table 4 - 3 - 1.

(3) Secondary Canal

The Secondary Canal which begins at the diversion dam on the Tjirandjan River at Bodjongpitiug and runs out of the Project Area at the siphon crossing under the rail way, was surveyed : plofile leveling of 100 m. intervals. Length from station NO. 0 to NO. 45 + 16.0 is 4,516 m.

Structures in the Secondary Canal are shown in Table 4 - 3 - 2.

(4) Secondary Lateral

The Secondary Lateral which starts at the diversion work of the Secondary Canal runs through the Project Area. At stations of 50 m. intervals along this leveling was carried out. Between station NO. 0 and NO. 37 + 33.0, length is 1,883 m. Structures in the Seconday Lateral are shown in Table 4 - 3 - 3.

(5) Provincial Road

a) Bodjonpitjung - Tjirandjang

Bodjonpitjung - Tjirandjang Line beginning at the intersection of Tjipater Line was surveyed ; stations at 100 m. intervals. Distance between No. 0 and No. 25 + 9.3 is 2,509.3 m.

b) Bodjongpitjug - Tjipeujeum Line

Bodjongpitjug - Tjipeujeum Line which starts from the intesection of Bodjongpitjug-Tjirandjang Line and runs through the Project Area toward Tjipeujeum was surveyed in the same way. Distance between No. 0 and No. 20 + 59.2 is 2,059.2 m.

c) Bodjongpitjug - Tjipater Line

Bodjongpitjug - Tjipater Line which begins at the intersection of the Bodjongpitjug - Tjirandjag Line and ends at the begining point of the Main Canal was surveyed. Distance between No. 0 and No. 21 + 68.3 is 2,168.3 m.

(6) Access Road

Proposed Access Road planned to run from Bodjongpitjug to the Main Canal via Tjitapen village was surveyed : distance between No. 0 and No. 15 + 67.0 is 1,567.0 m.

Table 4-3-1 List of Structures in Main Canal

Station	Accum. Distance	Structure	Remarks
No. 0	0.00 M.	Diversion weir	Tjirandjang River
No. 0 + 38.40	38.40	Turn Out	
No. 5 + 73.10	573.10	Turn Out	
No. 8 + 50.00	850.00	Aqueduct	
No. 9 + 35.00	935.00	Turn Out	
No.11 + 91.20	1,191.20	Bridge	
No.16 + 92.00	1,692.00	Syphon	
No.17 + 25.00	1,725.00	Turn Out	
No.22 + 64.00	2,264.00	Turn Out	
No.23 + 59.00	2,359.00	Aqueduct	Drainage Canal
No.25 + 41.50	2,541.50	Turn Out	
No.26 + 49.60	2,649.60	Bridge	
No.30 + 96.30	3,096.30	Drop	
No.31 + 77.90	3,177.90	Turn Out	
No.32 + 94.30	3,294.30	Culvert	
No.35 + 60.00	3,560.00	Bridge	Bamboo
No.36 + 44.30	3,644.30	Bridge	
No.37 + 68.50	3,768.50	Bridge	
No.38 + 95.50	3,895.50	Turn Out	
No.39 + 10.50	3,910.50	Bridge	
No.42 + 88.70	4,288.70	Bridge	
No.43 + 85.70	4,385.70	Culvert	
No.45 + 6.90	4,506.90	Turn Out	
No.45 + 38.80	4,538.80	Bridge	
No.45 + 81.00	4,581.00	Turn Out	
No.46 + 26.00	4,626.00	Crossing Road	
No.46 + 39.00	4,639.00	Bridge	
No.46 + 84.00	4,684.00	Culvert	Tjibodas River

Table 4-3-2 List of Structures in Secondary Canal

No	Accum. Distance	Structure	Remarks
No.0	0.00	Diversion Dam	Tjirandjang River
No. 2 + 17.00	217.00	Bridge	Bamboo (B = 0.8)
+ 48.00	248.00	Weir	
+ 90.50	290.50	Bridge	Concrete (B = 1.5)
No. 4 + 76.00	476.00	Turn Out	
+ 88.50	488.50	Bridge	
No. 6 + 48.00	648.00	Diversion Weir	Secondary Lateral
No.10 + 54.00	1,054.00	Turn Out	
+ 79.00	1,079.00	Aqueduct	Tjibiuk River
No.15 + 33.00	1,533.00	Culvert	
No.17 + 68.50	1,768.50	Bridge	Concrete
No.21 + 92.00	2,192.00	Drop	
No.24 + 36.00	2,436.00	Bridge	
+ 81.00	2,481.00	Drop	
No.27 + 19.00	2,719.00	Bridge	Bamboo
No.28 + 38.00	2,838.00	Drop	
No.29 + 60.00	2,960.00	Bridge	Wooden
No.30 + 95.00	3,095.00	Drop	
No.32 + 56.00	3,256.00	Bridge	
No.33 + 60.00	3,360.00	Drop	
No.38 + 65.00	3,865.00	Drop	
No.42	4,200.00	Turn Out	
No.45 + 11.2	4,511.20	Syphon	
+ 16.0	4,516.00	Rail Way	

Table 4-3-3 List of Structures in Secondary Canal

No.	Accum. Distance (M)	Structure	Remarks
No. 0	0.00	Diversion Work No.1	Secondary Canal
No. 8 + 9.00	409.00	Bridge	Bodjongpitjung - Tjipeujeum Road
No. 9 + 5.00	455.00	Division Work No.2	
No.15 + 39.50	789.50	Drop	
No.33 + 12.00	1,662.00	Drop	
No.35	1,750.00	Drop	
No.36 + 17.00	1,180.00	Drop	
No.37 + 33.00	1,883.00		Provincial Road

N

TJIBODAS RIVER

SECONDARY CANAL

MAIN CANAL

WEIR

DIVERSION DAM

TJIBIUK RIVER

SECONDARY LATERAL

TJIRANDJANG

BODJONGPITJUNG

TJIRANDJANG RIVER

DIVISION WORK

LEGEND

- – – – ; BOUNDARY of DISTRICT
- x x x x x ; BOUNDARY of P.P. TJIHEA
- • • • • ; BOUNDARY of PILOT FARM

SCALE OF METERS

0 500 1,000

51

5. DATA

(1) Rainfall Data at P.P. Tjihea

* Yearly Rainfall

1961	2,050 mm
1962	2,416
1963	2,126
1964	2,700
1965	—
1966	1,892
1967	1,762
1968	2,706
1969	2,823
1970	—

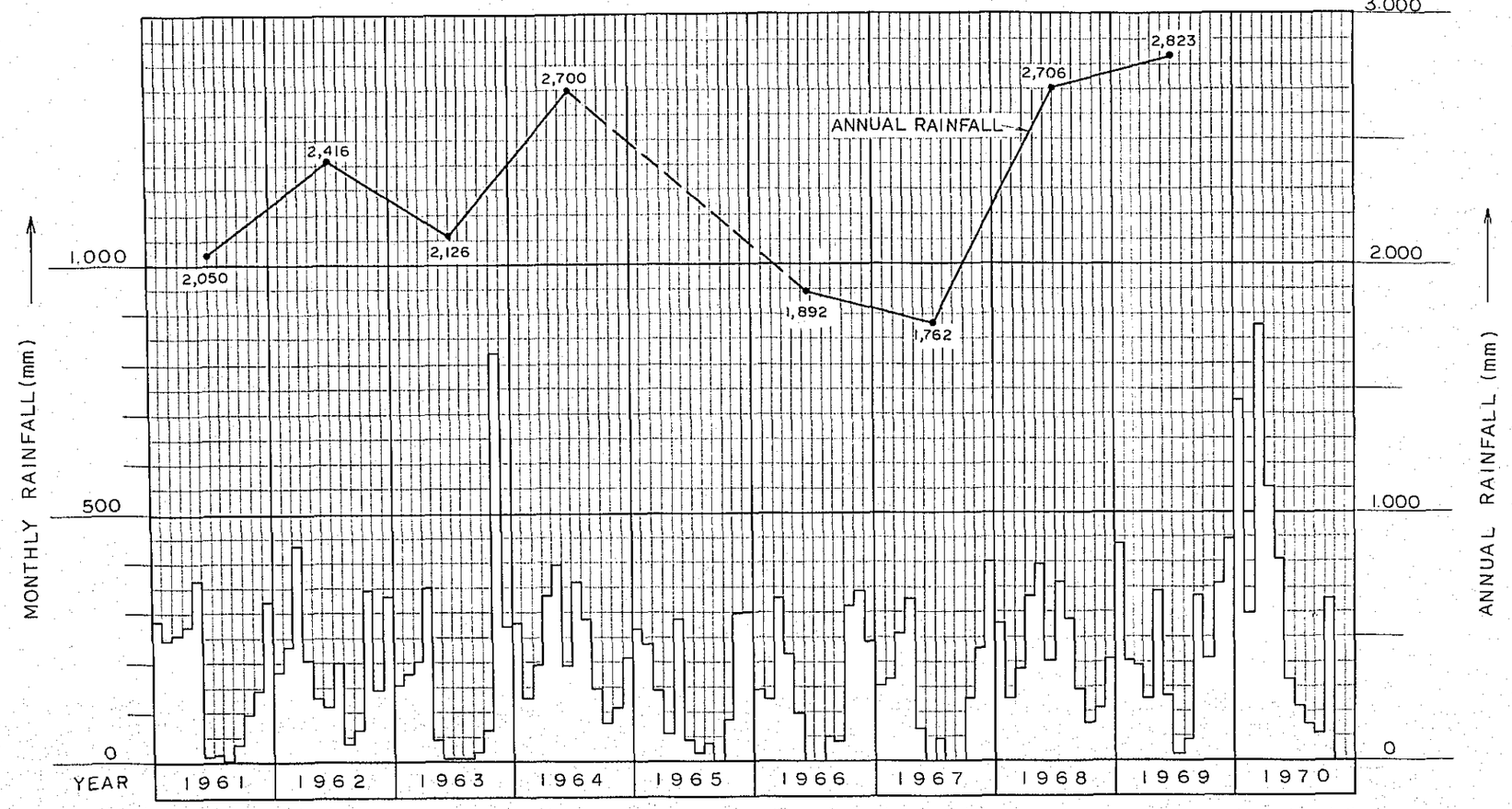
* Mean Monthly Rainfall

Jan.	290 mm
Feb.	193
Mar.	307
Apr.	277
May	252
Jun.	86
Jul.	113
Aug.	82
Sept.	92
Oct.	171
Nov.	283
Dec.	303

* Maximum Daily Rainfall

10.	Feb., 1961	77 m
14.	Jul., 1962	107
21.	Nov., 1963	325
27.	May, 1964	87
6.	Apr., 1966	80
18.	Dec., 1967	90
27.	May, 1968	87
27.	Jan., 1969	101

