04

THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

FIELD REPORT

ON

THE MASTER PLAN SURVEY OF THE SECOND STAGE

FOR

THE IRRAWADDY BASIN

AGRICULTURAL INTEGRATED DEVELOPMENT PROJECT

JANUARY 1979.

JAPAN INTERNATIONAL COOPERATION AGENCY

THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

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JAPAN INTERNATIONAL COOPERATION AGENCY

His Excellency U Ye Goung,
Minister of Agriculture and Forests,
The Socialist Republic of the Union of Burma

Dear Sir,

Re: Submission of Report on the Master Plan Survey of the Second Stage for Irrawaddy Basin Agricultural Integrated Development Project

It is my great pleasure to submit herewith the Field Report of 20 copies on the Master Plan Survey of the Second Stage for Irrawaddy Basin Agricultural Integrated Development Project in compliance with the Scope of Works.

This report summarizes the current agricultural situation prevailing in the Project Area as well as some portion of measures to be taken up.

The final report which may comprise the study conducted so far and substantial parts of the study inclusive of project formulation, project evaluation and recommendation will be concluded fully conforming to intentions of the Burmese Government during the next stage.

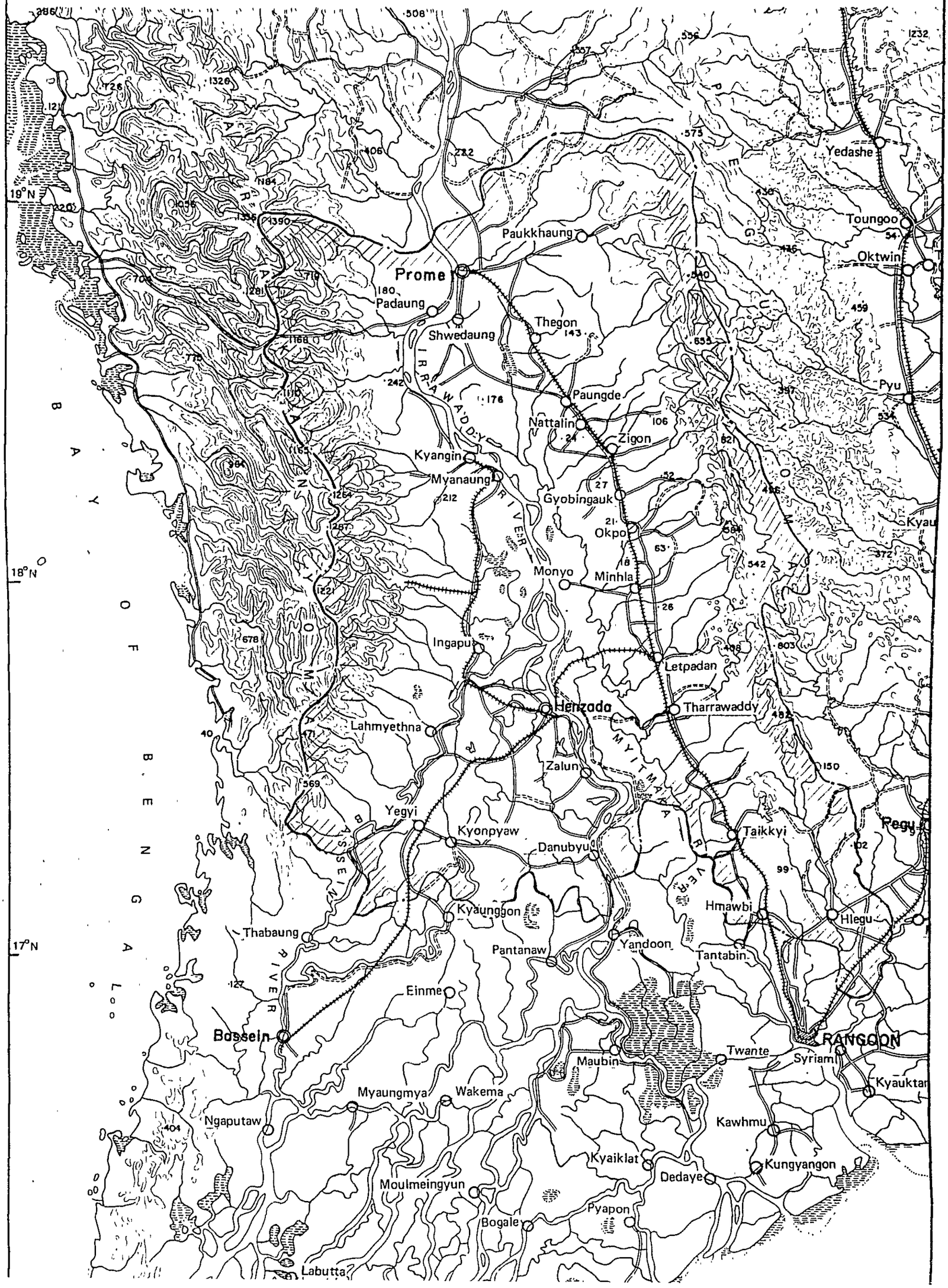
In this occasion, I would like to express my deep appreciation for sincere cooperation and assistance extended to us by you and your staff throughout the course of our study in your country.

I remain,

Yours faithfully,

HEIJIRO YOSHIHARA
Team Leader
The Master Plan Survey Team
of the Second Stage for the
Irrawaddy Basin Agricultural
Integrated Development Project.

GENERAL MAP


19°N
18°N
17°N
BAY OF BENGAL
Prome
Padaung
Shwedaung
Thegon
Paukkhaung
Yedashe
Toungoo
Oktwin
Pyu
Paungde
Nattalin
Zigon
Kyangin
Myanaung
Gyobingauk
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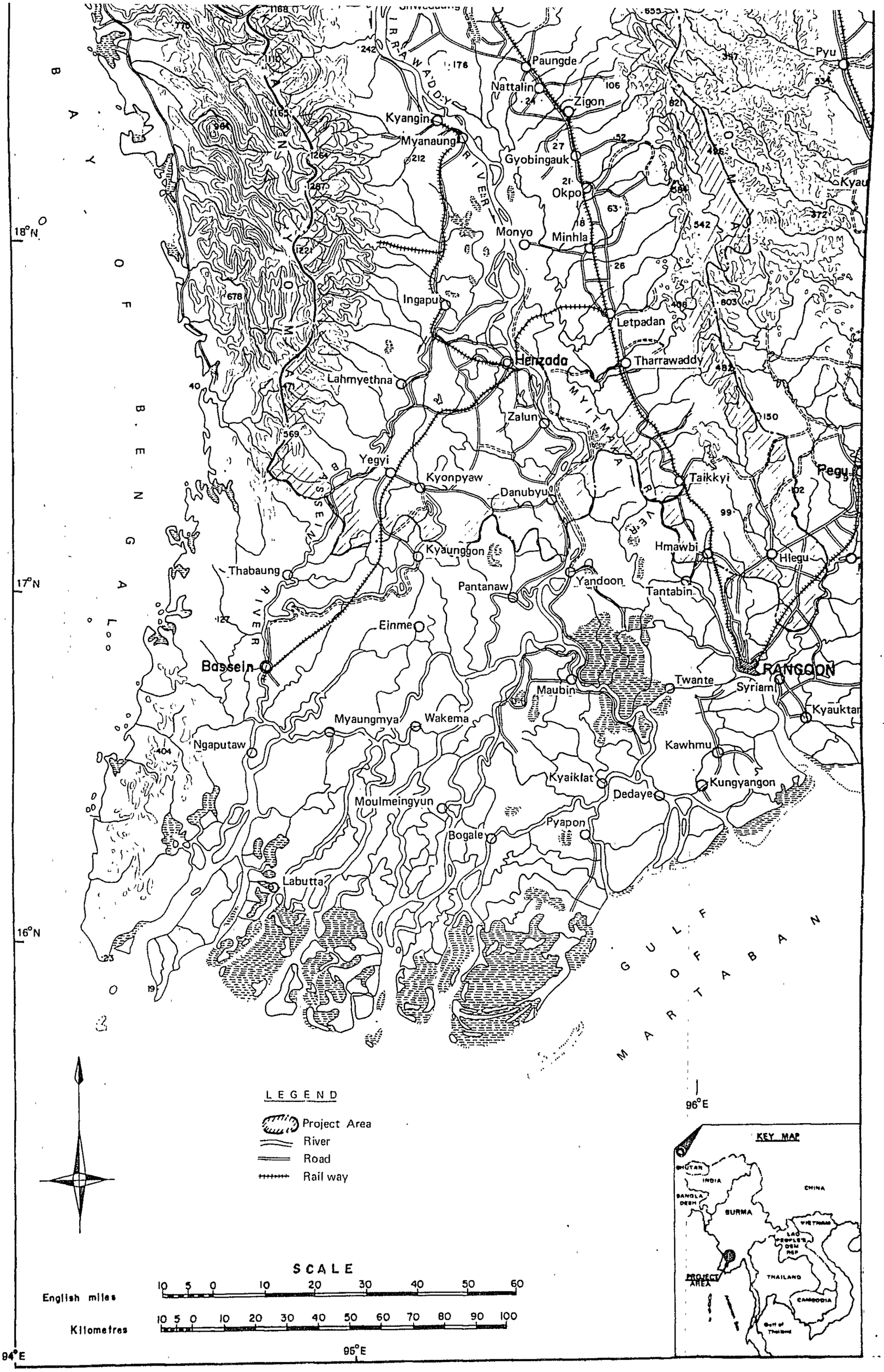
Taikkyi
Hmawbi
Hlegu
Kyaunggon
Thabaung
Pantanaw
Yandoon
Tantabin
Einme
Bassein
RANGOON
Twante
Syriam
Maubin
Myaungmya
Wakema
Ngaputaw
Kawhmu
Kyaiklat
Dedaye
Kungyangon
Moulmeingyun
Pyapon
Bogale
Labutta
IRRAWADDY RIVER
BASSEIN RIVER
MYITMAKA R.
YEZA R.
PEGU YOMA
ARAKAN YOMA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G U L F O F M A R T A B A N
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Kawhmu
Kyauktan
Kyaiklat
Kungyangon
Dedaye
Moulmeingyun
Pyapon
Bogale
Labutta
IRRAWADDY RIVER
NGAWUN RIVER
BASSEIN RIVER
MYITMAKA RIVER
YOMA
18°N
17°N
16°N
94°E
95°E
96°E
LEGEND
Project Area
River
Road
Rail way
SCALE
English miles
10 5 0 10 20 30 40 50 60
Kilometres
10 5 0 10 20 30 40 50 60 70 80 90 100
KEY MAP
BHUTAN
INDIA
BANGLA DESH
BURMA
CHINA
VIETNAM
LAO PEOPLE'S DEM REP
THAILAND
CAMBODIA
PROJECT AREA

MEMBER OF THE MISSION

Project Planning (Leader)	Mr. Heijiro YOSHIHARA	Director of Sanyu Consultants Inc.(SCI)
Regional Development	Mr. Kouki MITSUNOBU	Manager of Engineering Department, SCI
Regional Economy	Mr. Zenzaburo YAMAGUCHI	Technical Advisor, SCI
Agro-Economy	Mr. Yoshitomo MIYANISHI	Staff of Overseas Project Department, SCI
Hydrology	Mr. Hironori TAKAHASHI	Section Chief of Engineering Dept., SCI
Irrigation	Mr. Masahiro IIDA	Section Chief of Overseas Project Engineering Dept., SCI
Draingage & Polder	Mr. Nobuo ICHIJI	Technical Advisor, SCI
Soil	Mr. Hisashi ISHIKAWA	Technical Advisor, SCI
Agronomy	Mr. Chuzo SAIKA	Technical Advisor, SCI
Forestry	Mr. Eiji NITSUU	Staff of Overseas Project Dept., SCI
Inland Fishery	Mr. Toranosuke YOSHIMITSU	Technical Advisor, SCI
Hydro-Analysis	Mr. Toshinobu NAKANO	Staff of Engineering Dept., SCI

MEMBER OF COUNTERPART

NAME	STATUS
U Ba Aye	Executive Engineer Survey Section Irrigation Department
U Tha Tun Oo	Deputy General Manager Agriculture Corporation
U Way Phyo	Assistant Engineer Hydrology Section Irrigation Department

ITINERARY OF THE SURVEY TEAM
(1978/79)

DATE	DESCRIPTION
23rd Oct.	Left Japan for Bangkok
24th Oct.	Arrived in Burma Courtesy call to Japanese Embassy in Burma
25th Oct.	Courtesy call to Deputy Minister of the Ministry of Agriculture and Forests (MAF) and to the Planning and Statistic Department, MAF
26th Oct.	Meeting with the Advisory Group (AG)
27th Oct.	Courtesy call to Director General of Irrigation Department (ID), MAF
28th Oct.	Data collection from Departments and Corporations concerned
29th Oct.	Holiday
30th Oct.	Field survey with the AG
31st Oct.	National Holiday, Meeting with the AG Prepared the monthly report for JICA
1st Nov.	Field survey with the AG and meeting with Survey Department
2 - 3rd Nov.	Data Collection from Departments and Corporations Concerned
4th Nov.	- ditto -
5th Nov.	Holiday
6th Nov.	Data collection and arrangement
7th Nov.	Field Survey
8th Nov.	- ditto -

DATE	DESCRIPTION
9th Nov.	Mr. Mitsunobu arrived in Burma Field survey
10 - 15th Nov.	Field survey
16 - 18th Nov.	Data collection, arrangement and analysis
19th Nov.	Holiday
20 - 22nd Nov.	Data collection, arrangement and analysis
23rd Nov.	- ditto -
24th Nov.	National Holiday
25th Nov.	Field survey Data collection, arrangement and analysis
26th Nov.	Holiday
27 - 28th Nov.	Data collection and analysis
29 - 30th Nov.	Field survey, data collection and analysis Prepared the monthly report for JICA
1st Dec.	Field survey, data collection and analysis
2nd Dec.	Mr. Miyanishi arrived in Burma Field survey, data collection and analysis
3rd Dec.	Holiday
4 - 6th Dec.	Field survey, data collection and analysis
7th Dec.	Mr. Ichiji left for Japan
8th - 9th Dec.	Field survey, data collection and analysis
10th Dec.	Field survey, Holiday
11 - 16th Dec.	Field survey and data collection
17th Dec.	Holiday, Field survey
18 - 19th Dec.	Field survey and data collection
20th Dec.	Colombo Plan (c/p) experts, Messrs Goto and Shimada arrived in Burma, Field survey and data collection

DATE	DESCRIPTION
21 - 22nd Dec.	Field survey, data collection and analysis
23rd Dec.	Messrs Yamaguchi, Saika, Yoshimitsu and Nitgu left for Japan Field survey, data collection and analysis
24th Dec.	Holiday
25 - 26th Dec.	Data collection and analysis
27 - 30th Dec.	Field survey, data collection and analysis
31st Dec.	Holiday, prepared monthly report for JICA
1st Jan/1979	Holiday
2 - 3rd Jan	Field report preparation
4th Jan.	National Holiday
5 - 6th Jan.	Field survey and Field report preparation
7th Jan.	Holiday
8 - 13th Jan.	Field report preparation
14th Jan.	Holiday
15 - 20th Jan.	Field report preparation
21st Jan.	Holiday
22 - 23th. Jan.	Field report preparation
24th Jan.	Meeting with Burmese Government and the AG
25 - 27th Jan.	Field trip
28th Jan.	Holiday
29th Jan.	Meeting with the Japanese Embassy and the AG
30th Jan.	Leave for Bangkok
31st Jan.	Arrived in Japan