RAINFALL FLUCTUATION AT P.P. TJIHEA



	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Total Apr–Sept	Total Oct–Mar	ANNUAL
1961	284	247	256	273	364	12	16	2	34	97	143	322	701	1.349	2.050
1962	180	232	437	207	129	111	199	38	63	346	143	331	747	1.669	2.416
1963	156	177	203	350	46	7	6	7	20	62	821	271	436	1.690	2.126
1964	278	125	192	333	397	191	360	284	145	77	109	209	1.710	990	2.700
1965	266	235	142	55	286	42	14	36	—	82	296	300	—	1.321	—
1966	143	126	329	218	94	0	0	50	40	311	341	240	402	1.490	1.892
1967	151	165	255	327	64	0	47	0	0	125	229	399	438	1.324	1.762
1968	278	125	188	333	397	201	360	284	145	77	109	209	1.720	986	2.706
1969	436	203	192	126	341	131	13	43	330	206	357	445	984	1.839	2.823
1970	726	293	878	550	406	162	110	75	55	325	—	—	1.358	—	—
Average	290	193	307	277	252	86	113	82	92	171	283	303	944	1.406	2.309

DAILY RAINFALL

UNIT : mm

YEAR : 1961

ANNUAL RAINFALL : 2,050

DAY	MONTH											
	1	2	3	4	5	6	7	8	9	10	11	12
1				10	28	8					17	40
2		3	22		25							8
3		13	6	10	35							5
4	10		14	50							24	
5	2		18	10	18						7	
6	6		25	50							9	
7	8	20	9		18						14	
8	40											10
9	30		45	25	34							7
10		77			29		16					
11	9	9	19	25	25							2
12	8		33	2	13							3
13	8			18	13						8	8
14		28		10	5							5
15		17		3	5						6	1
16		36	3		1							40
17	12	5	4	4								
18	12	5		2	45							
19	42	12	2	14	22						43	
20	6	10	8	35								39
21	13	3		2								58
22		7	29	3								8
23			4						30			14
24	9								2			
25	10									37	5	25
26	22											30
27					43	2			2		10	
28		2										
29	27									18		17
30	10					2		2		20		2
31			15		5					22		
TOTAL	284	247	256	273	364	12	16	2	34	97	143	322

DAILY RAINFALL

UNIT : mm

YEAR : 1962

ANNUAL RAINFALL : 2,416

DAY	MONTH											
	1	2	3	4	5	6	7	8	9	10	11	12
1	30	40	10	8	53					1	6	
2	10			23	33						14	
3							35					
4				3							2	
5							1					
6				15				11				
7		57		21								
8		17	10	4		34					7	21
9	8		8		6			9			1	38
10	6		15						59		10	25
11			3					7				15
12		30				23	6	9		13	3	60
13	13	4	63			29				35		3
14	12	2				2	107					
15			11			4	21	2		5		
16	13		92			19					27	6
17	2		18				24			2	4	9
18	5			55			2					3
19	3	30		16			3					
20	13	2								6		6
21				5							5	8
22	49	12	25							3		63
23		2	42	10						1	17	15
24	6	18	8	3						96	5	10
25			25	22					2			9
26	10	8	48						2	55		5
27		10		15						30	20	2
28			27	2						2	7	2
29			24	5	2					22	12	1
30					35					5	3	
31			8							70		30
TOTAL	180	232	437	207	129	111	199	38	63	346	143	331

DAILY RAINFALL

UNIT : mm

YEAR : 1963

ANNUAL RAINFALL : 2,126

DAY	MONTH											
	1	2	3	4	5	6	7	8	9	10	11	12
1	17	17		13	17						6	
2		7		40	2					5	17	
3		6				2					45	
4								2				
5		2	7								85	35
6		3	8	13						6	14	35
7			17			1						1
8										16		
9			8	8								8
10	9			13						4		
11	7	8	25	3								
12	2	12	35									
13	10	1	28		5			5				85
14	15		14									
15	1	4										5
16	4	4	15									
17	2			32			6					7
18	10	35	24	13						5		
19	10										125	
20	8	7									175	
21				85							325	
22	2	11		12					5			
23	13	43		9					8	5	25	
24	19			2								
25	7	4	5	4								
26				6		4						10
27		10	4	56								3
28	3	3	8									
29			4	23								
30	17		1	18	20				7	20	4	30
31					2					1		52
TOTAL	156	177	203	350	46	7	6	7	20	62	821	271

DAILY RAINFALL

UNIT : mm

YEAR : 1964 ANNUAL RAINFALL : 2,700

DAY	MONTH											
	1	2	3	4	5	6	7	8	9	10	11	12
1	10		6									
2	15	10					15					15
3	30			21				13				
4			23		6						10	
5	5						65	27			20	5
6	45			64	28			5			30	3
7						10	3	2			8	5
8	6	10										
9	5					3				25		31
10	25	3		15	15	10						5
11			25		15		14					
12	10			67								6
13			20		15	23				11	16	20
14				74	29	7	14					4
15			10	1	12			80	13			
16	25	30					30	60	20		5	
17		40		40				9	14			
18			8			4	13		15			
19			10		20	25		64	10		7	
20			5			1		14			3	
21						16				26		
22	19			12		80	1		30	3		15
23		10										25
24		5	3	25		5					10	30
25	10	2		14	50							
26			13						40			25
27	18		24		87	2						
28			27		60	5	52	10		7		
29	35	15	2		60		49					
30			16				33		3			
31	20						71			5		20
TOTAL	278	125	192	333	397	191	360	284	145	77	109	209

DAILY RAINFALL

UNIT : mm

YEAR : 1965 ANNUAL RAINFALL : ——

DAY	MONTH											
	1	2	3	4	5	6	7	8	9	10	11	12
1		25	4			2	9				40	30
2	43	3	3	11	20	4						
3	7	17	4	2								
4		12		10							18	10
5	14	8		8	20							
6	5	40	9	5						3	88	
7	2	19		5								45
8	3			9	47							
9	25	2	20	5		12						10
10	8	4	10									
11	7	7										
12	5	3	2									
13	16		1								5	
14	6		5					17			20	
15	3	14	2								20	20
16	11	11	14									13
17	6	4	17									
18	2	14	2		31							8
19	2	4	1									15
20		4	7		34		5	6				
21	4	3			2					10		4
22	1	25	41		51							65
23	22				10						7	18
24					5							
25					7							
26	43	4			10						18	
27		8			20							
28	2	4			25	2				5	45	
29	2					16		13		4	35	52
30	27					6						10
31					4					60		
TOTAL	266	235	142	55	286	42	14	36		82	296	300

DAILY RAINFALL UNIT : mm

YEAR : 1966 ANNUAL RAINFALL : 1,892

DAY	MONTH											
	1	2	3	4	5	6	7	8	9	10	11	12
1	10				13					15	5	17
2	1									43		
3			3		8							3
4	10		7	40	6							2
5		10	2		18			1	5		10	
6	10			80							5	8
7			18	12						34	25	7
8			8								55	
9			25									6
10			23		4					25		4
11	25	22	4							5	25	5
12	14		30						8	2	10	
13	8		20							4		
14		14									43	
15	6	35	50		10					12		70
16	12	15								16	20	6
17	8				8					5	13	15
18	19		18		5			49			5	
19			14								16	25
20		5										
21	7		15		22						15	
22			15								9	60
23			5	14						15		
24		10								15		
25		15	30	10						10	15	1
26				17							10	9
27			5	10						5		
28				10					12	25	25	2
29	13		25	15						70	10	
30			4	10					15		25	
31			8							10		
TOTAL	143	126	329	218	94	—	—	50	40	311	341	240

DAILY RAINFALL UNIT : mm

YEAR : 1967 ANNUAL RAINFALL : 2,050

DAY	MONTH											
	1	2	3	4	5	6	7	8	9	10	11	12
1			4	10								
2	17										10	2
3	2	5	2	4	32							30
4		3	5	45	2		10					70
5							15					2
6			15	59			22					19
7			7	5						40	1	3
8		10	4							60	5	
9	16	40	20	5							10	19
10	1	19			30							10
11												
12											6	6
13			7								10	20
14	45										10	
15		7	15	15								8
16	9											
17	2	21		32							50	
18	9			10								90
19												
20		1	6							10	2	7
21		20		50							75	
22		14	20							8	26	60
23	6		3							7	5	53
24			1									
25		20										
26	9			52								
27	15	5	25								14	
28	9		45									
29				40							3	
30	11		70								2	
31			6									
TOTAL	151	165	255	327	64	—	47	—	—	125	229	399

DAILY RAINFALL UNIT : mm

YEAR : 1968 ANNUAL RAINFALL : 2,706

DAY	MONTH 1	2	3	4	5	6	7	8	9	10	11	12
1	10		6									
2	15	10					15					15
3	30			21				13				
4			25		6						10	
5	5						65	27			20	5
6	45			64	28			5			30	3
7						10	3	2			8	5
8	6	10										
9	5					3				25		31
10	25	3		15	15	10						5
11			25		15		14					
12	10			67								6
13			20		15	23				11	16	20
14				74	29	17	14					4
15			10	1	12			80	13			
16	25	30					30	60	20		5	
17		40		40				9	14			
18			8			4	13		15			
19			10		20	25		64	10		7	
20			5			1		14			3	
21						16				26		
22	19			12		80	1		30	3		15
23		10										25
24		5	3	25		5					10	30
25	10	2		14	50							
26			13						40			25
27	18		24		87	2						
28			27		60	5	52	10		7		
29	35	15	2		60		49					
30			10				33		3			
31	20						71			5		20
TOTAL	278	125	188	333	397	201	360	284	145	77	109	209

DAILY RAINFALL

UNIT : mm

YEAR : 1969

ANNUAL RAINFALL : 2,823

DAY	MONTH											
	1	2	3	4	5	6	7	8	9	10	11	12
1		15	11		15				75		70	
2		7			8	15				5		10
3		3		5	5						100	
4		5						38			4	
5	10	8		30	10	26					17	35
6		5	11			21					20	2
7		18			2	10					30	38
8					1						20	30
9					12	59			45			40
10		5							25		12	
11	12	10	1					5	25			30
12	10	5	13						23			40
13		5										40
14		20	5		35							
15		16	3		40							
16	38				5						35	40
17	13	36	5		9							
18	1	1	45		10		13		6			
19	6			6					3			13
20			1		28				42			20
21					10							
22	46			5	13				38			53
23	8								25			
24	35	9	10		5				6	84		21
25	8	21	40		50					30.5		
26	50	5	20	15	50							
27	101		13	4	48				2	40		
28		9	1	40					10	28	2	
29	5		13	11					5	3.5	45	2
30	87			10							2	31
31	6									15		
TOTAL	436	203	192	126	341	131	13	43	330	206	357	445

DAILY RAINFALL

UNIT : mm

YEAR : 1970

ANNUAL RAINFALL : ——

DAY	MONTH											
	1	2	3	4	5	6	7	8	9	10	11	12
1			21	5	80							
2	35		5	80								
3			4	90								
4	40	35	15		60					20		
5				30	5							
6		25		13		15						
7		5	116									
8	95		63	72		5	45	20				
9	3	3	60				12					
10		20										
11	40	22	5						55.5	14		
12			2	65	35	14						
13	99		35			50				3		
14	11		50	35	15					4		
15	40		25		30				15			
16	45		70			60				39		
17	5					18		50		21		
18	115											
19	112			50	30		13					
20	15	10	64				5		14.5	4		
21	25		80				35					
22	5		113									
23		90								12		
24	5				120			5		14		
25		73	75							96		
26	15	5								10		
27	10		15		10					66		
28		5	50	60						8		
29	3				12					9		
30	8		10	50	9					5		
31												
TOTAL	726	293	878	550	406	162	110	75	55	325		

(2) Discharge Date at Tjisokan River

* Place - Sukarama (2.5 km Down stream from Tjisokan Diversion Dam)

Date	Flow Area	Volocity	Discharge
28, Jan., 1964	32.25 m^2	0.37 m/s	12.06 m^3/s
"	31.33	0.36	11.27
29, Jan., 1964	35.30	0.34	12.14
"	32.80	0.33	10.68
"	33.75	0.32	10.84
30, Jan., 1964	30.65	0.31	9.44
"	28.30	0.28	8.02

* Place - Babakanasen (27 km Downstream from Tjisokan Diversion Dam)

Date	Frow Area	Volocity	Discharge
2, Mar., 1964	92.69 m^2	0.53 m/s	49.44 m^3/s
"	92.50	0.53	49.05
2, May., 1964	91.63	0.48	43.50
"	87.25	0.48	43.07
"	88.25	0.42	36.97
"	85.06	0.41	35.05

* Place - Tjihondje (10 km Upstream from Tjisokan Diversion Dam)

(i) Mean Monthly Discharge (1922 – 1932)

Month	Discharge	Month	Discharge
Jan.	24.0 m^3/s	Jul.	8.0 m^3/s
Feb.	25.0	Aug.	5.1
Mar.	28.3	Sept.	4.4
Apr.	28.5	Oct.	13.5
May.	23.3	Nov.	22.5
Jun.	12.1	Dec.	27.1

(ii) Max. and Min. Discharge (1922 – 1932)

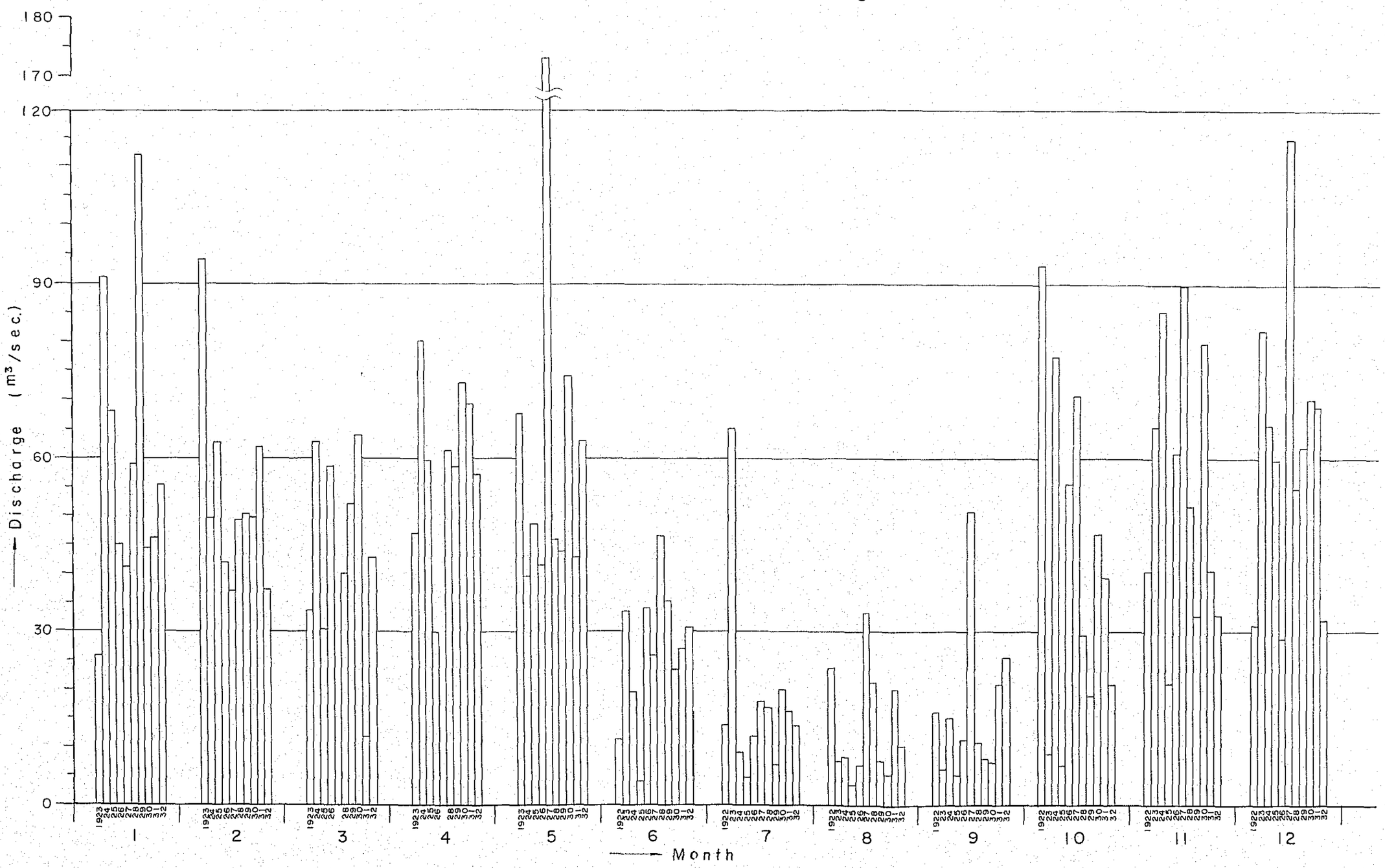
Year	Maximum		Minimum	
1923	94.2 m^3/s	(Feb.)	2.6 m^3/s	(Oct.)
1924	90.9	(Jan.)	3.0	(Sept.)
1925	68.2	(Jan.)	2.4	(Aug. and Sept.)
1926	61.3	(Nov.)	1.5	(Oct.)
1927	173.0	(May)	2.2	(Sept.)
1928	61.3	(Apr.)	2.4	(Oct.)
1929	112.0	(Jan.)	1.7	(Sept.)
1930	80.0	(Nov.)	1.6	(Sept.)
1931	69.3	(Apr.)	2.6	(Sept.)
1932	63.2	(May)	2.4	(Sept.)

DISCHARGE OF TJISOKAN RIVER

(m^3/sec)

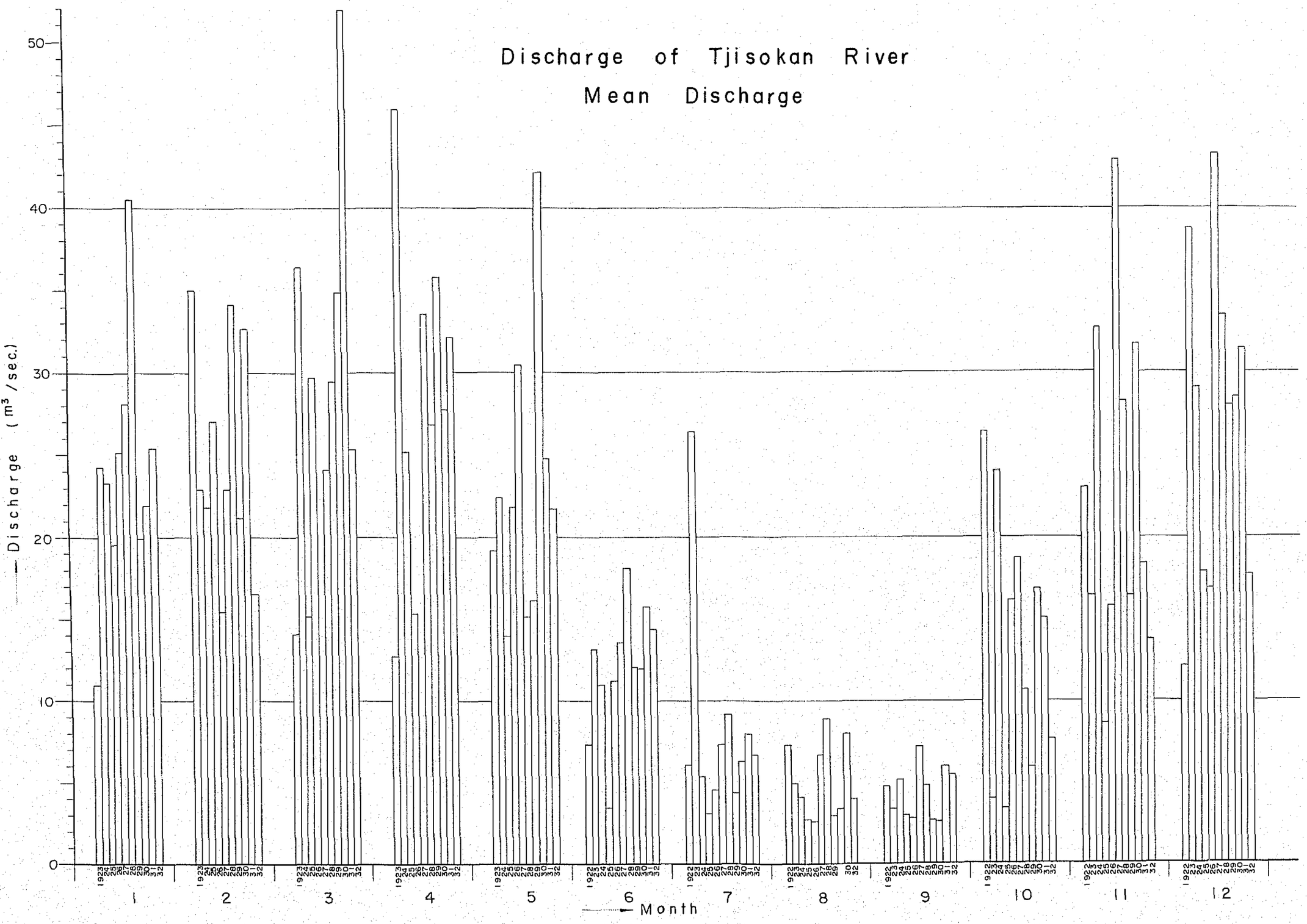
YEAR		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	Mean	-	-	-	-	-	7.41	6.16	7.32	4.86	26.4	22.9	14.1
1922	Maximum	-	-	-	-	-	11.4	14.10	23.7	16.2	93.0	40.4	31.3
	Minimum	-	-	-	-	-	5.92	4.61	4.42	3.05	7.25	11.4	6.97
	Mean	11.0	34.9	14.2	12.8	19.2	13.2	26.4	5.12	3.29	4.18	16.4	38.7
1923	Maximum	26.0	94.2	33.4	47.3	68.0	33.4	65.0	7.81	6.23	9.27	65.5	81.9
	Minimum	6.05	10.9	7.71	7.24	6.59	7.71	8.22	3.67	2.70	2.60	4.05	16.3
	Mean	24.3	23.1	36.4	45.9	22.5	11.1	5.37	4.09	5.24	24.0	32.7	29.1
1924	Maximum	90.9	49.6	63.0	80.2	39.6	19.3	9.24	8.40	14.90	77.6	85.3	66.0
	Minimum	9.48	13.7	16.3	27.1	12.8	6.3	4.08	3.30	3.00	6.4	14.4	13.0
	Mean	23.4	21.9	15.2	25.0	14.0	3.54	3.14	2.71	3.02	3.44	8.46	17.7
1925	Maximum	68.2	62.3	30.4	59.6	48.5	4.26	4.73	3.39	5.1	7.0	21.4	59.5
	Minimum	14.4	12.5	8.5	10.7	5.9	3.14	2.70	2.40	2.40	2.53	3.11	6.0
	Mean	19.5	27.1	29.7	15.3	21.9	11.3	4.4	2.6	2.8	16.1	15.8	16.7
1926	Maximum	45.0	42.2	58.5	30.4	41.3	34.2	11.9	6.7	11.4	55.8	61.3	29.4
	Minimum	7.8	14.3	14.7	8.0	8.1	5.1	2.8	1.7	1.7	1.5	4.1	9.7
	Mean	25.2	15.5	22.1	29.5	34.9	13.6	7.4	6.7	7.2	18.7	42.8	43.3
1927	Maximum	41.3	37.0	59.9	77.0	173.0	26.1	17.9	33.5	50.7	71.0	90.0	115.0
	Minimum	17.5	8.7	9.6	14.9	15.4	7.4	4.9	3.2	2.2	7.0	22.6	18.7
	Mean	28.1	23.0	24.1	33.6	15.2	18.2	9.2	9.0	4.8	10.6	28.2	33.4
1928	Maximum	58.9	49.3	39.9	61.3	46.1	46.4	17.0	21.4	11.1	29.4	52.2	55.1
	Minimum	13.8	14.2	11.7	14.1	8.7	8.5	4.7	4.4	3.0	2.4	15.2	17.3
	Mean	40.6	34.2	29.5	26.9	16.2	12.1	4.4	3.0	2.7	5.9	16.3	27.9
1929	Maximum	112.0	50.5	51.9	58.5	43.9	35.6	7.1	7.5	8.0	19.3	32.7	62.3
	Minimum	17.5	19.6	16.1	12.7	7.8	5.5	3.3	2.2	1.7	2.1	4.7	11.1
	Mean	20.0	21.1	34.9	35.8	42.2	12.0	6.3	3.4	2.7	16.8	31.7	28.4
1930	Maximum	44.6	49.5	64.1	72.7	74.0	23.6	20.1	5.3	7.5	47.0	80.0	70.4
	Minimum	7.2	10.0	21.9	16.6	14.7	5.8	4.1	2.4	1.6	3.9	12.4	9.5
	Mean	22.0	32.7	51.9	27.8	24.8	15.8	8.0	8.1	6.0	15.0	18.3	31.4
1931	Maximum	46.4	61.7	12.0	69.3	42.8	27.1	16.3	20.2	21.1	39.6	41.2	69.1
	Minimum	10.5	15.6	16.4	8.8	14.3	10.1	4.2	4.0	2.6	3.4	8.7	8.2
	Mean	25.5	16.6	25.4	32.2	21.7	14.4	6.7	4.0	5.5	7.6	13.6	17.6
1932	Maximum	55.6	37.3	42.8	57.2	63.2	30.8	13.8	10.2	25.6	20.8	33.4	32.2
	Minimum	11.0	7.4	14.5	19.2	11.6	8.5	4.3	3.0	2.4	2.88	5.0	6.6