CONTENTS

ABBREVIATION MEASURES and GLOSSARIES

ABBREVATIONS

AC	Agriculture Corporation
ADB	Asian Development Bank
AMD	Agricultural Mechanization Department
APS	Advance Purchase System
Ave	Average
BKT	Basket (s)
CIF	Cost, Insurance and Freight
^{o}C	degree centigrade
DF	Department of Fishery, MAF
DG	Director General
DLWPSC	Divisional Level Work Program Scheduling Committe
DY	Deputy
EL	Elevation
FC	Foreign Currency
FD	Forest Department, MAF
FERD	Foreign Economic Relation Department
FIC	Foodstuff Industries Corporation
FOB	Freight on Board
F/S	Feasibility Study
FY	Fiscal Year (from April to March)
GM	General Manager
GNP	Gross National Product
HP	Housepower
HWL	High Water Level
HYV	High Yielding Variety (of paddy)
Hz	Hertz per second
IBRD	International Bank for Reconstruction and Development
ID	Irrigation Department
IDA	International Development Agency

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KV	Kilo Volt
KVA	Kilo Volt Ampere
KWH	Kilo Watt Hour
LC	Local Currency
LIV	Local Improved Variety
LS	Lump Sum
LWL	Low Water Level
LV	Local Variety
MAF	Ministry of Agriculture and Forests
MD	Managing Director
MHD	Meteorological and Hydrological Department
MI 1	Ministry of Industry No. 1
M/P	Master Plan
MPF	Ministry of Planning and Finance
MWL	Mean Water Level
NWS	Normal Surface Water
ph	Potential of Hydrogen
PPFC	Peoples's Pearl and Fishery Corporation, MAF
PPM	Pert (s) per Million
%	Per cent
PSD	Planning and Statistics Department, MAF
SD	Survey Department, MAF
SLRD	Settlement and Land Records Department, MAF
STA	Station
TC	Timber Corporation, MAF
TEM	Township Extension Manager
TSP	Triple Super Phosphorus
UCC	University Computer Center
UGCF	Union Government Consolidated Fund
V	Volt
VID	Village Track Banks

MEASURES

LENGTH

mm	millimeter (s)
cm	centimeter (s)
m	meter (s)
km	kilometer (s)
inch	25.4 mm
ft	foot (feet) = 12 inch = 30.48 cm
mile	5,280 feet = 1.609 km

AREA

sq.cm	square centimeter (s)
sq.m	square meter (s)
sq.km	square kilometer (s) = 100 ha
MSM	Million Square Meter (s)
ac	acre (s) = 4,047 sq.m
sq.mile	square mile = 2.59 sq.km = 640 ac
ha	hectare

VOLUME

l.	litter
cu.m	cubic meter
MCM	Million Cubic Meter
cu.ft	cubic foot (feet) = 28.32 l
cu.yd	cubic yard = 0.765 cu.m
AF	Acre Foot (feet) = 1,233.48 cu.m
Qt	quart = 1/4 gl = 1.136 l (UK) = 0.946 l (US)
gl	gallon = 4.543 l (UK) = 3.785 l (US)

Note; UK : British Measure
US : US Measure

WEIGHT

g	gram (s)
Kg	Kilogram (s)
ton	metric ton
Oz	Ounce = 28.4 g
lb	Pound = 16 Oz = 0.454 Kg
lg ton	long ton = 1,016 Kg

OTHERS

cm/sec	centimeter per second
m/sec	meter per second
Km/sec	Kilometer per second
mile / hr	mile per hour = 1.609 Km/hr = 0.447 m/sec
ft/sec	foot (feet) per second = 0.305 m/sec
cu.m/sec	cubic meter per second
cfs, cusec	cubic foot (feet) per second = 0.0283 cu.m/sec
gl/sec	gallon per second = 4.543 l/sec = 0.0757 l/min

GLOSSARY

lakh	100,000
crore	10,000,000
viss	1.633 Kg
Pyi	2,127 Kg
basket	20.9 Kg (paddy)
basket	34.0 Kg (rice)
bag	75.6 Kg (rice)
Apinthaung	Tidal flat
Chaung	River
Chaunggyi	Stream
Gyaung	stream or creek

Hlaing	Hill
In	Lake or swamp area
Inma	Lake
Kan	Pond
Kerser	Hill
Kho	Hill
Klo	Stream
Kundan	mountain range
Kwin	Well
Kyo	Hill
Kyun	Island
Law	Stream
Le	Hill, mountain range
Myaung	Stream
Paya	Pagoda = temple
Sagyet	Grazing ground
Sakan	Camping ground
San	Spring, stream
Taung	Mountain
Te	Hut
Tu	Mountain range
Yo	Stream
Yoma	Mountain range

I. Introduction

Brief History of the Project

1.01 In response to the request of the Government of the Socialist Republic of the Union of Burma, the Government of Japan dispatched the seven-member Preliminary Survey Team for about 40 days from 21st September to 29th October, 1977, to the field.

The Survey Team consulted with Burmese Authorities concerned to grasp the Government's concrete idea of the Irrawaddy River Basin Agricultural Integrated Development Project, furthering to outline the Project Area, to collect data concerning agriculture, forestry and fishery, and to conduct field investigation.

The Government of Japan, according to the Survey, has sent the twelve-member First Survey Team to the field for about 50 days from 6th February to 30th March, 1978, to make a master plan study. In the course of this survey, the South Nawin Dam Project has come up as the first priority project in due consideration on economical and technical evaluation of various irrigation projects and on the policy of the Burmese Government. The South Nawin Dam Project is one of the so-called "Quick-yielding Project" that the Burmese Government has been longing for. While the surveying, other general field investigation and data collection have been continuously carried out.

Purposes of the Second Survey

1.02 The Government of Japan, considering the fact that the Project covers a vast area and a wide range of survey fields like agriculture, forestry, fishery, etc, has provided a special advisory committee composed of experts and specialists in the respective fields, in the JICA.

According to advices by the Committee, the twelve-member Second Survey Team was dispatched to the field for about 100 days from 24th October 1978 to 30th January, 1979.

The Second Survey aimed at identifying projects in the respective fields of agriculture, forestry and fishery to draw up the outlines of the projects as well as to conduct continuous data collection and field investigation.

The Second Survey Team has carried out following surveys and investigations, accordingly.

i) Definite bordering of the Project Area
ii) Regional economy
iii) Agriculture
iv) Agri-supporting service (Extension)
v) Agro-economy
vi) Rivers, meteorology and hydrology
vii) Irrigation and drainage
viii) Soil
ix) Forestry
x) Fishery
xi) Further data collection
xii) Other related miscellaneous, etc.

Related activities

1.03 In compliance with the request of the Burmese Government, the Government of Japan dispatched a so-called S-W Mission (Mission for Scope of Work) for consultation with Burmese Authorities concerned regarding the Scope of Works of feasibility study for the South Nawin Dam Project proposed with top priority.

As a result that the Mission consulted with the Authorities concerned on 4th December, 1978, the Government of Japan has decided to carry out the first feasibility study on the South Nawin Dam Project for a period from January to March, 1979, and the second feasibility study will be conducted in the next fiscal year.

II. Background

II.1. Outline of economic planning

The Target

2.01 The 20-year economic plan has the target to grow the Gross Domestic Products (G.D.P.) by 5.9 percent annually so as to double the national income within 20 years. Along with this guideline the first, the second and the third four year plans have been executed up to now.

The third four year plan has started this year with the purpose of the following:

1) to be based on the principle of 20-year plan
2) to increase the productivity
3) to promote the export
4) to increase the investment by the State Enterprises, co-operatives and private enterprises
5) to upgrade the people's standard of living.

It has the target to grow the G.D.P. by 5.5 percent annually and at the end of the plan period by 19 percent on the basis of the price standard in 1969/70. For this purpose, the investment is planned to increase by 21 percent, the export by 12 percent, and the import by 13 percent.

The total public investment is shared as follows:

Sectoral Allocation of Public Investment in the Third Four Year Plan

Sr. No.	Sector	Percent of Total Public Investment	
1.	Agriculture, Livestock and Forestry		33.30
1).	Agriculture	18.76	
2).	Livestock and Fishery	9.38	
3).	Forestry	5.16	
2.	Mining		6.10
3.	Industry		26.75

Sr. No.	Sector	Percent of Total Public Investment
4.	Power	7.97
5.	Construction	3.75
6.	Transport and Communication	13.13
7.	Trade and Social Sectors	9.00
	Total	100.00

The investment in the sector of industry includes the investment for the construction of new urea plant which will contribute greatly to the agricultural development.

The top priority is put on the investment in the agriculture sector. It has the features as (1) low capital intensity (2) short gestation period and (3) high linkage with other sectors.

Gross Domestic Products (G.D.P.)

2.02 According to the report to the "Hluttaw" the provisional G.D.P. in 1976/77 can be broken down as follows in the classification of Goods, Service and Trade.

Goods	31,292.4	Million Kyats
Service	5,013.9	" "
Trade	9,814.5	" "
Total	46,720.3	" "

The net output adjusted by reproduction of raw materials is estimated at 26,773.3 Million Kyats.

The GDP has been yearly increasing to mark 6.0 percent growth (Provisional) in 1976/77, and per capital income in 1976/77 is US $ 130.000.

The industry wise GDP in 1976/77 is classified as follows:

	%
Agriculture, Forestry and Fishery	36.0 (Slightly decreased)
Manufacturing and Mining	12.0 (Slightly increased)
Construction	1.7
Electric power & power generation	5.2
Trading	24.7
Other services	19.6

Foreign Trade

2.03 The foreign trade balance had been in deficit until 1976 when having turned into the black.

1) Export

The major foreign currency earner is the agriculture products, and the forestry products comes the second. Main destinations of export rice are Indonesia, Sri Lanka, Vietnam and Singapore in order. The forestry products are exported to Japan, Hong Kong, Singapore, West Germany and Denmark in order. (1976).

2) Import

The outstanding import item are raw materials for manufacturing and machinery, and chemicals and food oil are followed.

These items are imported from Japan, Holland, Singapore, West Germany, etc.

II.2. General descriptions on farm production and agricultural policy

General descriptions on farm production

2.04 The cropwise sown acreages ratios to total sown acreage are 55 percent for paddy, 19 percent for oil seed crops, seven percent for peas and beans, five percent for miscellaneous cereals, two percent for fiber plants and twelve percent for others.

Rice is the staple food as well as the main export item of the country. Groundnuts and sessaman are the second largest production items to rice because of their big consumption as food oil. Peas and beans come the third with good consumption in the traditional diet of the country.

Most of the agricultural production is carried out under one-crop-a-year system (the two-crops-a-year is only 16 percent), because the dry season lasts about seven months between the middle of October and the middle of May, and the irrigation facilities are poorly provided in the country (Irrigation ratio to the total farm lands is only 12 percent).

The acreage of the total cultivated area is bout 9,880 thousand ha (24.7 million acre), including considerable fallow lands. Potential arable lands, which will be developed to farm lands by land reclamations, are mainly extending in the Upper Burma. Thereby, the country is considered to have a rather large potential to expand its arable land.

The target of agricultural sector in the economic development plan

2.05 In the economic development plan (20-year plan), the agricultural sector is regarded as the most important sector due to the following reasons.

i) Agricultural production increase is essentially required to cope with the population increase and to establish the self-sufficiency of food.

ii) Agriculture is the supplier of raw materials of various agri-industries.

iii) Farm products are the major export items to obtain foreign currency.

iv) Modernization of Burmese economy depends largely upon modernization and mechanization of agriculture in which a great number of the people are engaged.

v) Welfare of rural inhabitants should be secured in preventing them from many harms and evils attended with urbanization.

Guideline of food-stuff production increase

2.06 There are two ways to increase agricultural production; intensive use of existing farm lands and expansion of new farm lands. The intensive use of existing farm lands includes cropwise yield increase per unit acreage and expansion of multi-cropping farm lands.

Yield increase per unit acreage

2.07 Tendencies of intensification of paddy cropping (yield increase per acre) and expansion of farm lands for 10 years from 1967 to 1977, have shown that the former increased by 12 percent and the latter by only four percent. The yield increase per acre had contributed to paddy production increase by 63 percent of the total and expansion of farm lands by 37 percent in the above decade.

Under the circumstances, the authorities concerned have taken up the yield increase per acre as the most important agricultural policy, particularly in paddy production. The Whole Township Paddy Production Development Project, which will be detailed in the following paragraph, is the very policy to be taken by the Government to meet this requirement.

The said project has resulted in a good success and the Government has decided to expand the objective area of this undertaking year by year.

Implementation of such intensified production increase programme essentially requires for providing proper and effective extension services and various input materials of fertilizers and other chemical pesticides.

Burma has applied less fertilizers than those southeast Asian countries do. The consumptions of fertilizers should be increased much more in terms of agriculture as the corner stone of the national economy.

The fertilizers consumed in 1976/77 was estimated at about 110,000 tons, 100,000 tons of which was urea. Although the fertilizers have been increasingly consumed, no other kinds of fertilizers than urea has been applied so much.

Urea has been domestically produced by two plants, which have total capacity of 130 thousands tons per annum. Almost of all produced urea has been distributed through the related organization.

With promotion of paddy production increase programme, sharp increase of demand for fertilizers is expected in the very near future. The increasing demand is estimated at 250 thousand tons in 1979/80 and at 300 to 350 thousands tons in 1981/82.

In order to cope with the situation, a new urea plant is planned to be constructed.

Promotion of multiple - cropping

2.08 The Government has endeavoured to promote the expansion of multi-cropping acreages (almost two-crops-a-year) as a means of intensification of production. In general, the expansion rate of two-crops-a-year acreage had grown by 0.7 percent annually until 1974 from 1962, but since 1975/76 the expansion rate has declined.

As an example, in the rain-fed paddy fields where the second crops such as groundnuts and pulses are to be cropped in the dry season after paddy harvesting, soil should retain an adequate amount of moisture after the rainy season. So, the fields after paddy harvesting should be ploughed as soon as possible for the second cropping. It will be impossible, however, to make land preparation in a quick and successful manners by one pair of animals and some manpower that the ordinary farm households can secure at present. Thereby, the farmers who grow the second crops should inevitably provide farming machinery, but actually, available tractors number about less than 8,000 in total of the Government owned and the cooperative owned, and the power tillers about less than 1,300 only. For the time being, the number of animals should be increased to cope with the situation. Consequently, the livestock development centre should be established to play an important role in this regard.

Irrigation project

2.09 Irrigation projects aim at stabilizing production of paddy and intensifying the use of existing farm lands by two crops a year. Every year drought and/or floods cause damages to the fields of about five percent to the total paddy cropping acreage. Particularly, those crops of sesame and cotton have been damaged by almost 20 to 30 percent of the respective cropping acreages. In view of recent world-wide changeable climatic condition, irrigation facilities should be indispensable to be provided so as to carry out agriculture free from those damages. A due consideration, however, should be given to the fact that the irrigation projects, which require for a huge investment, would be a heavy burden to the finances.

Expansion of farm lands

2.10 The Government has no plan to reclaim or develop new farm lands by large-scaled immigration to thinly populated areas, because there are about 4.5 million acres of potential arable lands extending among the existing farm lands and large-scaled immigration requires for a great amount of investment for road construction, housing and other necessary facilities.

However, it is permitted to reclaim new farm lands or recultivate once-given-up arable lands on the individual basis.

Reclamation for paddy field, rubber or palm plantation is allowed up to 50 acres. In the case, for four years from starting cultivation no cultivation tax is imposed and for seven years income tax is exempted.

Segmentation of farm lands

2.11 The Revolutionary Government has promoted the nationalization of farm lands along with the Socialism policy since its establishment in 1962, but admitted the right of cultivation for the lands according to the scale of farm management at the time of 1962. Therefore, still now some farmers cultivate over 40.5 ha (100 ac.), though the national average is only 2.2 ha.

On the other hand, with population increase by annual 2.2 percent, there have increasingly appeared those farmers who have no lands to cultivate, and are estimated at about 25 percent of the total farmers. These no land farmers are hired at the wage of 7 K/day as farm labourers under the large scale farmers. (Wages differs from kinds and types of works.) They apply to the registeration for sharing the right of cultivation of lands by the Village Council and wait for the land to be shared.