Discharge of Tjisokan River
Maximum Discharge

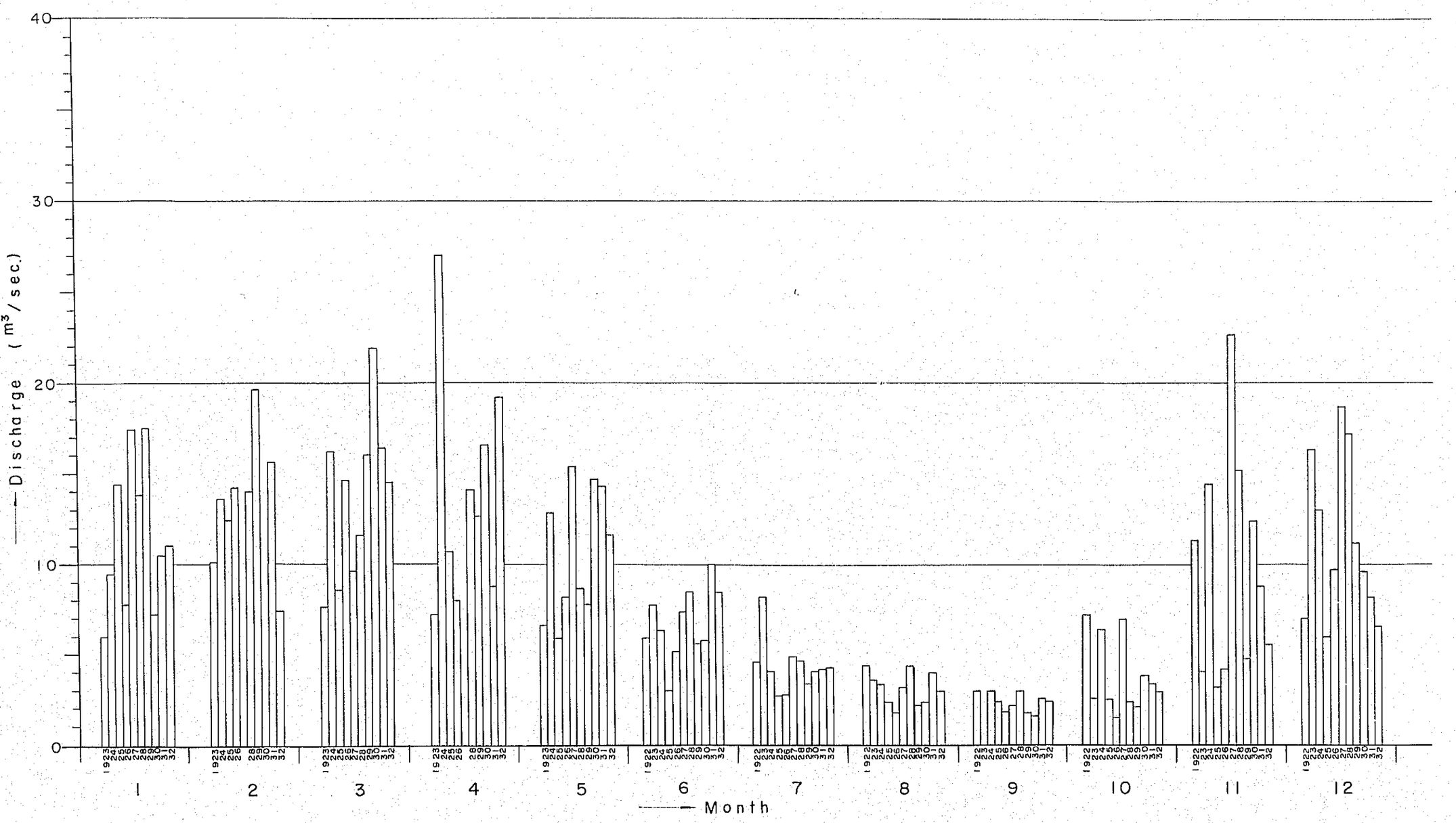


Discharge of Tjisokan River

Mean Discharge



Discharge of Tjisokan River
Minimum Discharge



Tjisokan at Tjihondje

Villege: Tjibarekbek Region: Tjiandjur

Place : On the left bank at Kampong Tjihondje

Daily report discharge in m^3/sec in 1922

Day	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1						-	6.79	4.83	-	13.0	34.2	18.9
2						-	6.26	9.77	-	16.4	20.6	19.4
3						-	5.92	10.10	3.78	13.1	15.7	15.3
4						-	5.75	23.7	4.16	17.6	28.5	15.1
5						-	5.43	16.6	4.16	18.3	29.7	30.3
6						-	5.28	10.8	3.84	11.3	40.4	31.3
7						-	5.20	9.30	3.84	7.45	33.5	22.6
8						-	5.28	8.05	3.78	7.25	25.8	16.6
9						-	5.35	6.88	3.78	8.87	20.6	14.8
10						-	5.35	6.17	3.90	8.98	19.4	-
11						-	5.35	5.66	3.72	17.6	25.2	-
12						-	5.20	5.28	-	15.5	34.5	-
13						-	5.13	5.05	-	10.8	26.1	-
14						-	5.20	4.83	-	8.87	14.6	-
15						-	5.35	5.35	-	8.56	24.3	-
16						-	9.30	5.28	-	7.75	11.7	-
17						-	6.79	4.83	3.26	22.8	11.5	-
18						8.66	7.16	4.55	3.10	15.9	11.5	-
19						7.85	12.7	4.42	3.05	37.1	21.1	-
20						11.4	14.1	5.50	3.10	54.0	20.8	-
21						7.65	7.45	6.70	3.26	64.0	13.6	7.75
22						7.16	6.17	7.25	3.90	93.0	11.7	7.45
23						6.97	5.50	5.75	3.78	61.5	11.4	6.97
24						5.92	5.13	4.83	4.42	35.5	19.4	7.16
25						6.79	4.98	4.55	3.78	50.0	20.1	10.8
26						8.25	4.90	4.42	5.35	53.5	28.2	9.30
27						7.06	4.75	-	16.2	33.2	22.6	8.15
28						6.43	4.68	-	7.95	22.3	38.1	9.77
29						6.26	4.61	-	6.61	18.3	23.4	11.8
30						5.92	4.83	-	9.08	26.4	29.4	10.6
31						-	5.28	-	-	39.4	-	8.05
Mean						7.41	6.16	7.32	4.86	26.4	22.9	14.1
Maximum						11.4	14.1	23.7	16.2	93.0	40.4	31.3
Minimum						5.92	4.61	4.42	3.05	7.25	11.4	6.97