The Village Council will give the right of cultivation to the farmers in the waiting list, when any farm land is given up by death of farmers or the Council confiscate the right from farmers who do not perform their duty to sell the compulsory quota paddy to the Government.

However, the population increase tends to segment the farm lands. This is proven by the fact that the national average of cultivated land per farmer was 2.3 ha in 1961/62 but reduced to 2.19 ha in 1975/76.

II.3 Extension Service

2.12 Extension service organization is established by Extension Division of AC as headquarter, and the respective extension service section provided with, Division and State, township, Village tract and village. The regular staff assigned to extension works totals 5,367 persons in the whole country.

Village managers and village tract managers, the extension staff working in the fields, totals 5,082 persons. The areas where these extension staff is intensively positioned are Sagaing and Mandalay Division in the Upper Burma and Pegu, Irrawaddy and Rangoon Division in the Lower Burma.

These extension staff and township managers (190 persons) have devoted themselves a great deal to the works in distribution of fertilizers, pesticides, seeds, and some of the duties which may be assigned by local authorities, preparation of statistics, collection of repayment of agricultural credit, etc., only to devote

themselves about half of their time to extension service works.

2.13 The executive budget of extension works is about 70 million kyats, including direct salary, operation cost, etc. The allocation of this amount to the village manager is about 14,000 kyats per person in being divided by cadre-regular staff, about 5,000 persons.

2.14 In principle, the Diploma -- the graduates from Agricultural Institute, or the BAG - the graduates from the Agricultural University are assigned to Township Manager as qualified staff.

Recently, the BAG has been increased in number to be assigned to the position.

The village managers are selected from the graduate from Agricultural High School, but some BAGs and Diplomas have been assigned to the village managers and this ratio is about five percent of the total village managers.

The salary for the BAG is 185 Kyats/month for Diploma 165 Kyats/month, respectively, before appointment as the regular staff. The recent proposal is made to raise these salaries up to 200 Kyats and 185 Kyats per month, respectively.

2.15 The village managers and village tract managers, so-called field staff, total 5,000 persons in regular staff and in addition to them, about 1,000 apprentices are employed on one-year contract basic. One field staff covers the works for about 5,000 ac. or about 1,000 farm households.

The field staff do not have their own office space, making visits to farmers from one to another and sometimes lodging in the house of friend, relatives or farmer. During the services, the staff visit once or twice a month to the Township offices they are belonging to for reporting various matters.

2.16 The field staff have carried out their services about the following items on the case-by-case or individual basis; introduction of quality seeds, shortening of nursery period, dense planting, application of manure, weed control, and other general farming techniques.

As a means of extension, the staff have tried to held possibly many meetings at meeting rooms of People's Council or at the temples and farmers houses etc. Distribution of leaflets, sticking postars and conducting demonstration plots are also common extension means. Besides the above, the Burma Broadcasting Service (BBS) broadcasts the agricultural programmes everyday. However, the popularity of the radio-sets is only about two percent in small transistor radio.

The Regional Party Unit, People's Council and Peasant Council have positively made cooperation in giving guidance, advices and control, and also supported to organize the farmers' organization with key farmer system.

2.17 Training and education of extension workers

1) Education

This year, the expected numbers of BAG, Diploma and high school graduates are 239 and 110 and 175 persons, respectively. Usually, the new employees as extension workers are 100 to 150 persons, but last year, about 300 new extension workers were employed to meet the increasing demand of the position, and further sharp increase is anticipated.

In order to cope with the situation, the third four-year plan aims at increase in number of the students of the above three educational institutions.

In consideration of the above measures, there will be no problems as far as education and employment of new extension workers are concerned.

2) Training

The AC is fully responsible for all in-service training together with short-term training for farmers and 6-month training for soldiers. The budget for these three training amounts to 1.8 million Kyats per annum, more than half of which is spent for in-service training, about 800,000 Kyats for farmers training and about 100,000 Kyats for soldiers training.

The in-service training, in principle, is given to the BAGs and Diplomas for one month, and to the High School graduates for six months. Recently, however, the high school graduates are assigned to their own position in the field after one-month training so as to meet the urgent requirement from the sites.

The training is carried out in 16 Central Research Institutes in the country. Every training course provides 15 to 16 cropwise programmes and every year about 1,000 trainees complete the respective courses. However, there is a considerable shortage in numbers of audio-visual equipment and farming machinery for training.

Problems in Extension Works

2.18 Although further positive employment of extension workers may meet the increased demand in numbers, the young extension-workers will be short in their experience to solve a wide variety of problems they face in technical and farm management matters. So, the in-service training should be strengthened to cope with the actual situations.

To provide subject matter specialists in a certain field will be helpful to level up the quality of extension workers, to keep a close contact with the related research institutes, and to develop the farming techniques which should be applied to break the bottlenecks the Burmese agriculture is facing now.

Various machinery, equipment facilities should be provided to assist the extension workers in their activities; they are, means of transportation, facilities for demonstration, audio-visual equipment, measuring devices, experimenting tools, and equipments, meteorological appliances, calculators for statistics, printing machines, etc.

Whole Township Paddy Production

Development Project

2.19 The Government has a plan to increase the extention workers in number so that 5,000 ac in one staff's charge can be reduced to about 3,000 ac. As an approach to this programme, a certain area is selected as the base for intensive extension works.

In 1975, the authorities concerned selected Pha-lon Village Tract in Taikkyi Township and the increased number of extension workers rendered their services to a limited number of farmers to carry out intensive extension works with systematic application of fertilizers and chemicals. The said farmers could double the paddy yield per acre (about 80 basket per acre) within only two years.

Observing the results, the farmers in whole Taikkyi Township required the authorities concerned to extend this intensive method to the whole Township area. The Whole Township Production Development Project was formulated as such, and now extended nationwide.

In this project, one extension workers can cover only about 1,000 ac, and the training camps were provided for extension works. The intensive extension works aimed at introduction of HYV, shortening of nursery period, densely planting, increasing application of fertilizer, establishment of fertilizer application standard, etc.

In 1977/78, the first project year, two townships in the whole country were selected as project areas, one of which, Taikkyi is in the Project Area.

In 1978/79, the project was extended to cover 23 townships of the country, among which 6 townships of Taikkyi, Okpo, Henzada, Kyonpyaw, Hlegu and Hmawbi townships are in the Project Area.

Japanese Government has contributed some of these townships to supply fertilizers and other farming materials in grant.

Next year, this project will be extended further to cover 40 or 50 townships in whole Burma.

III. Present Situation of the Area

III.1 Natural Conditions

Location

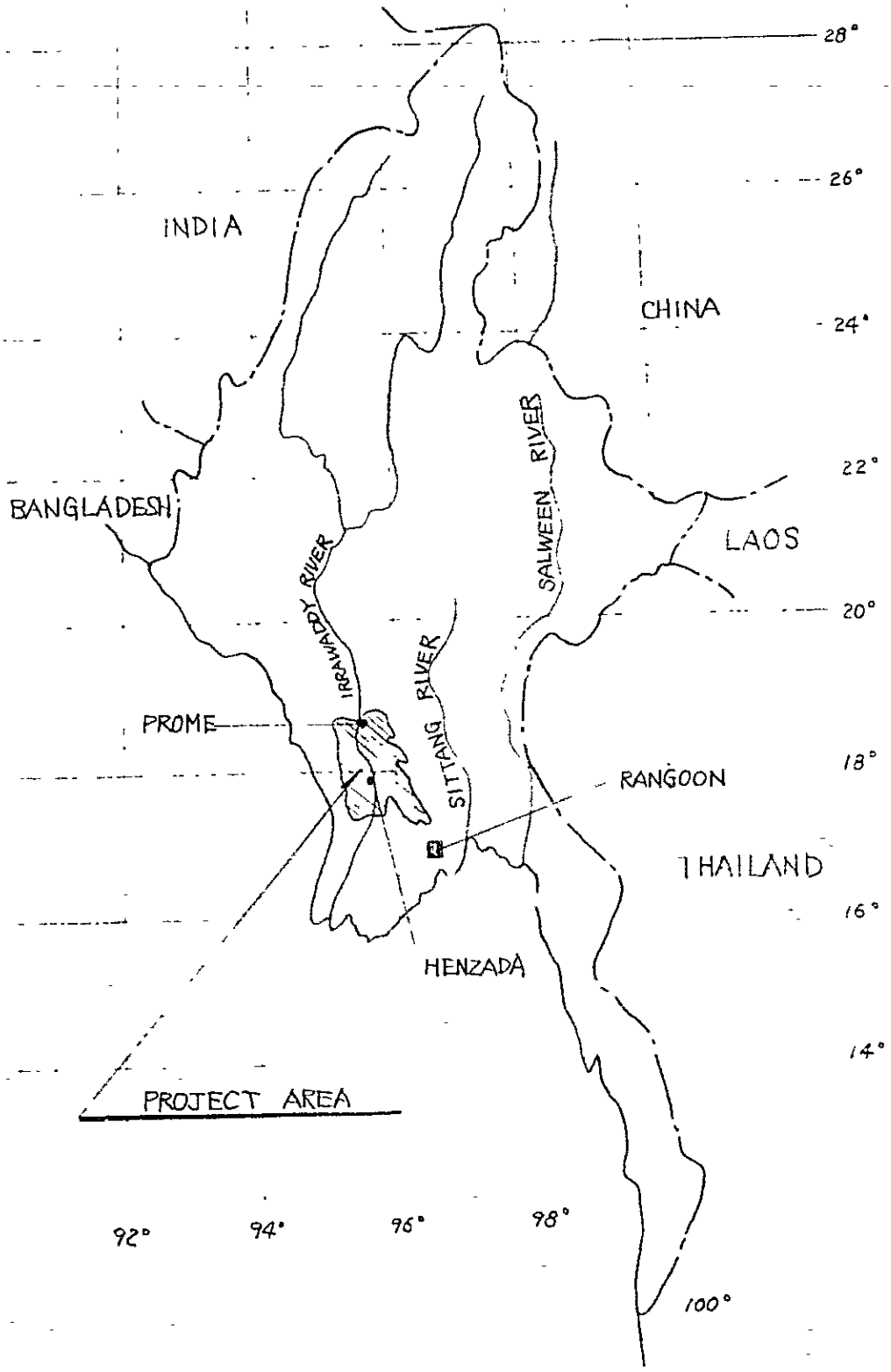
3.01 The Project Area is located northwest of Rangoon, extending from latitude 16°55' to 19°10'N and from longitude 94°40' to 96°20'E. The Project Area is bordered by the Arakan Yoma on the west and by the Pegu Yoma on the east, respectively. The Irrawaddy River flows in the centre of the Project Area. The width of the Irrawaddy River is about 5.0 Km (3.0 miles), but no bridge exists in the Project Area. Transportation across the River all depends upon ferries and thereby smooth flow of people and goods between the left bank and the right bank has been hindered to a great extent. (Refer to Fig.3-1)

3.02 The major municipalities in the Project Area are Prome, and Henzada. Prome is located at the northern edge of the Area, 250 Km (160 miles) from Rangoon, and the two cities are linked with a railway and a highway. Henzada, a central city in the southern part of the Project Area, is located at the right bank of the Irrawaddy River and the railway from Rangoon only reaches opposite side of the River to cross over by ferry. No railway directly linking two cities is available but navigation through the Irrawaddy and other waterways are well developed.

Topography

3.03 The Project Area consists of two topographical factors of the hilly area and the plain area. The former extends along mountainous area of the Arakan and the Pegu Yomas, and the latter extends along the Irrawaddy River, the Myitmaka river and the northern part of Irrawaddy Delta. In the area from Prome to Kyangin along the Irrawaddy River, there is no fear for flooding on the right bank because the hilly area and plateau developed

FIGURE 3-1 LOCATION OF PROJECT AREA



therefrom are very close the River side, whereas on the left bank even Prome has been sometimes attacked by flooding due to being in lower elevation than that in the right bank. The area in downstream from Kyangin is a vast delta formed by the Irrawaddy River, and the river course has not been stable yet around there. The plain area has some 12 m (40 ft) in its elevation, sometimes being damaged by floods. The average river bed slope between Prome and Henzada is about 1/10,000.

3.04 The hilly mountains of the Pegu Yoma, ranging 500-800m (1,700 - 2,700 ft) in altitude, forms a watershed of the Myitmaka river and the Sittang River. In the area, gentle river bed slope and well-developed valley, if suitable site found, will allow a large dam to be constructed. The steep Arakan Yoma, ranging about 1,200m (3,700 ft) in its altitude, forms a watershed of the Irrawaddy River and other rivers running down to the Bay of Bengal, and there are many well-suited dam sites found therearound.

Geology

3.05 The geology of the Project Area consists of Tertiary formation with sedimentary faces as base rocks. Quarternary formation with both Pleistocene and Holocene alluvials are unconformally overlying on the base rocks across on both sides of the Irrawaddy River with stretching vast plain. The basic stratigraphic succession of formation in the Project Area is shown in the following table.

Basic Stratigraphic Succession

Epoch	Period	Age	Series	Description
Quarternary		Holocene		alluvium and plain located both sides of Irrawaddy River
		Plistocene		
Tertiary	Neogene	Pliocene	Irrawaddy	almost sandstone, foot-hill area of Pegu and Arakan Yoma
		Niocene	Pegu	Sandstone/shale, hilly and mountainous range of Arakan, Pegu Yoma.
	Palaeogene	Oligocene		
		Eocene		Shale, foot of Arakan Yoma
		Palaeocene		

3.06 The proposed dam sites are located in the area with the sandstone or sandstone/shale of the Irrawaddy series of the Pegu series. Both, fresh rocks appear to have no problem as the foundation rocks of dam with 60m high embankment (about 200 ft), although comparatively soft. In the northeast of Prome, there are three faults found running in parallel. These faults, extending toward the northwest of the Project Area, may not give direct influence to the proposed dam sites. However, many

minor faults developed from three major faults, have been observed in the northern part of the Project Area, and further consideration should be given to them when the dam site investigation is carried out.

Climate

3.07 The Project Area has a tropic climate influenced by the monsoon, having three season in its rough classification as the rainy season, winter and summer. The rainy season lasts from the middle of May to the middle of October, and most of the annual rainfall is concentrated in this season. The annual rainfall on an average is about 1,300 mm (about 50 in.) in Prome, and about 2,300 mm (about 90 in.) in Henzada, respectively. The northern limit of paddy cropping in the rainfed fields lies in Prome, and the Prome-Toungoo line is the boundary of the Upper Burma and the Lower Burma. After the rainy season, the winter starts from November and lasts up to January. The temperature during the winter marks the lowest through the year with monthly mean minimum temperature at about 16°C, and the relative humidity also decreases to 40 percent in Prome and some 70 percent in Henzada, respectively. Three months from February to April are the summer, the hottest season in a year. The monthly mean, maximum temperature in April reaches 40°C in Prome and 38°C in Henzada respectively. The summer ends with the monsoon coming. (Refer to Fig.3-2)

3.08 Annually, five or six typhoons attack the country during a period between July and October; however, the typhoons cause only little damages due to retaining their minor magnitude after crossing over the Indo-China Peninsula.