Tjisokan at Tjihondje

Villege: Tjibarekbek Region: Tjiandjur

Place : On the left bank at Kampong Tjihondje

Daily report discharge in m^3/sec in 1923

Day	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1	7.91	10.9	14.3	8.11	6.86	8.83	64.5	7.81	3.67	2.76	4.75	81.9
2	8.32	11.1	15.5	9.71	6.86	8.32	37.9	7.81	3.43	3.92	5.75	59.8
3	7.71	30.7	13.9	8.85	6.77	10.1	65.0	7.81	3.31	4.31	5.40	58.5
4	7.24	20.3	13.0	12.0	6.59	9.08	40.7	7.81	3.25	5.23	6.60	52.8
5	6.95	17.5	-	17.3	8.01	9.27	24.3	6.00	3.25	5.83	7.38	31.3
6	7.91	56.7	-	15.5	7.81	8.22	19.1	6.00	3.20	5.44	6.55	35.2
7	7.33	37.1	-	21.9	16.5	7.71	19.1	6.32	3.14	4.24	65.5	23.7
8	9.49	25.1	-	13.5	15.7	7.81	22.4	6.14	3.20	4.10	11.5	22.4
9	9.27	31.3	-	12.0	17.3	10.2	23.2	5.88	3.20	4.15	10.3	24.6
10	7.81	86.0	-	9.82	19.3	9.06	19.3	5.71	3.14	4.45	9.5	30.4
11	7.24	94.2	26.9	10.7	21.4	8.11	35.2	5.54	3.09	5.12	19.5	22.0
12	6.68	44.8	33.4	13.1	37.9	9.71	31.0	5.30	3.03	3.66	16.23	23.5
13	6.05	34.1	24.3	10.4	32.0	12.2	18.2	5.22	3.09	3.24	17.3	26.9
14	7.62	53.7	20.3	12.0	33.0	11.6	18.4	5.00	3.09	3.27	10.6	31.6
15	-	35.6	16.3	13.6	25.1	12.1	50.2	4.92	3.64	3.27	7.24	43.6
16	-	25.7	16.7	47.3	24.6	17.5	43.2	4.85	6.23	2.49	5.71	32.3
17	-	24.6	12.8	19.6	68.0	19.3	23.7	4.71	3.45	2.92	4.92	30.4
18	-	42.0	12.1	15.4	39.1	17.9	18.6	4.50	3.43	3.31	4.31	38.7
19	-	66.2	10.6	12.8	28.8	14.1	47.7	4.44	3.11	4.11	4.05	41.1
20	-	36.3	9.6	13.0	21.4	10.7	44.4	4.31	2.41	3.92	4.92	7.40
21	12.7	39.5	9.38	11.4	17.1	9.16	22.2	4.11	3.87	3.85	5.71	64.0
22	13.0	37.9	9.06	9.94	20.0	13.9	18.9	4.05	3.37	3.20	9.38	57.6
23	11.4	25.7	15.4	10.3	16.3	33.4	17.5	3.98	3.81	3.03	17.5	37.5
24	14.8	20.3	16.9	9.71	13.5	26.3	16.1	3.92	2.70	2.81	23.2	29.4
25	16.9	19.1	10.7	8.85	14.6	14.3	16.1	3.92	2.70	2.60	65.5	-
26	26.0	17.9	9.6	8.43	16.5	12.1	12.8	3.92	2.70	3.92	41.6	-
27	20.0	16.3	8.95	7.81	12.5	11.8	11.1	3.92	2.76	4.37	39.1	-
28	14.8	15.4	8.11	7.33	12.8	10.3	9.94	3.85	3.03	5.71	29.1	-
29	13.0	-	7.71	7.33	11.3	10.1	9.27	3.73	3.73	3.79	20.7	-
30	12.0	-	7.71	7.24	9.82	31.6	8.74	3.73	2.81	7.33	22.2	16.5
31	12.0	-	10.8	-	9.16	-	8.22	3.67	-	9.27	-	16.3
Mean	11.0	34.9	14.2	12.8	19.2	13.2	26.4	5.12	3.29	4.18	16.4	38.7
Maxi-mum	26.0	94.2	33.4	47.3	68.0	33.4	65.0	7.81	6.23	9.27	65.5	81.9
Mini-mum	6.05	10.9	7.71	7.24	6.59	7.71	8.22	3.67	2.70	2.60	4.05	16.3

Tjisokan at Tjihondje

Villege: Tjibarekbek Region: Tjiandjur

Place : On the left bank at Kampong Tjihondje

Daily report discharge in m^3/sec in 1924

Day	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1	19.3	16.5	16.3	79.7	36.1	12.2	-	4.22	4.01	45.8	75.0	45.8
2	18.0	14.9	16.9	62.5	31.7	13.7	-	4.36	4.50	46.2	53.9	59.1
3	21.9	15.8	16.7	63.4	25.6	17.3	-	4.15	3.94	15.8	59.1	45.8
4	19.3	27.7	22.9	60.0	20.2	13.9	-	3.87	5.00	9.36	47.9	42.0
5	15.2	22.6	19.9	60.8	17.5	19.1	-	3.80	5.48	7.20	39.6	30.6
6	14.2	17.1	16.7	62.1	20.6	15.6	9.24	3.80	5.64	6.40	32.0	26.5
7	13.7	14.4	28.3	49.2	20.9	12.8	7.60	4.01	4.01	7.90	29.3	28.6
8	13.1	24.2	26.8	36.1	27.1	11.1	6.80	4.43	6.60	8.30	25.6	21.6
9	26.2	20.4	26.8	55.2	38.4	19.3	6.40	4.29	7.60	11.90	29.0	23.9
10	17.7	31.0	27.4	49.2	39.6	18.4	6.12	4.15	8.60	11.5	22.1	66.0
11	13.4	37.2	29.3	34.6	23.9	13.4	5.88	3.87	-	12.1	17.1	36.1
12	11.2	30.6	41.2	42.0	29.6	11.3	5.88	3.80	-	38.0	14.4	20.6
13	10.3	22.4	33.4	56.1	-	10.3	5.56	3.66	-	22.6	19.3	17.5
14	10.3	46.6	36.8	47.1	-	9.36	5.32	3.54	-	65.1	21.9	16.5
15	10.2	49.6	55.7	49.2	-	9.00	5.24	3.48	-	77.6	16.3	14.7
16	9.72	31.3	40.8	50.5	-	8.80	5.08	3.48	-	47.1	31.3	13.7
17	9.48	23.4	37.6	41.6	-	8.60	5.00	3.66	-	31.7	28.3	15.4
18	16.1	20.4	31.7	32.0	19.3	8.20	4.92	3.54	-	32.7	28.0	14.2
19	13.4	18.2	42.0	29.3	21.6	7.80	4.78	3.48	5.56	29.3	31.0	13.6
20	48.4	16.7	29.9	30.6	21.4	-	4.71	3.54	5.96	25.6	23.4	17.5
21	25.9	15.9	41.2	80.2	18.2	-	4.64	3.54	4.85	22.6	17.1	13.6
22	29.9	14.5	39.2	51.2	16.1	8.00	4.57	6.40	5.00	16.5	15.6	13.0
23	90.9	13.7	29.9	39.2	18.0	7.10	4.57	8.40	3.60	13.0	20.9	46.2
24	49.2	34.2	37.6	35.3	17.7	6.80	4.50	5.48	3.36	11.2	14.7	44.5
25	37.6	22.6	47.5	30.3	14.7	6.70	5.88	4.50	3.25	12.2	14.5	28.0
26	32.4	18.6	59.1	27.1	23.9	6.50	5.48	3.66	3.20	15.6	15.9	38.4
27	38.4	17.1	63.0	37.2	22.6	6.30	4.71	3.54	3.10	14.5	23.7	36.4
28	37.2	16.9	53.9	29.6	17.8	6.60	4.36	3.30	3.00	11.6	85.3	31.3
29	34.9	15.8	48.8	29.6	15.1	-	4.22	3.42	4.15	17.8	75.4	24.2
30	24.8	-	52.1	27.1	13.4	-	4.22	3.60	14.9	18.0	54.4	33.1
31	19.7	-	59.1		12.8		4.08	3.94	-	40.0		22.9
Mean	24.3	23.1	36.4	45.9	22.5	11.1	5.37	4.09	5.24	24.00	32.7	29.1
Maxi-mum	90.9	49.6	63.0	80.2	39.6	19.3	9.24	8.40	14.9	77.60	85.3	66.0
Mini-mum	9.48	13.7	16.3	27.1	12.8	6.30	4.08	3.30	3.00	6.40	14.4	13.0

Tjisokan at Tjihondje

Villege: Tjibarekbek Region: Thiandjur

Place : On the left bank at Kampong Tjihondje

Daily report discharge in m^3/sec in 1925

Day	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1	20.5	62.3	12.3	31.5	23.6	4.26	3.17	2.80	2.40	2.53	4.93	7.9
2	19.0	41.7	17.8	24.9	48.5	4.06	3.15	2.80	2.40	2.53	6.9	6.0
3	17.8	29.0	16.9	27.1	40.7	3.98	3.07	2.78	2.41	3.41	4.11	6.0
4	26.3	26.5	13.2	23.5	27.8	3.84	3.04	2.71	2.41	5.1	3.74	6.8
5	21.4	20.4	12.6	29.5	22.7	3.84	3.04	2.70	2.45	3.74	3.53	8.3
6	65.9	17.8	12.5	42.3	19.3	3.80	2.99	2.69	2.48	3.11	3.25	9.4
7	68.2	22.7	12.4	59.6	19.2	3.74	2.91	2.69	2.49	3.41	3.12	10.0
8	22.8	28.4	11.4	36.5	17.3	3.80	2.91	2.81	2.47	4.64	3.11	11.7
9	20.5	24.9	10.2	26.4	14.5	3.78	2.97	2.92	2.48	4.23	3.15	11.6
10	24.4	18.2	9.2	22.5	16.0	3.70	2.99	2.84	2.48	3.07	7.2	29.4
11	26.6	19.5	8.6	18.9	14.6	3.60	2.99	2.87	3.14	2.87	14.7	24.8
12	24.7	16.7	8.5	19.5	12.5	3.54	3.00	2.80	3.88	2.79	5.1	18.0
13	20.8	14.4	10.7	17.2	11.4	3.63	2.92	2.71	3.52	2.69	13.9	14.9
14	16.1	13.9	11.1	14.7	10.6	3.73	2.89	2.71	4.45	2.66	21.4	13.2
15	15.6	20.4	11.9	12.9	9.8	3.56	2.89	3.27	4.63	2.58	14.3	17.9
16	17.0	18.3	10.3	11.6	9.5	3.48	2.89	3.39	5.1	2.56	12.5	13.4
17	15.0	18.3	9.7	10.7	9.6	3.41	2.90	2.88	3.89	2.86	19.6	21.5
18	14.4	17.7	8.9	11.6	11.0	3.42	3.56	2.71	3.30	4.16	9.9	20.6
19	14.8	19.4	12.1	13.0	10.1	3.35	4.73	2.61	3.00	7.0	8.7	13.4
20	20.0	20.2	16.6	12.9	8.9	3.27	3.68	2.59	2.82	4.37	11.2	16.4
21	15.2	28.4	15.5	11.9	8.3	3.31	3.51	2.58	2.80	4.05	11.0	15.1
22	20.5	20.5	13.7	12.8	8.2	3.34	3.30	2.58	2.80	3.28	6.5	12.5
23	24.1	18.6	14.7	37.2	7.9	3.33	3.99	2.54	2.84	3.26	9.1	14.1
24	22.0	18.1	18.0	21.6	7.3	3.30	3.75	2.57	3.23	2.85	9.1	16.0
25	23.5	16.4	16.6	40.6	6.9	3.28	3.09	2.52	3.36	3.44	8.7	20.3
26	20.7	14.0	15.9	25.6	6.6	3.28	2.97	2.52	2.88	4.90	7.4	22.4
27	20.9	13.0	25.9	31.3	6.4	3.18	2.89	2.51	2.72	3.48	6.6	59.5
28	18.2	12.5	29.0	39.3	6.1	3.14	2.81	2.51	2.62	2.99	6.1	32.1
29	15.4	-	26.6	33.2	5.9	3.17	2.79	2.50	2.55	2.70	6.6	31.9
30	16.0	-	29.1	30.4	6.0	3.22	2.70	2.43	2.56	2.62	8.2	23.4
31	37.5	-	30.4	-	6.1	-	2.76	2.40	-	2.61	-	20.2
Mean	23.4	21.9	15.2	25.0	14.0	3.54	3.14	2.71	3.02	3.44	8.46	17.7
Maxi-mum	68.2	62.3	30.4	59.6	48.5	4.26	4.73	3.39	5.1	7.0	21.4	59.5
Mini-mum	14.4	12.5	8.5	10.7	5.9	3.14	2.70	2.40	2.40	2.53	3.11	6.0

Tjisokan at Tjihondje

Villege: Tjibarekbek Region: Thiandjur

Place : On the left bank at Kampong Tjihondje

Daily report discharge in m^3/sec in 1926

Day	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1	16.7	18.0	25.5	23.1	8.1	17.9	5.0	2.9	2.1	1.5	10.1	15.9
2	25.8	15.4	37.9	24.4	10.9	17.0	4.7	2.8	11.4	1.5	9.7	20.0
3	29.9	15.4	43.3	30.4	11.3	12.1	4.5	2.7	4.5	1.5	6.9	19.1
4	24.9	14.3	33.4	21.7	13.6	13.7	4.6	2.8	2.9	1.5	6.5	15.3
5	26.1	18.2	34.7	20.1	21.9	26.8	4.5	2.8	4.1	1.5	8.7	11.8
6	18.8	41.4	27.7	23.0	23.9	34.2	4.3	2.8	2.6	2.3	11.5	12.2
7	16.4	28.4	31.2	25.7	16.0	23.2	4.2	2.8	2.2	2.4	7.1	18.2
8	18.3	27.5	39.9	23.2	20.2	15.5	4.1	2.7	1.8	2.7	5.2	29.4
9	16.5	34.5	58.5	17.8	14.6	12.7	4.4	2.6	1.7	3.5	4.4	25.6
10	15.1	28.5	58.2	15.5	24.2	11.3	5.1	2.5	1.7	2.3	4.1	18.1
11	12.5	24.0	39.8	21.4	27.0	10.4	6.9	2.6	1.7	6.9	4.6	14.8
12	11.3	23.5	46.1	19.9	18.5	9.9	11.9	2.5	2.2	11.3	8.8	13.0
13	11.1	29.7	31.3	14.8	15.8	9.0	5.5	2.5	3.3	15.0	13.7	18.8
14	9.9	30.1	23.7	13.0	13.1	8.6	4.7	2.3	2.2	41.6	16.4	15.9
15	8.6	26.8	21.9	12.9	32.1	8.3	4.2	2.4	1.7	55.3	20.1	14.3
16	7.8	36.2	32.4	12.0	32.0	7.8	4.1	2.4	1.9	18.2	28.9	14.8
17	11.9	27.3	35.0	11.0	23.4	7.7	3.8	2.4	3.6	20.8	19.5	14.9
18	11.9	28.3	25.7	10.4	25.6	8.6	3.7	2.4	3.4	15.3	16.6	12.0
19	12.6	24.7	19.2	10.6	36.6	10.1	3.5	2.2	2.2	12.1	15.2	12.4
20	12.2	20.0	20.6	10.5	41.3	8.7	3.4	2.1	2.5	46.4	19.3	11.5
21	10.7	23.8	18.7	11.6	39.8	7.0	3.4	1.9	3.1	55.8	18.1	11.0
22	15.3	22.7	14.7	9.9	33.0	6.5	3.3	1,9	2.0	43.4	40.4	12.9
23	17.9	18.9	15.2	9.8	32.0	7.4	3.2	1.9	1.8	18.1	61.3	10.3
24	25.5	35.3	15.7	10.8	29.3	9.6	5.1	1.9	1.7	11.7	26.9	9.7
25	21.8	40.2	18.7	10.8	26.3	8.1	4.8	3.2	3.1	8.4	19.0	19.3
26	21.8	42.2	14.9	10.2	19.2	6.1	3.6	6.7	2.6	6.5	14.8	18.6
27	32.7	36.0	23.8	8.7	16.4	5.7	3.2	4.4	3.4	14.4	12.4	16.6
28	32.5	26.2	24.2	8.0	14.6	5.4	3.2	2.5	2.1	32.9	13.2	23.9
29	41.1	-	28.5	8.7	13.2	5.2	3.1	2.0	1.8	18.4	15.7	27.8
30	45.0	-	34.9	9.0	12.2	5.1	2.8	1.8	1.7	14.6	16.2	21.0
31	23.2	-	26.5	-	11.6	-	2.8	1.7	-	9.8	-	19.6
Mean	19.5	27.1	29.7	15.3	21.9	11.3	4.4	2.6	2.8	16.1	15.8	16.7
Maxi-mum	45.0	42.2	58.5	30.4	41.3	34.2	11.9	6.7	11.4	55.8	61.3	29.4
Mini-mum	7.8	14.3	14.7	8.0	8.1	5.1	2.8	1.7	1.7	1.5	4.1	9.7

Tjisokan at Tjihondje

Village: Tjibarekbek Region: Tjiandjur

Place : On the left bank at Kanpong Tjihondje

Daily report discharge in m^3/sec in 1927

Day	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1	18.5	15.1	21.5	17.2	173.0	25.6	10.8	5.5	3.6	21.0	41.9	46.0
2	18.7	13.1	18.5	19.4	46.4	20.7	10.6	5.7	4.1	46.7	39.0	45.9
3	29.4	11.9	59.9	21.5	48.7	17.7	9.4	5.5	6.8	71.0	34.3	41.7
4	39.6	11.2	59.8	28.6	80.0	14.6	11.2	4.5	9.2	30.0	26.1	43.9
5	29.5	10.4	44.9	33.9	53.7	12.8	9.8	4.1	5.2	22.5	31.3	33.4
6	25.3	8.8	-	54.5	38.2	11.8	7.8	4.4	3.8	16.0	83.9	25.0
7	29.4	9.8	-	46.0	31.6	12.9	7.0	4.1	3.3	12.5	37.0	40.0
8	26.9	12.0	-	40.0	29.2	25.6	6.9	3.9	3.3	10.0	38.2	68.5
9	26.9	14.4	-	30.7	30.6	14.0	6.6	3.8	3.1	8.2	74.0	115.0
10	23.5	15.4	-	28.7	35.3	12.7	6.4	3.9	3.0	7.0	64.0	113.0
11	18.7	17.7	-	22.7	28.7	11.4	8.5	7.7	3.0	19.6	90.0	62.8
12	19.8	24.5	-	19.3	23.7	10.9	10.0	6.9	2.7	36.0	63.3	50.0
13	41.3	18.4	-	18.3	21.7	10.4	8.0	6.0	2.7	23.5	39.9	43.4
14	29.2	12.0	18.3	18.0	30.5	9.1	7.4	4.3	2.8	20.2	32.3	34.9
15	22.2	9.8	17.1	17.4	25.7	9.0	5.9	3.8	2.5	20.0	50.8	35.9
16	21.6	8.7	17.3	14.9	20.5	9.0	5.5	3.5	2.5	13.1	37.4	41.2
17	19.1	11.1	15.1	16.5	19.5	8.1	5.4	3.5	2.8	14.6	32.8	53.5
18	22.4	10.8	15.4	17.1	18.1	8.1	5.3	4.2	2.8	11.2	48.0	54.0
19	21.3	9.7	12.7	-	24.5	8.1	5.1	3.5	2.6	16.7	78.5	44.7
20	19.5	8.8	11.5	-	33.8	8.4	4.9	3.3	2.2	18.5	43.4	32.9
21	19.5	14.2	11.6	-	31.3	13.1	6.8	3.2	2.7	16.4	29.9	34.0
22	19.8	37.0	10.2	-	30.0	14.2	17.9	3.7	3.2	13.8	24.1	31.1
23	20.9	23.7	9.6	-	27.9	16.0	10.0	23.3	4.0	19.6	22.6	26.4
24	19.7	19.0	11.9	-	24.2	11.0	6.5	33.5	5.4	19.3	28.8	25.2
25	25.9	16.0	18.6	39.6	19.1	9.2	6.0	15.8	4.5	11.0	22.6	24.9
26	38.2	26.6	35.2	28.9	16.9	7.4	5.3	10.0	20.7	9.2	22.6	20.5
27	39.0	22.1	26.7	33.6	15.4	20.6	5.0	6.9	50.7	8.2	25.9	18.7
28	31.3	21.8	21.9	31.7	20.3	26.1	5.1	5.4	29.9	8.1	29.9	21.9
29	24.4	-	19.6	32.0	25.7	15.6	4.9	6.2	13.9	9.6	32.6	33.8
30	20.9	-	15.9	77.0	26.1	12.5	5.1	4.3	9.6	10.5	59.2	40.4
31	17.5	-	14.0	-	33.0	-	5.6	3.8	-	16.9	-.	38.6
Mean	25.2	15.5	22.1	29.5	34.9	13.6	7.4	6.7	7.2	18.7	42.8	43.3
Maxi-mum	41.3	37.0	59.9	77.0	173.0	26.1	17.9	33.5	50.7	71.0	90.0	115.0
Mini-mum	17.5	8.7	9.6	14.9	15.4	7.4	4.9	3.2	2.2	7.0	22.6	18.7

Tjisokan at Tjihondje

Villege : Tjibarekbek Region : Tjiandjur

Place : On the left bank at kampong Tjihondje

Daily report discharge in m^3/sec in 1928

Day	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1	22.5	36.8	19.3	41.9	13.5	19.8	12.1	4.9	11.1	2.9	15.2	34.5
2	21.7	49.3	17.0	41.3	15.0	14.3	11.3	5.6	9.0	2.8	20.4	50.6
3	18.7	40.0	16.1	41.5	13.6	11.3	17.0	7.0	6.0	2.4	22.6	55.1
4	17.7	32.0	14.9	42.1	11.6	10.9	13.5	5.5	5.4	2.4	31.6	39.4
5	22.5	24.9	14.2	41.2	11.9	10.3	14.8	10.5	5.5	2.4	30.6	37.9
6	24.4	25.3	14.5	40.0	12.0	9.9	15.2	21.4	4.8	4.3	29.6	48.8
7	23.4	24.3	13.1	31.2	13.2	8.9	14.7	13.4	4.6	13.0	28.8	42.5
8	23.4	20.7	11.9	31.0	14.2	8.5	11.0	13.0	4.6	5.3	25.6	33.7
9	33.1	18.2	11.7	29.0	11.1	22.0	9.9	11.2	4.2	3.9	28.4	40.0
10	35.1	16.3	17.4	47.9	10.0	25.3	9.0	6.5	6.1	6.1	28.5	45.2
11	37.7	16.8	22.0	40.1	9.5	15.2	8.4	6.5	4.9	4.0	21.6	50.8
12	51.0	18.4	16.5	30.8	9.4	27.0	8.2	5.2	4.2	20.4	21.6	43.9
13	42.6	19.3	22.1	25.2	8.9	14.5	8.0	4.7	3.9	18.6	20.1	34.1
14	40.2	22.8	24.9	23.5	8.7	11.8	7.8	5.0	3.8	29.4	16.5	27.6
15	42.0	18.5	23.7	40.2	10.6	12.1	7.4	5.4	3.4	17.2	25.2	27.7
16	36.0	17.3	19.6	61.3	15.2	32.3	7.0	9.4	3.2	19.9	29.5	25.1
17	37.3	14.8	15.5	49.4	36.9	15.9	6.5	9.4	3.2	21.4	36.8	22.2
18	31.8	14.2	25.0	35.1	25.4	17.8	8.7	14.2	3.0	17.0	39.4	30.6
19	25.6	20.0	39.9	40.8	20.8	21.9	12.3	18.8	4.6	13.5	52.2	37.6
20	21.7	21.8	35.2	50.4	20.2	21.7	9.4	9.0	4.9	10.0	41.5	52.2
21	18.9	23.0	29.2	38.8	46.1	18.2	7.4	6.4	5.3	8.8	47.1	40.7
22	17.3	20.3	31.8	34.1	21.5	20.6	7.0	5.4	6.2	7.4	42.9	27.8
23	16.1	17.9	34.4	28.0	15.9	30.7	6.8	5.0	5.4	9.5	29.5	25.6
24	15.0	15.6	33.4	23.3	14.8	46.4	10.1	4.6	3.6	10.0	25.5	26.2
25	17.2	26.4	29.0	20.1	15.5	23.1	8.6	4.4	3.3	7.2	27.3	22.2
26	13.8	32.2	37.0	18.1	13.7	17.8	7.6	4.5	5.0	7.4	22.0	20.1
27	20.6	23.1	38.5	16.5	12.0	15.3	6.1	6.7	3.6	7.3	18.4	18.9
28	58.9	19.6	29.5	15.5	11.0	14.4	5.6	11.7	4.1	16.0	20.7	19.8
29	34.6	18.0	31.2	15.3	10.5	15.5	5.0	16.7	3.8	15.7	22.9	19.3
30	25.0		28.2	14.1	9.5	14.0	4.7	14.4	4.0	12.0	24.4	18.5
31	25.9		30.5		10.1		4.9	12.5		9.4		17.3
Mean	28.1	23.0	24.1	33.6	15.2	18.2	9.2	9.0	4.8	10.6	28.2	33.4
Maximum	58.9	49.3	39.9	61.3	46.1	46.4	17.0	21.4	11.1	29.4	52.2	55.1
Minimum	13.8	14.2	11.7	14.1	8.7	8.5	4.7	4.4	3.0	2.4	15.2	17.3