Rivers

3.09 The Project Area can roughly be divided into two river basins; the main stream of the Irrawaddy River and its branches - the Bassein river and the Myitmaka. The

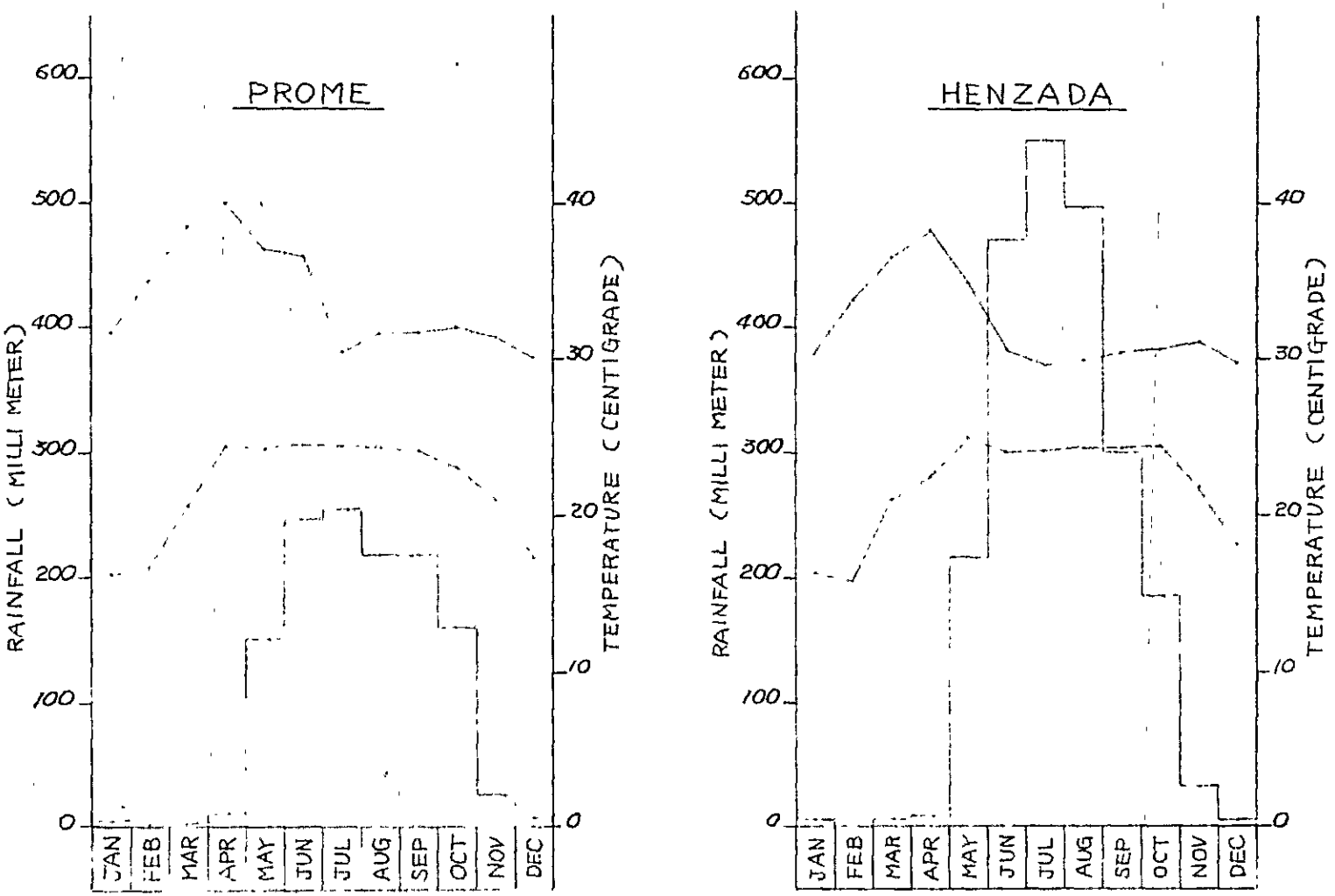


FIGURE 3-2 RAINFALL AND TEMPERATUR IN PROME AND HENZADA

right bank of the Irrawaddy River is all the basins of the Irrawaddy River, and the Bassein river with 11 tributaries flowing from the west down to the east. The left bank of the Irrawaddy River is almost the basin of the Myitmaka river, excepting for the Nawin river joining the Irrawaddy. (See Fig.3-3)

3.10 The Irrawaddy River originates in Tibet, the great mountain ranges in China, and flows into the Kachin State to run through the central part of Burma from the northern tip toward the Andaman Sea. The total distance of the river course reaches about 1,700 km with the catchment area of 376,200 Km^2. The mean flood discharge at Prome is 35,500 m^3/sec and the maximum flood discharge is recorded by 63,800 m^3/sec. Along the right bank of the Irrawaddy, embankments are almost provided downstream from Kyangin, but sometimes in floods overflows or embankment breakages have taken place. In the recent year, August in 1974, the flood caused damages to Myanaung and Henzada. Along the left bank, embankments had been provided several decades ago, but only a very few can be confirmed on their existence. The Myitmaka river, which was an Irrawaddy River course, flows down through the lowest-lying portion of the Project Area. Floods from the Myitmaka river are caused not only by flood discharge of the Myitmaka river itself, but also by over-flooding from the Irrawaddy, and the flooded water, once ponding in the low-lying hinterland, is very difficult to be drained out and remains swampy even in the dry season.

Groundwater

3.11 Movement of groundwater is closely related with geotectonics. Shales and sandstones reaching the Tertiary stratum are generally impervious or semi-pervious, and the Quarternary stratum consists of rough particle layers with silt or loam layers lying in between, but in the upper layers, clay content increases in quantity. The water

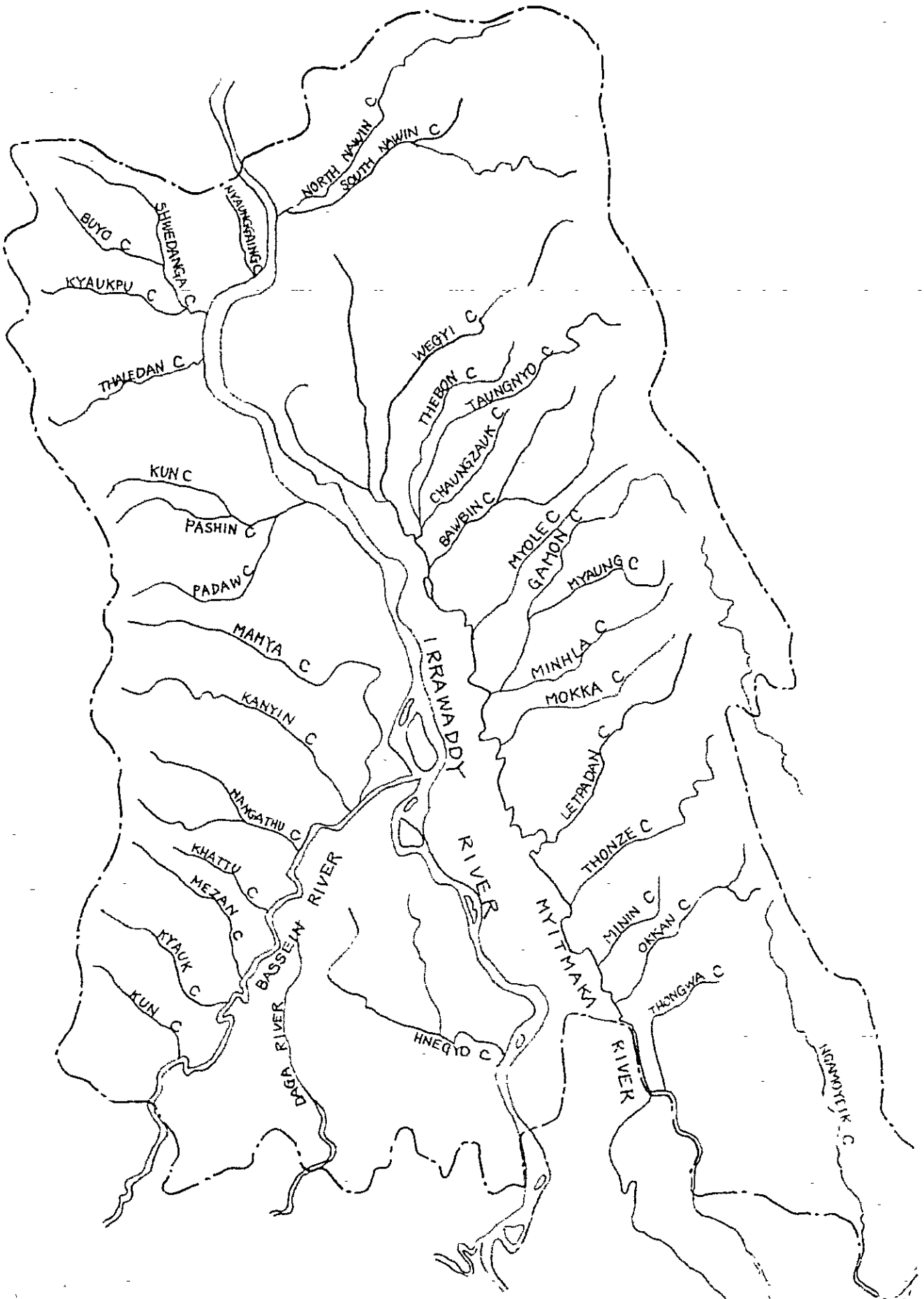


FIGURE 3-3 RIVER BASIN SYSTEM

table in the Project Area shows high level with seasonal fluctuation in coming up near to the ground surface in the rainy season and coming down about 8.0m below ground surface in the dry season. The domestic water in the Project Area is mainly supplied from shallow wells, which sometimes dry up in the dry season. There are no systematic large-scale irrigation areas by under ground water resources in the Project Area. Judging from the above conditions of the groundwater, the large-scale agricultural development potential will be definitely small by the use of groundwater as compared with that by the use of surface water.

Available Maps

3.12 Maps to cover the whole land of Burma have been prepared and controlled by Survey Department. The maps with following three kinds of scale are available.

One inch map	1/63,360
Half inch map	1/126,700
Quarter inch map	1/253,400

Survey was made in 1940's for the above maps. The Survey Department has been rectifying the maps on roads, rivers, etc on the basis of the aerial photos taken in 1972.

Soil

3.13 In the plain area, Meadow soils, Meadow Gley soils, Meadow Alluvial soils, Meadow Swampy soils and Alluvial soils are distributed, and the Meadow soils and the Meadow Gley soils are used for paddy fields, and the Alluvial soils are used for the Kaing-lands. Most of the Meadow Swampy soils have been left unused due to being long inundated throughout the year. The Meadow Alluvial soils, undulating in micro-relief, are used for the Ya-lands or gardens in elevated portions, and for paddy fields in low-lying portions, some of which have been unused due to ill-drainage.

3.14 As regards, soil productivity, the Meadow Gley soils and the Meadow Alluvial soils come next. The Meadow Swampy soils, after providing suitable measures for flood protection and drainage, will be expected to be highly productive. In the Kaing-lands, the Meadow Alluvial soils have high productivity and the Alluvial soils come next. In view of soil conditions, the Meadow Gley soils and the Meadow Swampy soils can be cropped with paddy for the winter crops, if sufficient irrigation water is available, and the Meadow soils and the Meadow Alluvial soils can be cropped with general crops.

3.15 In the upland, hilly and mountainous area, there are such various soils distributed as the Indaing Forest soils, the Lateritic soils, the Yellow Brown Forest soils, the Yellow Brown Forest Carbonate soils, the Primitive Crushed Stone soils, and the Arakan Mountainous soils. These soils are mostly found in the forest areas except for only some which are used as the Ya-lands and gardens adjoining the plain areas. For further expansion of farm lands, the Yellow Brown Forest soils and the Yellow Brown Forest Carbonate soils extending in the gentle slopes can be used as Ya-lands with considerable high productivity. The Lateritic soils and the Indaing Forest soils, productivity of both of which is not so high, can be used in the same manner as above. In that case, some measures should be taken for erosion control in the slopes. Other soils should be reserved as forest areas for water conservation and erosion control.

Present Land Use

3.16 The Settlement and Land Records Department prepares the statistic records of actual land use every year. Table 3-3 shows the Present Land Use (1976/77), which reveals that about 40 percent of the Project Area -- 1,177,000 ha (2,910,000 ac) - is cultivated areas, about 85 percent - 1,000,000 ha (2,470,000 ac) of which is paddy fields.

Table 3-1 Soil Characteristics of Plain Area

Sr. No.	Name of Soil	Area x1000ha	Clay - 4/ percent (%) 1/		PH	Texture	Drainage	Meliorative Measures	Adequate Land Use after Melioration 2/	Productivity 3/
1.	Meadow Soils	230	A	15-25	5.0-6.0	loam	poor	-	(R) paddy	P_2
			B	20-30	5.5-6.5				(D) general crops	Y_1
2.	Meadow Gley Soils	800	A	25-55	5.0-6.0	clayey loam	very poor	-	(R) paddy	P_1
			B	30-50	5.5-6.5				(D) general crops	Y_2
3.	Meadow Alluvial Soils	180	A	20-40	5.5-6.5	loam-clayey loam	well-poor	flood protection, partly drainage	(R) paddy	P_2
			B	20-35	6.0-7.0				(D) general crops	K_1
									general crops or garden (old levee of Irrawaddy Div.)	G_1, K_1
4.	Meadow Swampy Soils	150	A	60-80	5.5-6.0	clay	very	flood protection, drainage	(R) paddy	P_1
			B	65	5.5-6.5		poor		(D) general crops	K_2
5.	Alluvial Soils	80	A	10	5.0-6.5	sandy loam	excessive	river training	(R) (general crops)	(K_2)
			B	20	6.0-6.5				(D) general crops	K_2

Note: 1/ A: surface soil B: sub-soil
2/ R: rainy season (D): dry season
3/ P_1: good as paddy-land P_2: moderate Y_1: good as Ya-land Y_2: low
K_1: good as Kaing-land K_2: low G_1: good as garden
4/ less than 0.001 mm

Table 3-2 Soil Characteristics of Upland, Hilly and Mountainous Area

Sr. No.	Name of Soil	Area x1000ha		Clay - 3/ percent (%)	PH	Texture	Drainage	Meliorative Measures	Adequate Land Use after Melioration	Productivity 2/
6.	Indaing Forest Soils	100	A B	2- 5 5-15	5.5-7.0 5.0-6.0	sandy	excessive	erosion control	garden, upland crop, grazing land or forest	G_2, Y_2 Gr_2 F_2
7.	Lateritic Soils	70	A B	20 25	5.0-6.0 4.5-5.0	loam	well	erosion control	garden, upland crops or Forest	G_2, Y_2 F_2
8.	Yellow Brown Forest Soils	700	A B	15-25 15-30	5.0-5.5 4.5-5.5	loam	well	erosion control	garden, upland crops or Forest	G_1, Y_1 F_1
9.	Yellow Brown Forest Carbonate Soils	60	A B	25-30 25-30	7.0-7.5 7.5	loam	well	erosion control	garden, upland crops or Forest	G_1, Y_1 F_1
10.	Primitive Crushed Stone Soils	100	A B	- -	- -	gravelly loam	excessive	erosion control	forest	F_2
11.	Arakan Mountainous Soils	400	A B	- -	- -	loam	well	erosion control	forest	F_1

Note: 1/ A: surface soil B: sub-soil

2/ G_1: good as garden G_2: low Y_1: good as Ya-land Y_2: low

Gr_2: low as grazing land F_1: good as forest F_2: low

3/ less than 0.001 mm

Table 3-3 Present Land Use (1976/77)

Description	Area x 100ha	Percentage of Grand Total %	Percentage of Cultivated Area %
Cultivated area			
Paddy	9998	34.6	85.0
Ya-land	122	0.4	1.0
Kaing-land	873	3.0	7.4
Garden	719	2.5	6.1
Nipa palm	14	0.0	0.1
Shifting culture	46	0.2	0.4
Total	11772	40.7	100.0
Reserved forest	9202	31.9	
Unreserved forest	1120	3.9	
Culturable waste	2424	8.4	
Unculturable land	4356	15.1	
Grand Total	28874	100.0	

(Source: Settlement and Land Records Department)

(Cultivated area includes area cultivated within reserved forest area and demarcated grazing lands.)