Tjisokan at Tjihondje

Villege : Tjibarekbek Region : Tjiandjur

Place : On the left bank at kampong Tjihondje

Daily report discharge in m^3/sec in 1929

Day	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1	17.5	43.0	41.0	14.7	29.9	11.3	6.9	3.4	2.2	2.2	6.3	32.5
2	17.6	45.2	37.9	16.8	24.7	21.1	6.4	3.1	2.1	2.2	9.2	20.1
3	18.0	37.2	44.2	17.0	37.7	35.6	6.0	2.9	2.1	2.7	7.4	23.3
4	19.2	30.7	35.9	15.4	43.9	14.7	5.6	2.9	2.1	2.9	4.9	24.8
5	20.9	37.4	27.0	17.1	34.2	12.4	5.3	2.9	1.9	3.2	4.7	43.2
6	21.9	50.5	32.3	14.4	30.0	12.0	4.9	2.9	1.9	2.4	8.8	51.2
7	25.6	47.5	26.9	12.7	22.1	23.1	4.8	2.7	3.2	2.1	23.5	43.4
8	22.9	40.8	24.4	13.3	18.3	17.0	4.5	2.7	4.1	9.4	22.6	62.3
9	26.4	39.9	26.2	14.7	18.2	25.2	4.4	2.6	3.3	19.3	26.0	42.2
10	34.3	45.6	29.0	16.1	16.3	18.8	4.2	2.5	2.5	15.5	30.8	37.6
11	112.0	47.5	35.4	15.5	14.0	13.7	4.2	3.0	2.0	6.8	21.3	30.9
12	67.3	37.4	38.6	13.0	13.4	10.7	4.0	7.5	2.0	7.5	15.2	29.9
13	42.3	33.2	51.9	31.3	12.7	9.4	4.0	4.4	1.7	4.9	11.3	38.6
14	57.2	30.5	41.6	30.3	12.3	8.3	4.0	3.0	2.6	5.1	11.7	29.4
15	60.1	27.8	38.1	58.5	11.5	7.8	3.9	2.5	5.6	4.0	15.8	26.3
16	44.6	30.2	47.7	48.6	10.5	7.4	3.9	2.6	8.0	3.4	15.1	27.1
17	39.0	28.5	36.4	51.6	10.0	7.0	3.9	3.1	6.0	2.8	16.2	33.6
18	37.1	25.2	32.2	35.3	9.7	6.9	3.7	2.4	2.9	2.4	17.9	31.1
19	35.5	21.9	28.7	46.1	10.2	6.6	3.5	2.2	2.2	2.5	16.5	24.4
20	32.5	19.6	26.3	49.2	10.0	6.4	3.4	2.3	1.9	2.5	14.0	21.0
21	36.2	22.9	24.3	38.5	9.6	6.5	3.4	2.4	1.9	7.0	14.2	18.7
22	32.1	19.7	23.5	29.9	9.2	6.3	3.4	2.3	1.8	7.7	17.3	16.0
23	30.3	25.2	21.3	30.3	14.6	6.0	3.3	2.3	2.7	11.9	9.8	14.2
24	34.7	29.6	20.5	25.3	13.1	5.5	3.3	4.4	2.9	9.4	7.6	13.9
25	48.9	27.4	19.5	19.2	9.7	5.5	3.3	4.3	1.8	4.6	9.8	14.6
26	57.1	36.8	17.5	26.4	8.5	6.8	3.3	3.8	1.7	3.5	13.5	12.7
27	55.1	38.9	17.8	17.6	8.0	20.4	3.8	2.9	1.7	3.1	30.3	11.1
28	77.2	38.2	17.1	30.5	7.8	14.1	4.3	2.6	1.7	3.6	29.2	11.7
29	55.8		17.9	28.5	11.2	8.4	7.1	2.4	1.9	11.0	24.9	15.6
30	42.5		16.8	30.4	13.3	7.5	5.2	2.3	2.0	10.3	32.7	31.7
31	37.2		16.1		8.6		3.7	2.2		6.6		33.0
Mean	40.6	34.2	29.5	26.9	16.2	12.1	4.4	3.0	2.7	5.9	16.3	27.9
Maxi-mum	112.0	50.5	51.9	58.5	43.9	35.6	7.1	7.5	8.0	19.3	32.7	62.3
Mini-mum	17.5	19.6	16.1	12.7	7.8	5.5	3.3	2.2	1.7	2.1	4.7	11.1

Tjisokan at Tjihondje

Villege : Tjibarekbek Region : Tjiandjur

Place : On the left bank at kampong Tjihondje

Daily report discharge in m^3/sec in 1930

Day	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1	31.9	17.3	35.7	20.8	65.4	13.3	5.6	5.3	3.1	18.1	33.4	57.6
2	20.3	15.8	35.9	18.3	51.8	12.3	5.7	5.3	2.9	8.1	44.8	44.6
3	15.4	14.1	27.9	18.5	61.9	13.7	6.9	4.5	2.7	4.1	45.2	34.4
4	34.5	13.0	32.9	20.2	74.0	20.9	6.0	4.1	2.4	3.9	37.1	27.5
5	44.6	13.3	40.8	20.7	61.3	23.6	5.7	4.2	2.4	8.8	32.1	24.6
6	36.4	24.9	28.6	24.2	46.3	21.0	5.4	4.3	2.2	47.0	24.2	70.4
7	27.1	18.8	22.5	20.4	60.1	16.2	5.2	3.7	2.2	21.3	20.8	55.1
8	24.5	18.3	30.8	23.1	59.4	17.3	5.2	4.0	4.0	30.4	19.4	50.6
9	23.1	15.8	35.7	25.7	47.5	14.0	5.1	4.3	4.2	22.3	17.0	47.3
10	16.2	14.6	35.7	21.2	41.3	12.8	4.8	3.7	2.4	19.6	12.4	35.0
11	13.4	12.0	39.4	16.6	38.9	11.4	4.6	3.3	2.8	27.1	15.6	39.5
12	12.0	11.9	44.6	24.1	33.8	10.5	4.8	3.2	2.7	12.5	34.2	31.4
13	11.4	12.8	57.7	27.9	39.6	9.6	4.7	3.3	2.3	12.4	35.6	29.3
14	9.5	15.1	41.0	32.3	53.1	10.0	4.4	3.3	2.3	15.9	25.9	27.6
15	8.2	15.6	33.9	37.8	60.0	10.0	4.2	3.3	2.2	8.5	25.1	27.9
16	7.2	11.6	27.5	29.0	37.1	20.7	4.1	3.1	2.2	6.1	31.0	33.4
17	9.7	10.0	36.4	37.4	47.8	20.6	4.6	3.1	2.3	6.7	29.7	32.1
18	9.8	10.0	29.8	72.7	44.9	11.5	4.7	3.4	2.2	6.5	28.0	27.0
19	15.5	10.3	21.9	70.5	52.8	9.3	4.6	3.2	2.0	6.1	29.2	22.0
20	14.8	13.2	27.3	44.0	54.9	8.1	5.1	2.8	3.7	4.6	28.5	21.7
21	23.6	19.4	29.0	51.0	35.5	8.7	7.5	2.7	3.9	7.9	27.6	20.1
22	22.6	19.4	31.9	42.4	30.5	8.3	6.2	2.6	2.7	8.2	35.4	16.5
23	25.2	40.8	34.7	44.2	32.8	7.9	7.6	2.5	2.3	17.2	34.9	14.5
24	17.8	49.5	36.5	57.5	33.3	7.7	20.1	2.5	1.9	29.4	24.5	12.7
25	13.8	40.9	36.2	49.7	28.8	7.4	10.7	2.5	1.8	28.9	22.2	13.0
26	16.0	39.7	37.8	47.6	24.1	7.2	7.9	2.7	1.7	20.6	22.5	11.9
27	18.0	47.6	64.1	43.6	21.8	6.6	7.2	3.2	1.7	16.0	51.4	12.0
28	17.4	44.8	38.8	39.0	20.2	6.4	10.0	2.7	1.7	13.2	41.4	11.5
29	34.3		31.9	42.2	18.4	5.9	6.8	2.4	1.6	18.3	40.4	10.5
30	27.3		30.6	49.5	16.5	5.8	4.8	2.8	7.5	26.4	80.0	9.8
31	19.4		24.9		14.7		6.3	3.7		45.9		9.5
Mean	20.0	21.1	34.9	35.8	42.2	12.0	6.3	3.4	2.7	16.8	31.7	28.4
Maxi-mum	44.6	49.5	64.1	72.7	74.0	23.6	20.1	5.3	7.5	47.0	80.0	70.4
Mini-mum	7.2	10.0	21.9	16.6	14.7	5.8	4.1	2.4	1.6	3.9	12.4	9.5