Cultivated lands other than paddy fields are occupied mostly by Kaing-lands accounting for about seven percent 87,000 ha (220,000 ac) of the total cultivated lands. The gardens occupy about six percent - 72,000 ha (180,000 ac), and the Ya-lands only one percent - 12,000 ha (30,000 ac). Besides cultivated lands, the reserved forest accounts for about 32 percent - 92,000 ha (227,000 ac) of the Project Area, and plays an important role in the forestry field. The culturable waste lands occupy about eight percent - 242,000 ha (560,000 ac), most of which belongs to the up-lands; and the swampy areas are statistically classified into un-culturable lands.

3.17 The present land use maps developed from aerial photos (1971/72) show that the belts of Kaing-lands and the swamp areas extend along the Irrawaddy River, the Myitmaka river and the Bassein river. The remaining part of the plain areas is used for paddy lands, with Ya-lands and gardens scattered on the edge of the upland. There are forest lands extending over the hilly and mountainous areas therearound.

III.2 Hydrological Situation

River Basins

3.18 The Project Area, in terms of river basins, can be roughly divided into two; the Myitmaka River basin composed of the Pegu Yoma in the east of the Irrawaddy River and the Irrawaddy/Bassein River basin composed of the Arakan Yoma in the west of the Irrawaddy River.

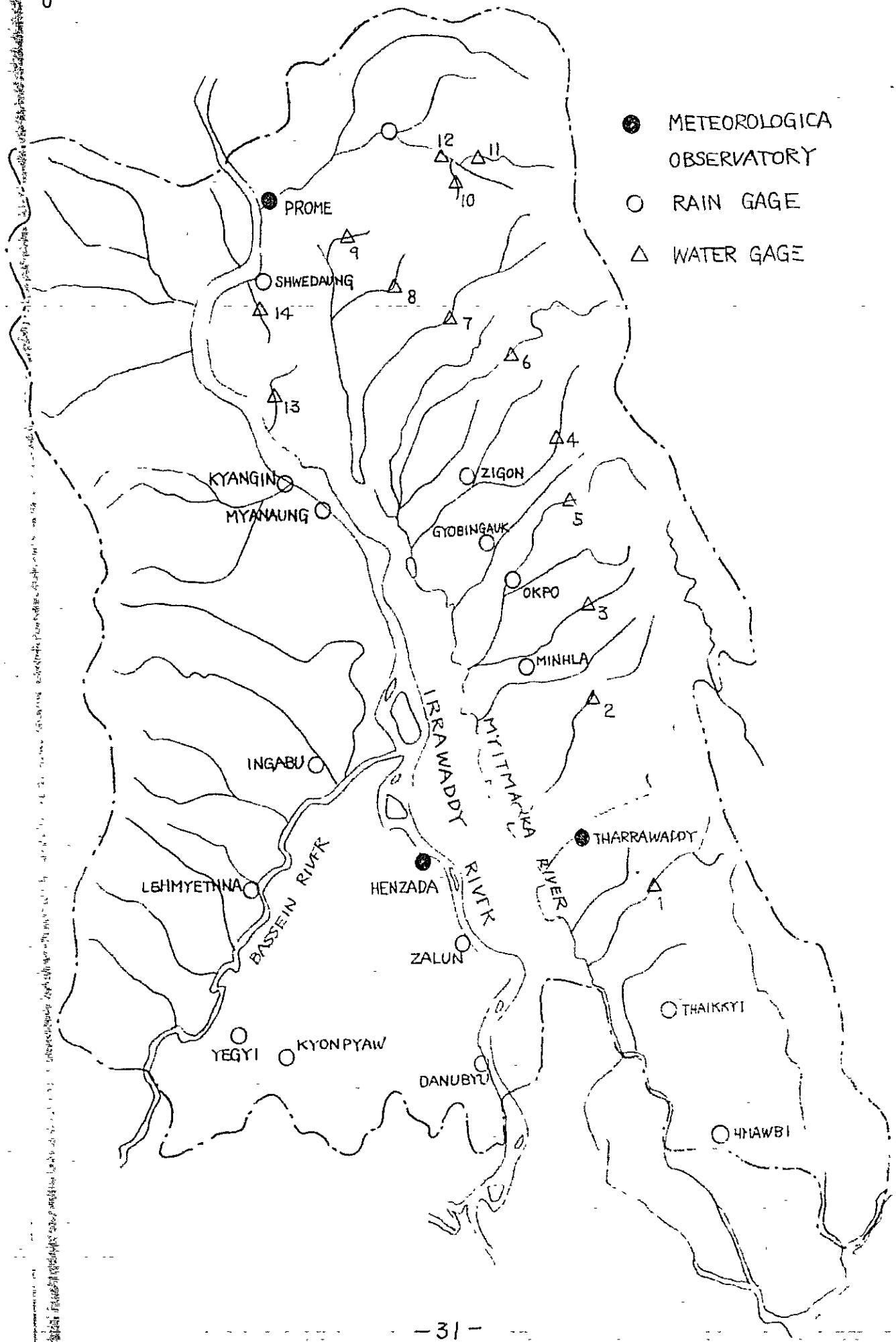
3.19 The Pegu Yoma presents a hilly topography with comparatively gentle slope, where the field-burning agriculture has been carried out and forest roads are developed to some extent to transport teak wood produced in the mountain, while the Arakan Yoma presents mountainous topography with considerably steep slope, where hardwood trees grow thickly and no access roads are available to be behind the development.

3.20 The field investigation made in the beginning of the dry season suggested that the Arakan Yoma origin tributaries of the Irrawaddy River have much more discharge and less sediment run-off than the Pegu Yoma origin tributaries of the Myitmaka river.

Rainfall

3.21 In the Project Area, total 19 rain gauge stations (ten in the east bank and nine in the west bank of the Irrawaddy basin) are located as shown in the location map Fig.3-4 attached hereto. Among them, observations in Tharrawaddy, Prome and Henzada have been conducted by the respective meteorological stations for a long period of time since 1947 up-to-now and the related records are deemed highly reliable. All the existing stations, however, are located in the plain area, and several new stations will be required in the mountain areas for data collection for hydrological analysis for the Project planning.

Fig. 3-4 LOCATION OF HYDRO-METEOROLOGICAL OBSERVATORIES



(The observation periods of the respective stations are illustrated in Fig. 3-5)

3.22 Local intensity of the rainfall, which is shown in the isohyetal map, has a tendency to cause 1,200 mm difference between the northern part (about 1,400 mm) and the southern part (about 2,600 mm). (Refer to Fig. 3-6). There are no correlation of annual rainfall found among Tharrawaddy, Prome and Henzada. In the Project Area, the annual maximum rainfall recorded was about 3,200 mm, and the annual minimum rainfall recorded was about 900 mm. (Refer to Table 3-4) For the monthly distribution of rainfall, the peak appears in the month of July and the even distribution in other months in the Project Area. Almost 97 percent of annual rainfall concentratively occurs in the period between May and October; particularly about 63 percent of the annual rainfall occurs in three months from June to August. (Tables 3-5, 3-6 and Fig. 3-7 show the monthly distribution of rainfall.)

3.23 The probable annual rainfall at Pharrawaddy and Henzada shows almost equal values; about 3,000 mm for 100 years of return period. The probable annual rainfall at Prome is about 2,000 mm for 100 years of return period. For the 10-years return period, the former two sites show about 2,600 mm and the latter site shows about 1,600 mm. (Refer to attached Fig. 3-8).

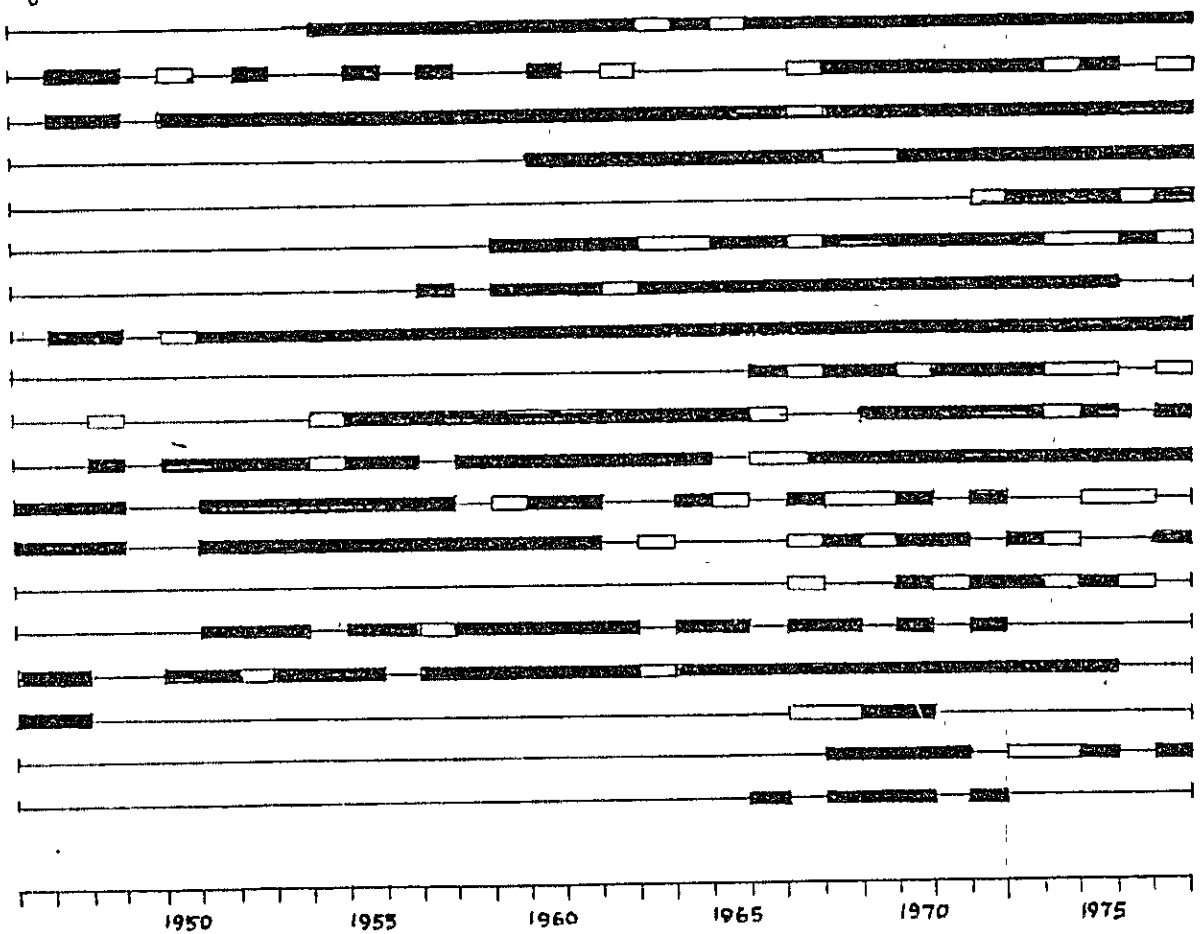
Probability Annual Rainfall

(Unit : mm)

Return Period	Tharrawaddy	Prome	Henzada
100	2,900	2,000	3,000
20	2,650	1,750	2,800
10	2,500	1,600	2,600
5	2,400	1,500	2,500
2	2,200	1,300	2,200

Fig 3-5 PERIOD OF OBSERVATION

STATION	
1	HMAWBI
2	TAIKKYI
3	THARRAWADDY
4	MINHLA
5	OKPO
6	GYOBINGAUK
7	ZIGON
8	PROME
9	PAUKKAUNG
10	SHWEDAUNG
11	HENDADA
12	KYANGIN
13	MYANAUNG
14	INGABU
15	ZALUN
16	DANUBYU
17	LEMYETHNA
18	YEGYI
19	KYONPYAW



FULL TERM

PART TERM

NO

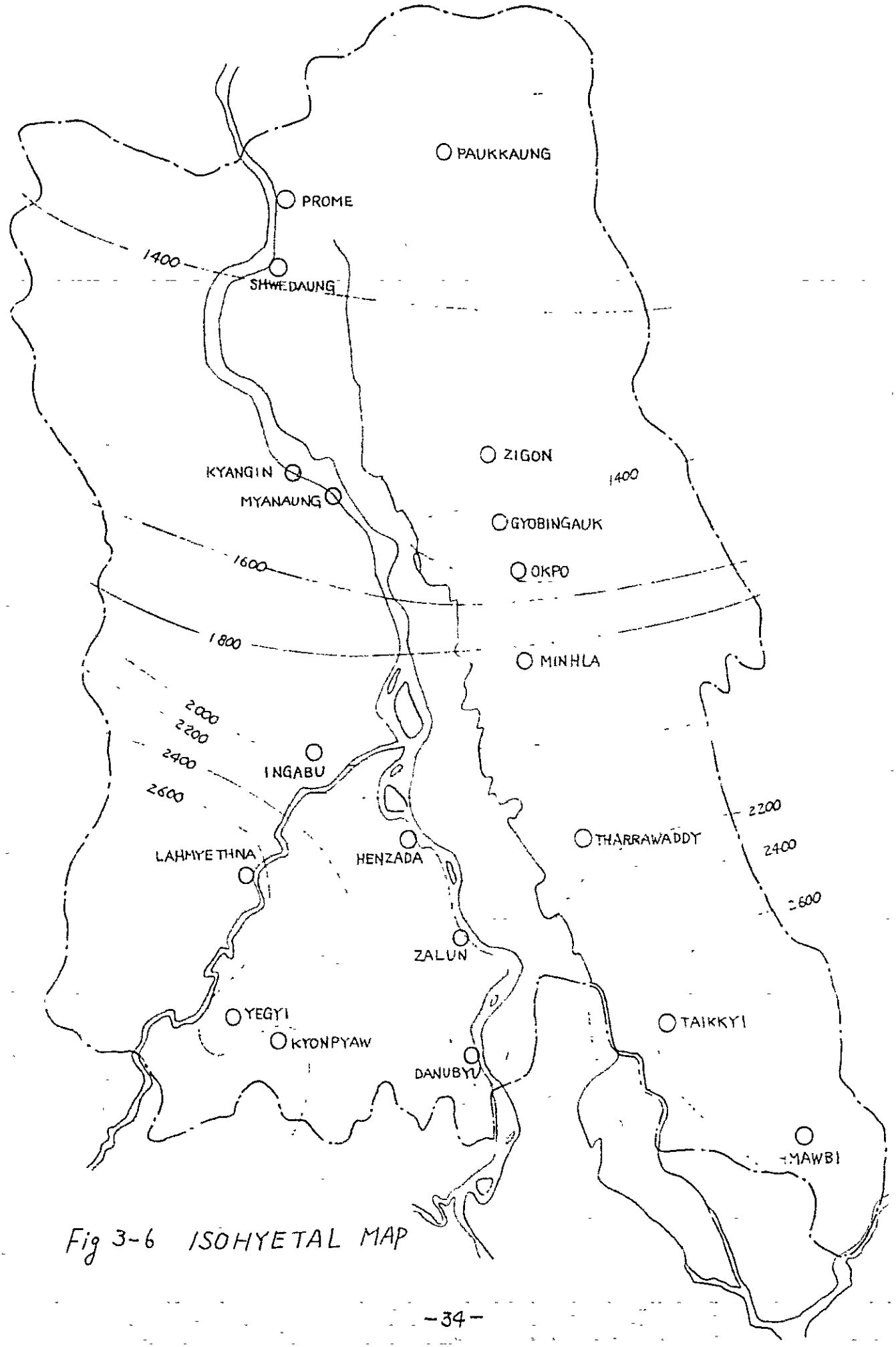


Fig 3-6 ISOHYETAL MAP

TABLE 3-4 MONTHLY AND ANNUAL RAINFALL

THARRAWADDY (Unit : mm)

Month	Mean	Maximum	Minimum
January	6.7	41.7	0.0
February	0.5	6.1	0.0
March	3.4	27.7	0.0
April	13.7	86.0	0.0
May	195.8	495.8	4.1
June	448.8	606.7	188.5
July	505.1	961.4	298.7
August	470.9	663.2	223.8
September	303.3	503.2	126.9
October	187.9	308.9	69.1
November	32.4	107.9	0.5
December	11.9	100.8	0.0
Annual Total	2180.6	2789.4 (1948)	1539.8(1972)

PROME

Month	Mean	Maximum	Minimum
January	4.6	47.0	0.0
February	1.0	25.7	0.0
March	0.8	5.6	0.0
April	10.4	45.2	1.0
May	151.5	321.6	24.6
June	246.3	407.0	93.0
July	254.1	423.0	142.5
August	218.5	396.0	115.6
September	218.7	396.0	80.0
October	160.2	392.9	41.1
November	25.6	139.0	0.0
December	6.5	55.9	0.0
Annual Total	1298.8	1749.0(1973)	889.8(1968)

TABLE 3-5 MONTHLY AND ANNUAL RAINFALL

HENZADA (Unit : mm)

Month	Mean	Maximum	Minimum
January	5.2	43.0	0.0
February	0.0	0.0	0.0
March	5.5	91.2	0.0
April	8.3	49.8	0.0
May	215.7	424.7	62.7
June	471.1	634.2	240.8
July	549.3	954.3	333.0
August	496.3	662.9	308.1
September	300.9	607.8	167.0
October	185.7	310.0	66.0
November	32.8	168.0	0.0
December	5.1	72.6	0.0
Annual Total	2276.3	2824.0 (1961)	1840.2 (1955)

TABLE 3-6 RAINFALL DISTRIBUTION

(UNIT : Percent)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
1. HMAWBI	0.2	0.2	0.3	0.5	11.6	18.7	22.4	22.1	15.2	7.1	1.1	0.5
2. TAIKKYI	0.1	0.1	0.3	0.8	9.3	20.1	23.8	22.3	13.5	8.5	1.3	0.1
3. THARRAWADDY	0.3	0.0	0.2	0.6	9.0	20.6	23.2	21.6	13.9	8.6	1.5	0.5
4. MINHLA	0.2	0.0	0.0	0.9	9.9	19.4	23.6	22.9	11.9	9.3	1.4	0.2
5. OKPO	0.1	0.0	0.5	0.2	15.6	14.5	18.6	21.0	17.0	9.5	2.6	0.5
6. GYOBINGAUK	0.1	0.0	0.0	0.3	11.4	21.7	21.1	19.2	14.2	10.4	0.9	0.6
7. ZIGON	0.1	0.0	0.1	0.8	10.7	22.5	22.0	17.9	13.5	9.7	2.6	0.1
8. PROME	0.4	0.1	0.1	0.8	11.7	19.0	19.6	16.8	16.8	12.3	2.0	0.5
9. PAUKKAUNG	0.1	0.0	0.1	0.5	11.6	24.4	17.7	19.0	13.6	9.1	3.9	0.0
10. SHWEDAUNG	0.1	0.0	0.0	1.1	10.8	19.9	18.9	17.0	19.3	10.7	1.8	0.6
11. HENZADA	0.2	0.0	0.2	0.4	9.5	20.7	24.1	21.8	13.2	8.2	1.4	0.2
12. KYANGIN	0.4	0.0	0.3	1.7	10.2	22.1	17.9	18.0	14.9	12.6	1.8	0.1
13. MYANAUNG	0.4	0.0	0.1	1.1	11.4	23.1	19.2	18.1	16.1	9.2	1.0	0.4
14. INGABU	0.4	0.0	0.4	0.7	9.0	20.9	27.2	19.3	13.8	7.2	1.1	0.0
15. ZALUN	0.1	0.0	0.1	1.0	9.2	21.5	23.7	21.6	15.3	6.6	0.9	0.1
16. DANUBYU	0.2	0.1	0.1	0.9	10.5	20.8	21.4	22.8	14.3	7.4	1.1	0.4
17. LEMYETHNA	0.2	0.0	0.0	2.7	8.8	19.7	26.2	24.1	11.4	6.4	0.4	0.0
18. YEGYI	0.0	0.0	0.2	0.3	13.5	20.4	25.2	22.1	10.1	7.5	0.6	0.2
19. KYONPYAW	0.0	0.0	0.0	3.0	10.5	17.7	26.0	22.6	11.6	6.0	2.6	0.0
MEAN	0.2	0.0	0.2	1.0	10.7	20.4	22.2	20.5	14.2	8.8	1.6	0.3

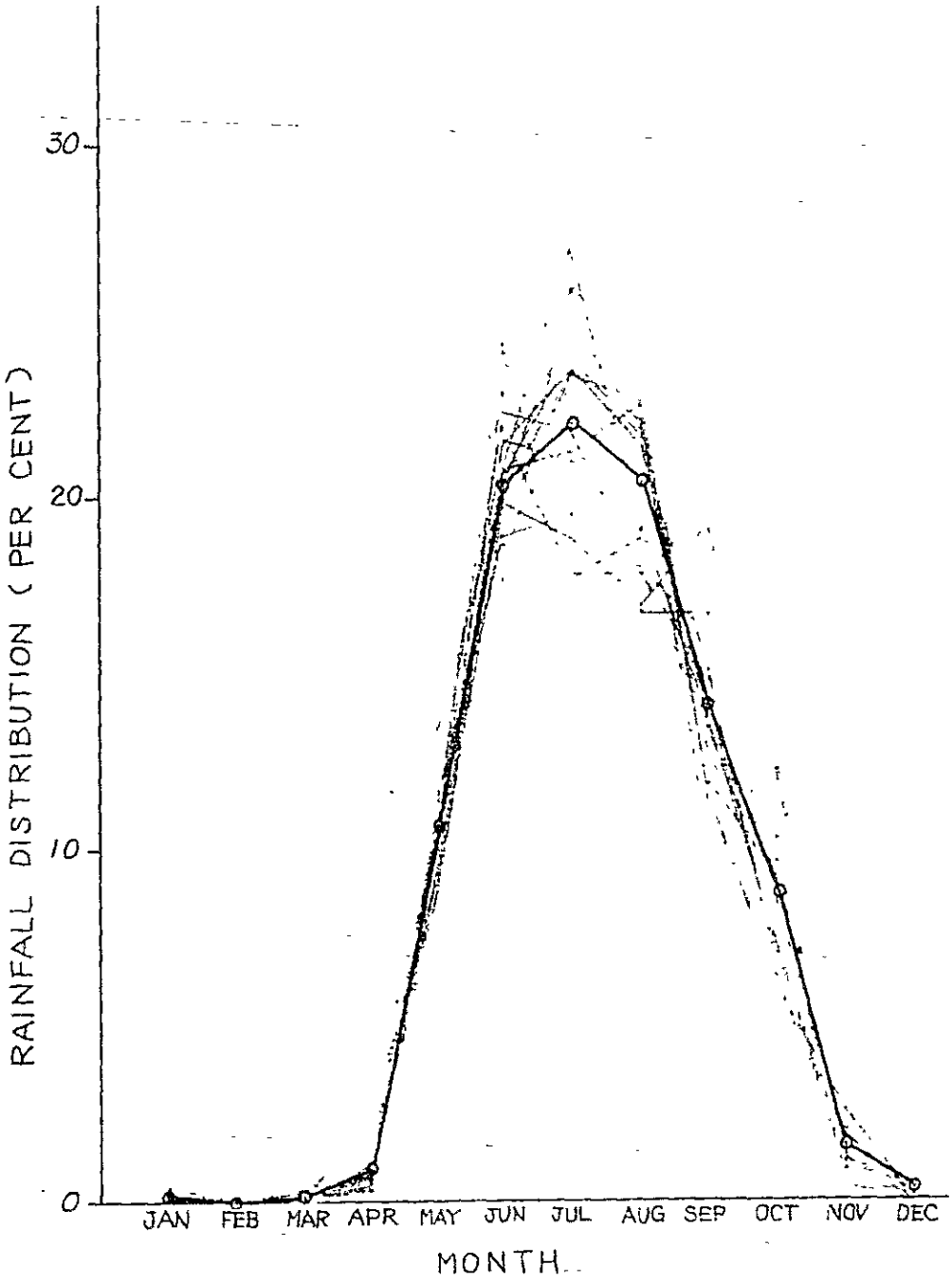


Fig 3-7 RAINFALL DISTRIBUTION

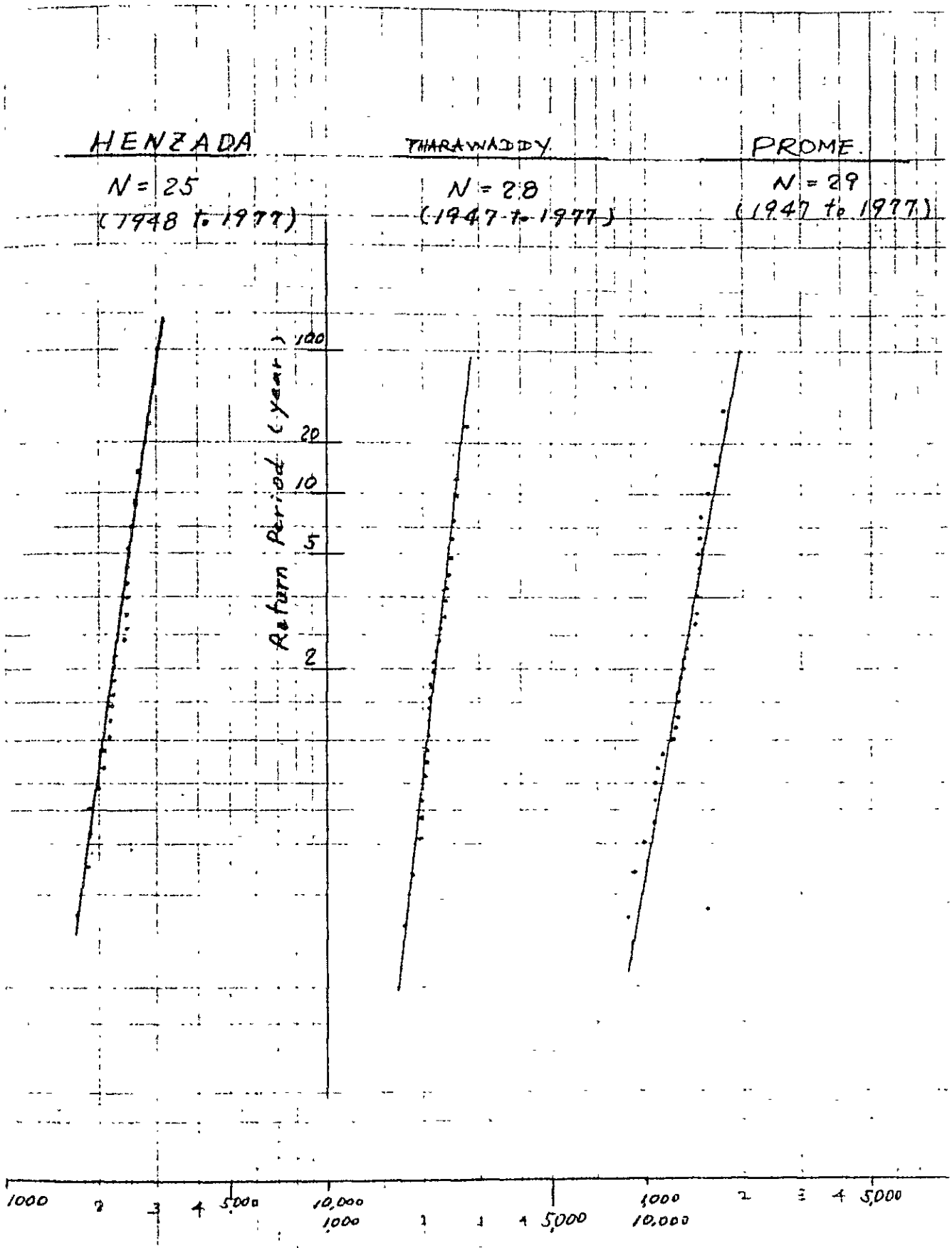


Fig 3-8 Probability Annual Rainfall

Runoff

3.24 As the runoff data, the daily discharge records are available regarding 14 rivers and streams in the left bank of the Irrawaddy river with their catchment areas in the Pegu Yoma as shown in Fig. 3-9. The observation on base runoff has not been made yet. The runoff lasts eight months from May to December with daily fluctuation. No discharge is observed at the end of the dry season. The discharge observations are required regarding rivers and streams on the right bank for planning of the Project on the right bank of the Irrawaddy river. Table 3-7 shows the respective monthly discharges of the above mentioned 13 rivers and streams. The Kadinbilin river (catchment area: about 240.9 km^2) has the monthly maximum discharge at 300Mm^3 and the annual maximum discharge at 520 Mm^3.

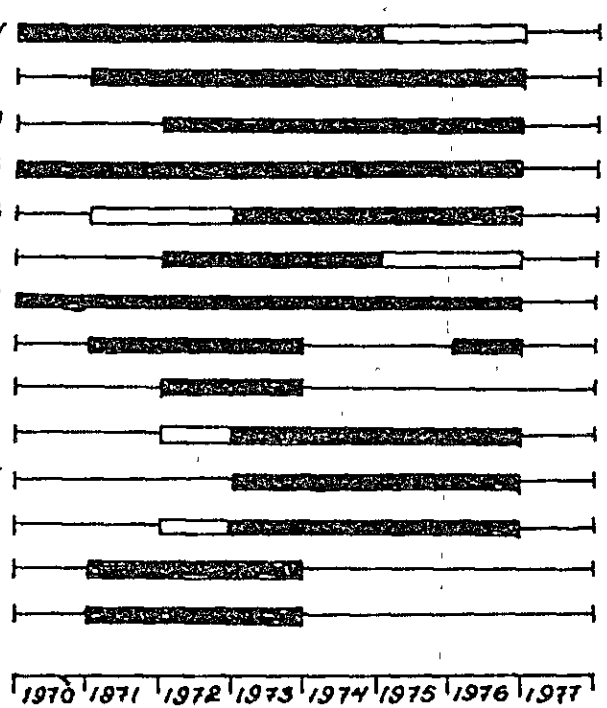
3.25 On the basis of relationship between accumulated rainfall and accumulated specific discharge, the rainfall loss was estimated at about 200mm, and the runoff coefficient varies with rainfall to show higher coefficient in the area with much rainfall. The annual runoff coefficient is about 30 percent on an average, the maximum about 45 percent and the minimum about 18 percent, respectively. (Refer to Fig. 10). Hydrographs for the Irrawaddy and the Myitmaka rivers, which differ from those of their tributaries on the daily basis, show a curve connecting the beginning of the rainy season with its end with the peak in August.