Tjisokan at Tjihondje

Villege : Tjibarekbek Region : Tjihondje

Place : On the left bank at kampong Tjihondje

Daily report discharge in m^3/sec in 1931

Day	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oce.	Nov.	Dec.
1	10.5	35.6	82.6	17.6	26.7	27.1	10.6	8.7	12.4	5.9	40.9	11.1
2	14.6	31.2	71.8	14.9	22.7	24.7	8.5	18.5	21.1	8.7	37.5	14.3
3	13.0	25.2	120.0	13.1	21.9	23.1	8.1	8.5	9.6	10.8	36.9	11.8
4	11.8	21.8	70.5	11.5	22.9	19.9	8.1	6.7	8.8	13.2	41.2	9.2
5	15.1	18.3	60.0	10.5	20.8	21.7	7.7	10.4	10.9	8.0	35.8	8.2
6	14.2	15.6	111.0	9.4	17.8	19.8	7.3	16.4	8.7	5.9	29.3	8.8
7	27.4	20.2	64.3	8.8	16.5	17.5	6.9	7.8	5.1	4.9	24.6	15.6
8	29.0	47.7	63.8	11.1	32.9	17.5	6.5	6.4	3.8	4.4	20.0	26.8
9	18.9	29.0	54.3	13.7	26.1	17.0	6.1	6.4	4.0	5.0	18.4	28.1
10	15.4	21.8	70.5	21.3	18.7	16.9	5.8	(6.6)	6.3	4.4	19.4	35.6
11	15.0	25.3	80.0	28.3	17.5	16.4	5.8	6.3	5.1	3.6	17.1	23.9
12	22.1	47.2	62.2	23.4	16.8	16.0	5.6	5.8	4.9	3.4	13.9	27.2
13	20.8	26.3	49.4	21.6	15.1	16.7	7.0	5.4	6.4	4.5	11.8	35.5
14	15.2	20.3	47.3	29.6	14.3	14.9	10.3	4.8	4.2	5.4	10.3	36.3
15	14.5	17.7	41.4	22.4	17.6	13.1	8.4	4,7	2.8	6.6	9.5	32.4
16	20.5	27.9	78.3	27.2	18.8	12.5	5.8	4.6	3.2	10.7	8.8	27.0
17	25.7	26.3	83.5	25.6	22.5	11.4	5.0	4.2	3.6	20.5	8.7	23.4
18	22.9	33.1	55.0	25.7	30.2	11.8	4.6	4.2	3.3	31.8	10.0	22.5
19	24.0	22.8	47.5	22.5	27.5	11.0	4.2	4.1	3.2	25.6	11.8	26.3
20	24.5	25.4	39.3	62.9	24.4	10.6	4.3	4.0	2.8	11.8	13.2	34.7
21	20.0	43.5	32.5	65.7	22.2	11.9	5.0	15.8	2.6	8.7	11.7	31.0
22	18.7	53.3	30.8	50.9	34.9	11.3	9.7	20.2	3.0	10.9	10.9	26.6
23	20.1	49.3	21.9	69.3	31.0	11.7	16.3	7.5	5.5	25.1	11.9	30.7
24	18.1	35.5	27.4	37.3	37.1	19.3	9.5	6.3	6.5	17.7	15.9	36.8
25	24.6	61.7	25.8	31.8	38.3	16.0	10.9	5.1	7.1	31.0	18.2	42.6
26	24.9	53.0	24.2	36.4	32.7	11.6	11.1	4.4	9.2	18.0	12.7	69.1
27	27.1	38.2	22.6	30.0	31.8	12.8	11.1	4.3	4.5	35.9	15.4	66.7
28	37.6	41.2	21.0	28.5	24.5	10.1	9.7	8.0	4.9	39.6	11.3	54.7
29	32.4		19.6	36.3	20.9	17.0	8.6	17.8	3.2	25.4	10.8	41.2
30	46.4		17.1	26.7	21.1	12.6	8.7	11.7	3.3	20.9	10.0	46.0
31	38.1		16.4		42.8		12.2	6.9		37.0		67.7
Mean	22.0	32.7	51.9	27.8	24.8	15.8	8.0	8.1	6.0	15.0	18.3	31.4
Maxi-mum	46.4	61.7	120.0	69.3	42.8	27.1	16.3	20.2	21.1	39.6	41.2	69.1
Mini-mum	10.5	15.6	16.4	8.8	14.3	10.1	4.2	4.0	2.6	3.4	8.7	8.2

Tjisokan at Tjihondje

Villege: Tjibarekbek Region: Tjiandjur

Place : On the left bank at Kampong Tjihondje

Daily report discharge in m^3/sec in 1932

Day	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1	55.6	10.3	16.7	39.6	20.2	15.8	9.5	4.7	3.0	5.8	9.1	22.5
2	47.2	9.7	29.3	46.0	17.3	14.2	13.8	4.3	3.0	4.4	7.0	14.7
3	47.2	9.7	20.4	41.7	13.4	14.1	8.7	4.1	3.1	3.6	7.8	13.1
4	33.9	7.4	31.6	57.2	12.1	12.2	7.9	4.0	3.1	3.2	8.2	20.0
5	28.3	11.4	27.6	39.2	11.9	10.7	9.5	3.7	3.0	2.99	12.4	21.9
6	26.8	18.1	19.2	29.8	12.9	9.7	12.8	3.7	2.89	2.88	10.2	19.4
7	25.4	13.4	16.6	23.0	13.4	9.5	9.8	5.6	2.91	2.88	9.6	19.5
8	23.8	9.5	14.5	26.2	12.8	10.9	7.5	10.2	3.9	3.2	12.8	31.7
9	29.3	14.0	18.3	29.4	13.8	9.4	6.9	5.9	2.93	3.9	10.2	32.2
10	31.0	17.5	17.4	25.0	12.7	9.2	6.8	4.6	3.0	4.7	6.7	28.9
11	24.6	12.3	25.5	26.3	11.6	8.5	6.3	3.8	3.0	4.0	5.2	27.3
12	24.0	15.0	33.8	27.6	13.4	15.4	5.9	3.7	3.1	4.4	5.0	31.7
13	25.8	15.8	29.0	28.7	31.0	21.6	5.5	3.6	6.8	4.4	5.2	29.6
14	21.4	17.2	42.8	30.6	63.2	12.0	5.7	3.5	5.8	3.5	7.4	25.0
15	21.9	37.3	27.0	31.5	48.4	13.3	5.7	3.4	5.7	4.6	13.5	22.0
16	21.2	24.4	26.6	32.8	48.7	17.0	5.6	3.3	2.43	6.9	12.3	18.9
17	19.3	28.6	29.5	34.1	34.9	14.3	5.1	3.1	3.9	8.3	12.2	17.3
18	17.5	26.8	29.3	35.4	35.2	12.7	5.0	3.1	3.2	6.8	21.7	16.1
19	16.1	20.9	23.7	36.4	29.6	19.1	6.0	3.1	2.79	6.8	33.4	17.3
20	16.8	24.2	25.5	38.6	23.5	17.8	5.6	3.3	2.55	7.5	29.3	14.5
21	21.2	24.3	22.8	39.8	20.7	10.1	4.6	3.4	2.45	9.3	17.7	12.6
22	42.6	16.9	20.1	40.7	16.3	10.7	4.4	3.3	2.40	8.2	15.9	15.1
23	46.6	14.6	29.2	42.0	16.2	17.2	4.5	3.2	2.40	6.8	14.0	12.6
24	24.1	14.7	24.6	32.0	18.7	30.8	4.4	3.1	2.48	20.7	15.9	10.1
25	18.4	12.6	26.2	25.1	17.1	26.9	4.3	3.2	2.57	13.2	17.2	9.0
26	15.4	12.1	23.6	24.9	16.1	17.8	4.4	3.8	17.4	16.9	13.3	8.5
27	12.6	13.9	26.3	23.3	18.8	15.7	7.3	4.8	25.6	11.8	10.9	7.8
28	11.0	13.1	29.0	19.6	14.2	11.0	7.4	3.9	17.9	9.6	13.7	7.4
29	13.4	15.5	26.9	19.3	15.5	11.9	5.4	3.3	14.4	20.8	20.8	6.8
30	15.2		29.0	19.2	22.1	11.6	4.8	3.1	7.8	10.5	30.2	6.6
31	12.8		25.5		17.4		6.4	3.0		12.3		6.9
Mean	25.5	16.6	25.4	32.2	21.7	14.4	6.7	4.0	5.5	7.6	13.6	17.6
Maxi-mum	55.6	37.3	42.8	57.2	63.2	30.8	13.8	10.2	25.6	20.8	33.4	32.2
Mini-mum	11.0	7.4	14.5	19.2	11.6	8.5	4.3	3.0	2.40	2.88	5.0	6.6

(3) Meteorological Date at Djakarta, Bogor and Bandung

	Latitude	Longitude	Elevation
Tjihea	6° 50' S	107° 10' E	260.0 m
Djakarta	6° 11' S	106° 50' E	8.0 m
Bogor	6° 35' S	106° 48' E	250.0 m
Bandung	6° 55' S	107° 36' E	730.0 m

	Day of Rainfall (days)	Hours of Rainfall (hr)	Evaporation (mm/day)	Humidity (%)	Cloudiness	Sunshine (%)	Thunder Storm
Djakrata	162	329	1.7	83	6.2	67	134
Bogor	251	603	2.2	81	6.8	57	287
Bandung	221	498	2.5	77	—	64	—

Metorology at Bogor, Djakarta and Bandung

Item / Place \ Month		1	2	3	4	5	6	7	8	9	10	11	12	Mean
Maximum	Bogor	28.9	29.0	29.5	30.2	30.3	29.9	30.1	30.7	31.0	30.8	30.3	29.4	30.0
Temperature	Djakarta	28.8	28.8	29.0	30.3	30.4	30.2	30.1	30.5	30.9	30.9	30.4	29.5	30.0
°C	Bandung	27.0	27.0	27.3	27.8	27.7	27.6	27.9	28.6	28.9	28.7	28.0	27.3	27.8
Minimum	Bogor	21.8	21.8	21.9	22.2	22.1	21.7	21.1	21.3	21.7	22.0	22.0	22.0	21.8
Temperature	Djakarta	23.3	23.3	23.5	23.7	23.6	23.2	22.8	22.7	23.0	23.3	23.5	23.3	23.3
°C	Bandung	19.4	19.2	19.2	19.3	18.9	18.0	17.1	17.0	17.8	18.4	18.8	19.2	18.4
Mean	Bogor	24.6	24.6	24.8	25.3	25.4	25.1	25.1	25.3	25.5	25.4	25.2	24.9	25.1
Temperature	Diakarta	25.7	25.6	26.0	26.5	26.6	26.3	26.1	26.3	26.6	26.7	26.4	25.9	26.2
°C	Bandung	22.4	22.4	22.5	22.7	22.7	22.3	22.1	22.4	22.8	22.8	22.5	22.4	22.5
Daily	Bogor	7.0	7.2	7.6	8.0	8.2	8.3	9.0	9.5	9.4	8.8	8.8	7.4	8.2
Variation	Djakarta	5.5	5.5	6.2	6.6	6.8	6.9	7.4	7.8	7.8	7.6	7.0	6.1	6.8
°C	Bandung	7.5	7.8	8.1	8.5	9.0	9.6	10.7	11.5	11.1	10.3	9.2	8.1	9.3
Rainfall	Bogor	354	352	368	401	354	249	191	227	312	417	389	320	327.8
mm	Djakarta	308	295	207	141	112	92	61	43	69	109	147	196	148.3
	Bandung	181	180	231	248	132	66	33	49	77	142	226	194	146.6