Existing Irrigation System

3.26 In Burma, the irrigation projects including dam and other infrastructural facilities had been commenced in the end of the 19th century, concentratively in Mandalay Division. These irrigation projects can be classified into three types; national irrigation projects under-taken by Irrigation Department (ID), village irrigation works carried

Fig 3-9 PERIOD OF OBSERVATION

RIVER	STATION	C.A(sq km)	PERIOD OF OBSERVATION
1. OKKAN	KYAUKPYINTHA	313.4	
2. THEGAW	KAUNG.LAUNG TINE	88.1	
3. KADINBILIN	KWETMA	240.9	
4. BAWBIN	BAWBIN	261.6	
5. GAMON	CHAUNG ZAUK	80.3	
6. TAUNGNYO	MAGYIBIN	349.1	
7. WEGYI	THEME	638.7	
8. THEGON	YONBINGET	69.8	
9. SHWELE	THAPANGAING		
10. DINGYI	MYODAUNG	323.7	
11. ALENAWIN	MAGWE	294.5	
12. SOUTH NAWIN	YATTHIT	639.7	
13. KYUN YAUNG	KWINLYAGYI	64.7	
14. KYUN CHAUNG	KYIDAING	72.5	



FULL TERM
PART TERM
NO

Table 3-7 (1) MONTHLY DISCHARGE

Name of River - Okkan
Hydrological Station - Kyaukpyintha
Township - Taikkyi
Catchment area - 313.4 sq.km

Note * No data
- No water
(Unit X 10^6 cu.m)

Year	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1970	-	-	-	-	7.2	28.7	34.5	45.3	33.1	32.4	7.4	-	188.6
1971	-	-	-	-	-	37.1	101.1	82.2	27.3	13.7	2.9	-	264.3
1972	-	-	-	-	2.9	21.0	92.0	139.8	53.8	22.8	14.4	4.3	351.0
1973	-	-	-	-	6.1	8.1	48.1	63.0	35.1	22.7	1.5	0.3	184.9
1974	-	-	-	-	6.2	37.9	96.0	97.7	85.4	45.0	-	-	368.2
1975	-	-	-	-	43.0	70.8	56.3	79.6	*	*	*	*	
1976	-	-	-	-	4.7	56.8	*	*	63.6	25.7	7.2	-	
1977	*	*	*	*	*	*	*	*	*	*	*	*	
Mean	-	-	-	-	4.5	26.6	74.3	85.6	46.9	27.3	5.2	0.9	271.3
Max	-	-	-	-	7.2	37.9	101.1	139.8	85.4	45.0	14.4	4.3	368.2
Min	-	-	-	-	2.9	8.1	34.5	45.3	27.3	13.7	1.5	0.0	184.9

(2) MONTHLY DISCHARGE

Name of River - Thegaw
Hydrological Station - Kaung-laung-tine
Township - Letpadan
Catchment area - 88.1 sq.km

Note * No data
- No water

(Unit X 10^6cu.m)

Year	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1970	*	*	*	*	*	*	*	*	*	*	*	*	
1971	-	-	-	-	-	1.6	11.9	26.0	6.0	7.4	5.6	3.1	61.6
1972	-	-	-	-	-	3.1	15.3	11.2	3.6	3.3	5.7	3.7	45.9
1973	-	-	-	-	0.6	2.9	7.0	9.2	8.6	7.9	1.2	-	37.4
1974	-	-	-	-	0.8	12.0	32.5	45.1	26.2	7.3	10.9	1.9	136.7
1975	-	-	-	-	0.0	12.6	23.1	40.4	30.6	15.4	1.1	-	122.9
1976	-	-	-	-	0.2	34.1	21.3	56.9	2.7	1.5	0.8	-	117.5
1977	*	*	*	*	*	*	*	*	*	*	*	*	
Mean	-	-	-	-	0.3	11.1	18.5	31.5	13.0	7.1	4.2	1.5	87.0
Max	-	-	-	-	0.8	34.1	32.5	56.9	30.6	15.4	10.9	3.7	136.7
Min	-	-	-	-	0.0	1.6	7.0	9.2	2.7	1.5	0.8	0.0	45.9

(3) MONTHLY DISCHARGE

Name of River - Kadinbilin
Hydrological Station - Kwetma
Township - Minhla
Catchment area - 240.9 sq.km

Note * No data
\- No water

(Unit X 10^6 cu.m)

Year	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1970	*	*	*	*	*	*	*	*	*	*	*	*	
1971	*	*	*	*	*	*	*	*	*	*	*	*	
1972	-	-	-	-	3.1	22.9	91.1	83.9	30.9	24.8	-	-	256.7
1973	-	-	-	-	9.8	21.8	28.0	46.5	61.0	26.9	3.6	2.8	200.4
1974	-	-	-	-	10.3	88.8	60.1	82.8	69.7	23.7	7.4	-	342.8
1975	-	-	-	-	4.1	74.2	62.6	42.4	24.5	12.0	13.3	0.4	233.5
1976	-	-	-	-	25.0	299.3	40.1	24.1	94.6	24.9	4.0	-	522.0
1977	*	*	*	*	*	*	*	*	*	*	*	*	
Mean	-	-	-	-	10.5	101.4	56.4	57.9	56.1	22.5	5.7	0.6	311.1
Max	-	-	-	-	25.0	299.3	91.1	83.9	94.6	26.9	13.3	2.8	522.0
Min	-	-	-	-	3.1	21.8	28.0	34.1	24.5	12.0	0.0	0.0	200.4

(4) MONTHLY DISCHARGE

Name of River - Bawbin
Hydrological Station - Bawbin
Township - Zigon
Catchment area - 261.6 sq.km

Note * No data
- No water

(nit X 10^6 cu.m)

Year	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1970	-	-	-	-	1.9	61.0	26.3	30.7	17.4	18.7	0.6	-	156.6
1971	-	-	-	-	0.7	11.0	10.4	14.5	13.1	7.5	2.1	-	59.3
1972	-	-	-	-	-	4.0	12.3	5.7	1.7	1.4	0.1	-	25.2
1973	-	-	-	-	1.7	0.8	9.2	5.9	2.8	4.5	0.6	-	25.5
1974	-	-	-	-	2.9	9.4	8.4	18.2	2.7	3.0	3.1	-	47.7
1975	-	-	-	-	3.8	11.6	9.8	23.1	12.6	13.5	4.9	-	79.3
1976	-	-	-	-	0.5	4.2	12.6	19.6	3.3	19.9	-	-	60.1
1977	*	*	*	*	*	*	*	*	*	*	*	*	
Mean	-	-	-	-	1.6	14.6	12.7	16.8	7.7	9.8	1.6	-	64.8
Max	-	-	-	-	3.8	61.0	26.3	30.7	17.4	19.9	4.9	-	156.6
Min	-	-	-	-	0.0	0.8	8.4	5.7	1.7	1.4	0.0	-	25.2

(5) MONTHLY DISCHARGE

Name of River - Taungnyo
Hydrological Station - Magyibin
Township - Nattalin
Catchment area - 549.1 sq.km

Note * No data
- No water

(Unit X 10^6 cu.m)

Year	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1970	*	*	*	*	*	*	*	*	*	*	*	*	
1971	*	*	*	*	*	*	*	*	*	*	*	*	
1972	-	-	-	-	-	-	45.0	18.2	17.3	11.5	1.4	-	93.4
1973	-	-	-	-	1.0	15.4	34.1	26.1	16.6	6.5	-	-	99.7
1974	-	-	-	-	26.3	45.9	78.2	105.2	118.3	157.6	-	-	
1975	-	-	-	-	-	-	-	92.0	54.3	-	-	-	
1976	-	-	-	-	17.3	87.2	50.8	-	-	-	-	-	
1977	*	*	*	*	*	*	*	*	*	*	*	*	
Mean	-	-	-	-	0.5	7.7	39.6	22.2	17.0	9.0	0.7	-	96.7
Max	-	-	-	-	1.0	15.4	45.0	26.1	17.3	11.5	1.4	-	99.7
Min	-	-	-	-	0.0	0.0	34.1	18.2	16.6	6.5	0.0	-	93.4

(6) MONTHLY DISCHARGE

Name of River - Wegyi
Hydrological Station - Theme
Township - Paungde
Catchment area - 538.7 sq.km

Note * No data
- No water

(Unit X 10^6 cu.m)

Year	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1970	-	-	-	-	6.2	23.1	45.8	102.4	40.0	57.6	10.7	-	285.8
1971	-	-	-	-	12.3	68.2	64.0	69.5	43.4	43.8	38.3	19.6	359.1
1972	-	-	-	-	0.3	11.4	58.9	48.4	13.2	17.5	4.9	1.9	156.5
1973	-	-	-	-	2.8	18.5	57.8	26.9	50.8	49.6	15.3	1.6	223.3
1974	-	-	-	-	1.1	45.0	90.3	56.6	29.4	16.6	11.6	-	250.6
1975	-	-	-	-	4.5	31.7	46.7	52.5	13.0	21.8	13.7	-	183.9
1976	-	-	-	-	15.9	40.6	54.8	56.7	31.2	34.7	15.8	9.1	258.8
1977	*	*	*	*	*	*	*	*	*	*	*	*	
Mean	-	-	-	-	6.2	34.1	59.7	59.0	31.6	34.5	15.8	4.6	245.5
Max	-	-	-	-	15.9	68.2	90.3	102.4	50.8	57.6	38.3	19.6	359.1
Min	-	-	-	-	0.3	11.4	45.8	26.9	13.0	16.6	4.9	0.0	156.5

(7) MONTHLY DISCHARGE

Name of River - Thegon
Hydrological Station - Yonbindet
Township - Thegon
Catchment - 69.8 sq.km

Note * No data
- No water

(Unit X 10^6 cu.m)

Year	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1970	*	*	*	*	*	*	*	*	*	*	*	*	
1971	-	-	-	-	1.4	7.9	15.4	6.3	6.2	3.9	-	-	41.1
1972	-	-	-	-	-	7.3	6.5	8.3	4.8	-	8.9	-	35.8
1973	-	-	-	-	10.6	6.0	0.6	-	-	-	-	-	17.2
1974	*	*	*	*	*	*	*	*	*	*	*	*	
1975	*	*	*	*	*	*	*	*	*	*	*	*	
1976	-	-	-	-	0.9	1.0	1.4	1.3	1.1	2.6	-	-	8.3
1977	*	*	*	*	*	*	*	*	*	*	*	*	
Mean	-	-	-	-	3.2	5.6	6.0	4.0	3.0	1.6	2.2	-	25.6
Max	-	-	-	-	10.6	7.9	15.4	8.3	6.2	3.9	8.9	-	41.1
Min	-	-	-	-	0.0	1.0	0.6	0.0	0.0	0.0	0.0	-	8.3

(8) MONTHLY DISCHARGE

Name of River - Shwele
Hydrological Station - Thapangaing
Township - Paukkaung
Catchment area - sq.km

Note * No data
- No water

(Unit X 10^6 cu.m)

Year	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1970	*	*	*	*	*	*	*	*	*	*	*	*	
1971	*	*	*	*	*	*	*	*	*	*	*	*	
1972	-	-	-	-	-	2.3	-	2.5	0.7	-	2.4	-	7.9
1973	-	-	-	-	6.0	10.2	15.4	0.6	0.3	-	-	-	32.5
1974	*	*	*	*	*	*	*	*	*	*	*	*	
1975	*	*	*	*	*	*	*	*	*	*	*	*	
1976	*	*	*	*	*	*	*	*	*	*	*	*	
1977	*	*	*	*	*	*	*	*	*	*	*	*	
Mean	-	-	-	-	3.0	6.3	7.7	1.6	0.5	-	1.2	-	20.2
Max	-	-	-	-	6.0	10.2	15.4	2.5	0.7	-	2.4	-	32.5
Min	-	-	-	-	0.0	2.3	0.0	0.6	0.3	-	0.0	-	7.9

(9) MONTHLY DISCHARGE

Name of River - Dingyi
Hydrological Station - Myodaung
Township - Paukkaung
Catchment area - 323.7 sq.km

Note * No data
- No water

(Unit X 10^6 cu.m)

Year	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1970	*	*	*	*	*	*	*	*	*	*	*	*	
1971	*	*	*	*	*	*	*	*	*	*	*	*	
1972	*	*	*	*	*	*	*	*	*	*	2.5	0.5	
1973	-	-	-	-	3.2	10.1	26.2	26.9	32.5	27.0	13.2	2.4	141.5
1974	-	-	-	-	0.4	12.1	17.5	27.8	21.4	8.6	5.1	1.6	94.5
1975	-	-	-	-	2.5	20.6	45.7	52.0	25.0	23.2	7.4	0.4	176.8
1976	-	-	-	-	6.8	22.7	45.0	33.0	27.2	29.7	7.4	3.6	175.4
1977	*	*	*	*	*	*	*	*	*	*	*	*	
Mean	-	-	-	-	3.2	16.4	33.6	34.9	26.5	22.1	8.3	2.0	147.1
Max	-	-	-	-	6.8	22.7	45.7	52.0	32.5	29.7	13.2	3.6	175.4
Min	-	-	-	-	0.4	10.1	17.5	26.9	21.4	8.6	5.1	0.4	94.5

(10) MONTHLY DISCHARGE

Name of River - Alenawin
Hydrological Station - Magwe
Township - Paukkaung
Catchment area - 274.5 sq.km

Note * No data
- No water

(Unit X 10^6 cu.m)

Year	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1970	*	*	*	*	*	*	*	*	*	*	*	*	
1971	*	*	*	*	*	*	*	*	*	*	*	*	
1972	*	*	*	*	*	*	*	*	*	*	*	*	
1973	-	-	-	-	4.1	7.2	16.9	16.1	22.4	14.3	6.7	1.2	88.9
1974	-	-	-	-	2.5	14.5	15.2	24.6	21.9	12.1	10.8	1.2	102.8
1975	-	-	-	-	0.9	15.3	25.6	34.7	23.9	13.5	2.2	-	116.1
1976	-	-	-	-	5.7	12.2	6.6	9.8	5.5	6.6	0.5	0.1	47.0
1977	*	*	*	*	*	*	*	*	*	*	*	*	
Mean	-	-	-	-	3.3	12.3	16.1	21.3	18.4	11.6	5.1	0.6	88.7
Max	-	-	-	-	5.7	15.3	16.9	34.7	23.9	14.3	10.8	1.2	116.1
Min	-	-	-	-	0.9	7.2	6.6	9.8	5.5	6.6	0.5	0.0	47.0

(11) MONTHLY DISCHARGE

Name of River - South Nawin
Hydrological Station - Yatthit
Township - Paukkaung
Catchment area - 639.7 sq.kn

Note * No data
– No water

(Unit X 10^6 cu.m)

Year	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1970	*	*	*	*	*	*	*	*	*	*	*	*	
1971	*	*	*	*	*	*	*	*	*	*	*	*	
1972	*	*	*	*	*	*	*	*	*	*	2.5	0.5	
1973	–	–	–	–	9.2	23.8	44.9	40.9	47.7	34.9	17.0	4.2	222.6
1974	–	–	–	–	5.0	25.8	55.4	65.3	54.1	24.5	18.7	5.6	264.4
1975	–	–	–	–	2.3	29.2	97.4	90.8	47.2	44.0	17.1	0.5	328.5
1976	–	–	–	–	16.8	55.6	73.1	72.3	55.3	54.2	9.4	–	336.7
1977	*	*	*	*	*	*	*	*	*	*	*	*	
Mean	–	–	–	–	8.3	36.1	67.7	67.3	51.1	39.4	15.6	2.6	288.1
Max	–	–	–	–	16.8	55.6	97.4	90.8	55.3	54.2	18.7	4.2	336.7
Min	–	–	–	–	2.3	23.8	44.9	40.9	47.2	24.5	9.4	0.0	222.6

Year	Jan.	Feb.	Mar.	Apr.	May.	June	July.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1970	*	*	*	*	*	*	*	*	*	*	*	*	
1971	-	-	-	-	-	-	2.8	3.4	1.4	1.8	-	-	9.4
1972	-	-	-	-	-	0.2	0.1	2.6	4.6	1.0	-	-	8.5
1973	-	-	-	-	-	5.5	2.2	1.1	1.7	4.2	0.3	-	15.0
1974	*	*	*	*	*	*	*	*	*	*	*	*	
1975	*	*	*	*	*	*	*	*	*	*	*	*	
1976	*	*	*	*	*	*	*	*	*	*	*	*	
1977	*	*	*	*	*	*	*	*	*	*	*	*	
Mean	-	-	-	-	-	1.9	1.7	2.4	2.6	2.3	0.1	-	11.0
Max	-	-	-	-	-	5.5	2.8	3.4	4.7	4.2	0.3	-	15.0
Min	-	-	-	-	-	0.2	0.1	1.1	1.4	1.0	0.0	-	8.5

(13) MONTHLY DISCHARGE

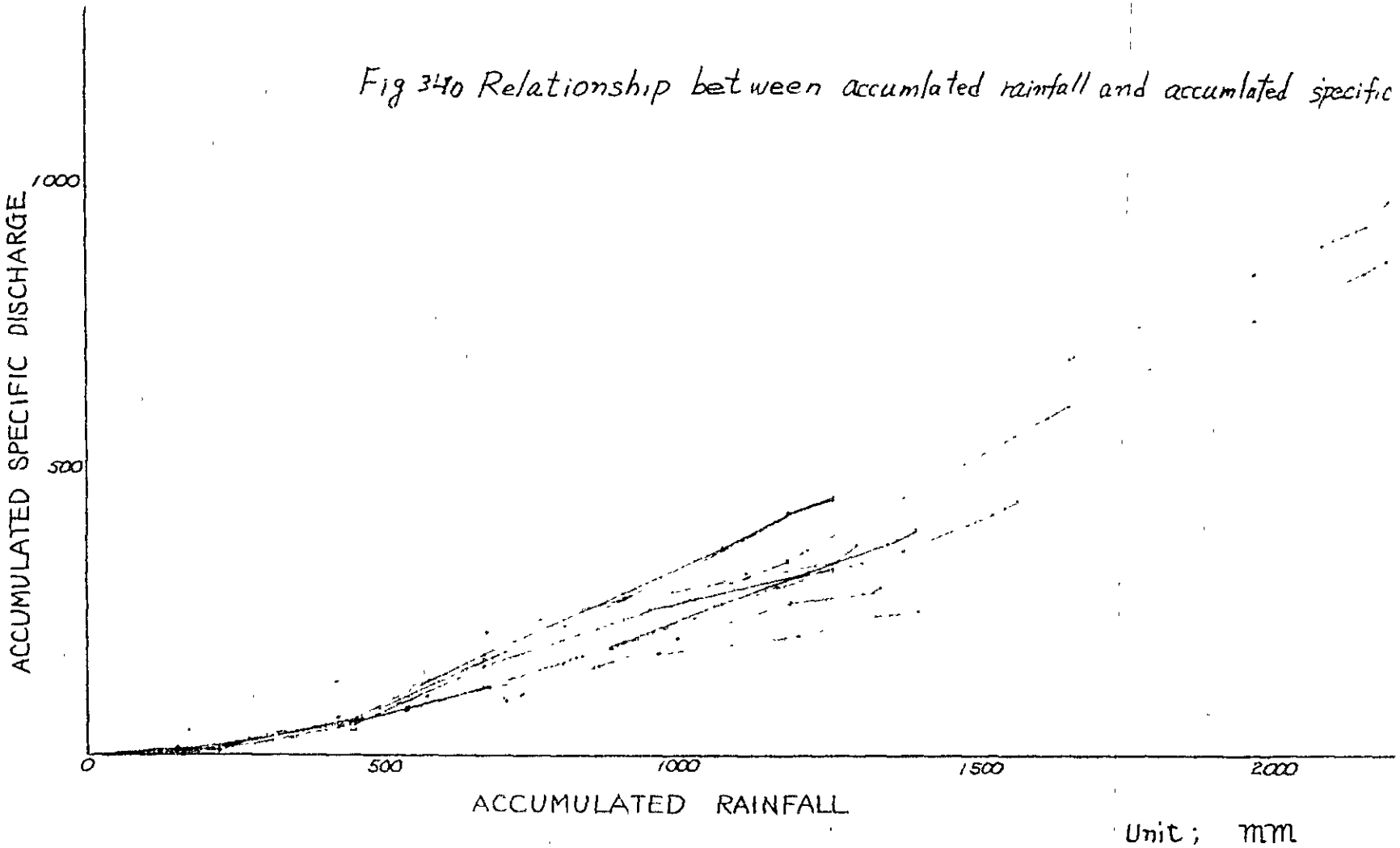
Name of River - Kyun Chaung
Hydrological Station - Kyidaing
Township - Shwedaung
Catchment area - 72.5 sq.km

Note * No data
- No water

(Unit X 10^6 cu.m)

Year	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1970	*	*	*	*	*	*	*	*	*	*	*	*	
1971	-	-	-	-	-	0.1	4.8	5.1	3.9	4.3	1.8	0.0	20.0
1972	-	-	-	-	-	7.9	0.1	26.1	4.0	3.2	1.3	0.2	42.8
1973	-	-	-	-	-	3.7	3.9	3.6	5.9	5.3	0.4	-	22.8
1974	*	*	*	*	*	*	*	*	*	*	*	*	
1975	*	*	*	*	*	*	*	*	*	*	*	*	
1976	*	*	*	*	*	*	*	*	*	*	*	*	
1977	*	*	*	*	*	*	*	*	*	*	*	*	
Mean	-	-	-	-	-	3.9	2.9	11.6	4.6	4.3	1.2	0.1	28.5
Max	-	-	-	-	-	7.9	4.8	26.1	5.9	5.3	1.8	0.2	42.8
Min	-	-	-	-	-	0.1	0.1	3.6	3.9	3.2	0.4	0.0	20.0

Fig 340 Relationship between accumlated rainfall and accumlated specific discharge



out by Irrigation Department and local community, and small-scale pump irrigation projects carried out by Agriculture Mechanization Department. A total irrigable area by these irrigation systems was estimated at about 950 thousand ha. in 1976/77, which accounts for about nine percent of the nationwide total acreage of the farm lands. (Refer to Table 3-8).

3.27 The force account basis projects are defined as those which require the project cost more than US $ 154,00 (Kyats 100,000) and 31 projects in the line have been completed up to now to cover about 413,000 ha. Most of these projects are formulated on the basic facilities such as dams and weirs. Almost of all canals are of earth canal type and the density of canal networks is low about 8m/ha, which will not effectively function for successful irrigation. (Refer to Table 3-9). There are three on-going projects, the total expected irrigable areas of which are estimated at about 93,000 ha. These projects are now implemented by the Government's own funds or assistances of the international financing agencies. (Refer to Table 3-10). There are five projects now under planning (Feasibility study stage or Final Design stage), the total expected irrigable areas of which are estimated at about 156,000 ha. These projects will be started in its implementation within a few years. (Refer to Table 3-11)

3.28 For village irrigation works (VIW) in the Project Area, there are 38 works existing to cover about 21 thousand ha of irrigable areas. (See Table 3-12). The Irrigation Department carries out designing, implementation, and operation/maintenance of these works, but 30 percent of the cost of works shall be shouldered by township or farmers. Many works covers only small areas below 500 ha.

Table 3-8 Net Irrigation Area

(Unit : '000 ha)

Major Facility	1975/76 National Level		1975/76 Project Area		1976/77 National Level (1)		1976/77 Project Area (2)		(2)/(1) (%)
Canals	631.5	(64)	20.9	(46)	626.9	(66)	20.2	(51)	3
Tanks	105.6	(11)	2.2	(5)	88.8	(10)	2.2	(6)	2
Wells	12.4	(1)	0.6	(1)	11.9	(1)	0.9	(2)	8
Pumps	103.0	(11)	17.6	(39)	94.4	(10)	13.6	(35)	14
Wind mills	0.7	(0)	-	(-)	0.5	(0)	-	(-)	-
Others	129.4	(13)	3.8	(9)	126.5	(13)	2.4	(6)	2
Total	982.6	(100%)	45.1	(100%)	949.0	(100%)	39.3	(100%)	4

Source : National level ---

Project Area --- Township office

TABLE 3-9 LIST OF MAJOR IRRIGATION PROJECT

Project	Location	Irrigable Area (ha)	Construction Period	Major Facilities				
				Dam	Weir	Pump	Canals (km) Main	Canals (km) Secondary
Pyugan Tank	Mandalay Div.	1,550	1961 - 62	1	-	-	6.2	2.7
Meiktila Lake	-ditto-	18,420	Burmese King age	1	-	-	1.0	36.1
Mondaing Tank	-ditto-	2,750	1962 - 67	1	-	-	-	-
Alongsithu Tank	-ditto-	4,630	1957 - 58	1	-	-	-	7.4
Taungpulu Tank	-ditto-	3,050	1954 - 55	1	-	-	0.6	-
Thitson Tank	-ditto-	8,580	1959 - 62	1	-	-	22.3	29.4
Kyetmauktaung T.	-ditto-	11,910	1961 - 68	1	-	-	30.4	117.8
Pyaungbya Tank	-ditto-	2,340	1965 - 70	1	-	-	20.8	8.0
Khetlan Tank	-ditto-	2,800	1967 - 73	1	-	-	24.6	4.2
Heho Tank	Shan State	2,000	1962 - 65	1	-	-	16.7	10.3
Ngwedaung T.	Kayah State	2,730	1964 - 65	1	-	-	14.0	10.6
Yezin Tank	Mandalay	6,400	1966 - 76	1	-	-	9.5	93.4
Washawng	Kachin	6,980	1962 - 67	-	1	-	19.5	71.3
Shwebo	Sagaing	91,930	1901 - 07	-	1	-	112.6	543.1
Ye-U	-ditto-	51,560	1911 - 19	-	1	-	101.9	308.0
Mandalay	Mandalay	42,360	Burmese King age	-	1	-	108.3	212.5
Htonbo Sedaw	-ditto-	1,080	Burmese King age	-	1	-	5.4	11.5
Panlaung	-ditto-	34,770	Burmese King age*	-	1	-	110.9	232.7
Zawgyi	-ditto-	38,650	-ditto-	-	1	-	160.0	226.4
Trans-Samon	-ditto-	1,200	1958 - 59	-	1	-	ND	ND

(cont'd)

Project	Location	Irrigable Area (ha)	Construction Period	Major Facilities				
				Dam	Weir	Pump	Canals (km)	
							Main	Secondary
Sameikkon	Mandalay Div.	600	1966 - 65	-	-	1	3.3	3.2
Letpan Chi-baw	-ditto-	400	1965 - 66	-	-	1	6.2	-
Mezali	Magwe Div.	38,710	Burmese King age*	-	1	-	86.1	270.0
Aingma	-ditto-	10,200	Burmese King age**	-	1	-	32.8	70.6
Salin	-ditto-	11,370	Burmese King age**	-	1	-	60.2	57.3
South Man	-ditto-	4,780	1965 - 70	-	1	-	32.0	27.4
Yinmale	-ditto-	2,480	1963 - 64	-	1	-	2.6	-
Kinmundaung	-ditto-	4,000	1959 - 60	-	1	-	2.1	-
Intein	Shan State	1,520	1963 - 64	-	1	-	9.6	-
Phailon	-ditto-	2,000	1965 - 68	-	1	-	19.2	-
Nymyang	-ditto-	1,200	1964 - 67	-	1	-	4.8	-
Total		412,950					1023.6	2353.9

Note: * 1912 English Government repaired.

** 1926 - ditto -

Table 3-10 Irrigation Project under Construction

Name	Location	Irrigable Area (ha)	Construction Period	Major Facilities			
				Dam	Weir	Canals (Km) Main	Secondary
Chaung Ma Gyi Dam	Pyawbwe	3,710		1	1	19.7	35.5
North Nawin	Prome	38,700		1	-	72.0	445.0
Sedaweyi	Mandalay	50,800		1	1*	113.6	1518.4
Total		93,210				205.3	1998.9

Note: * Existing

Source: Irrigation Dept.

Table 3-11 Proposed Irrigation Project
(Under the 3rd 4 years Development Plan)

Name	Location (Township)	Irrigable Area (ha)	Major Facilities				
			Dam	Weir	Pump	Canals (km) Main	Canals (km) Secondary
Mobye Irri.	Loikan	7,980	1*	-	-	58.9	132.5
Pump Irri.	Monywa + 4	21,900	-	-	1	**	**
Pyinmana	Pyinmana	8,080	1	1	-	19.5	204.8
South Nawin***	Paukkaung	32,000	1	-	-	**	**
Nyaunggyat**	Myittha	86,000	2	-	-	197.6	944.4
	TOTAL	155,960					

Note : * Existing dam
** Under detail investigation and design
*** The feasibility study of this project will be started within FY 1978

Source: Irrigation Department

Table 3-12 List of Village Irrigation Works

Sr. No.	Project Name	Location (Township)	Irrigable area (ha)	Remarks
	I. Pyay Division			
1.	Thitchaytin weir	Prome	511	
2.	Pyinmading Boottaw C. weir	"	418	
3.	Inya weir	"	1,106	
4.	Wayone weir	"	492	
5.	Chaungmagyi C. weir	"	498	
6.	Shwelay C. weir	"	237	
	Sub-total		3,262	
1.	Chinlegyi weir	Paukkaung	244	
2.	Yebyu weir	"	388	
3.	Kyantywa weir	"	568	
4.	Kyebinwaing Chitti weir	"	515	
	Sub-total		1,715	
1.	Kala Chaung weir	Shwedaung	594	
2.	Ginbaik weir	"	580	
3.	Mayanmankyun C. weir	"	511	
4.	Kyunyaung C. weir	"	703	
5.	Kokko Myaung weir	"	421	
6.	Thebyu weir	"	615	
7.	Nyaung Ding C. weir	"	626	
	Sub-total		4,050	
1.	Sani Taman weir	Paungde	381	
2.	Kanma Chaung weir	"	919	
3.	Thaphangon weir	"	437	
4.	Wetmyelu weir	"	628	
5.	Nyaunghla Taman weir	"	968	
6.	Kyobintha Taman weir	"	719	
	Sub-total		4,052	

Sr. No.	Project Name	Location (Township)	Irrigable area (ha)	Remarks
1.	Thayettaw weir	Thegon	921	
2.	Byamna Inn weir	"	404	
3.	Winlu Chaung weir	"	736	
4.	Leinthanpankmaw weir	"	972	
5.	Nyomabin weir	"	751	
6.	Thayet Khaing Kyo weir	"	810	
7.	Mwaytwintu weir	"	845	
8.	Ngettaw Mee Toomyaung weir	"	336	
	Sub-total		5,776	
1.	Chin weir	Padaung	481	
2.	Lutu weir	"	304	
3.	Kyauk weir	"	270	
4.	Yewe weir	"	659	
5.	Kathe weir	"	319	
6.	Inwin weir	"	120	
	Sub-total		2,153	
	Total		21,008	
	II. Irrawaddy Division			
1.	Win Sein Kwin Sluice	Myan aung	266	
	Sub-total		266	
	Total		266	
	G. Total		21,274	

3.29 The small-scale pump irrigation projects have been commenced since 1970 by the Agriculture Mechanization Department. The projects aims at lending portable pumps (5-6 Hp) to farmers for irrigating jute and cotton fields. Besides the above, there have existed many water tanks and weirs provided by farmers since old times; however, the details cannot be clarified due to lack of statistical data and records.

3.30 The above-mentioned projects have been playing vitally important roles to supply water not only for irrigation but domestic use in the dry season in the Central Burma suffering from chronological water shortage. However, there are some time-worn systems found functioning improperly. The country has been executing a comparatively small number of projects, although having a plenty of labour power and high level of engineering standard of the Irrigation Department. That may be because there are an absolute shortage of construction heavy equipments in quantity and of funds for purchasing spare parts to repair the equipments.

Irrigation Method

3.31 Almost of all the paddy fields are rainfed. Usually, in the early part of June when rain comes, farmers start ploughing and preparing nursery beds. In July, transplanting is carried out. In some inundated areas, transplanting is carried out in September after water goes down. The rainfall annually changes in its starting time and amount; and these series of farming works sometimes go ahead or other times go behind the general schedule mentioned above in order to meet the rainfall condition. Farming works depending upon rainfall causes the yield to be unstabilized. Under the circumstances, application of farming inputs such as fertilizers and other chemicals or introduction of HYV will allow merely a temporal effects available, but not a long-range stabilized farming available.

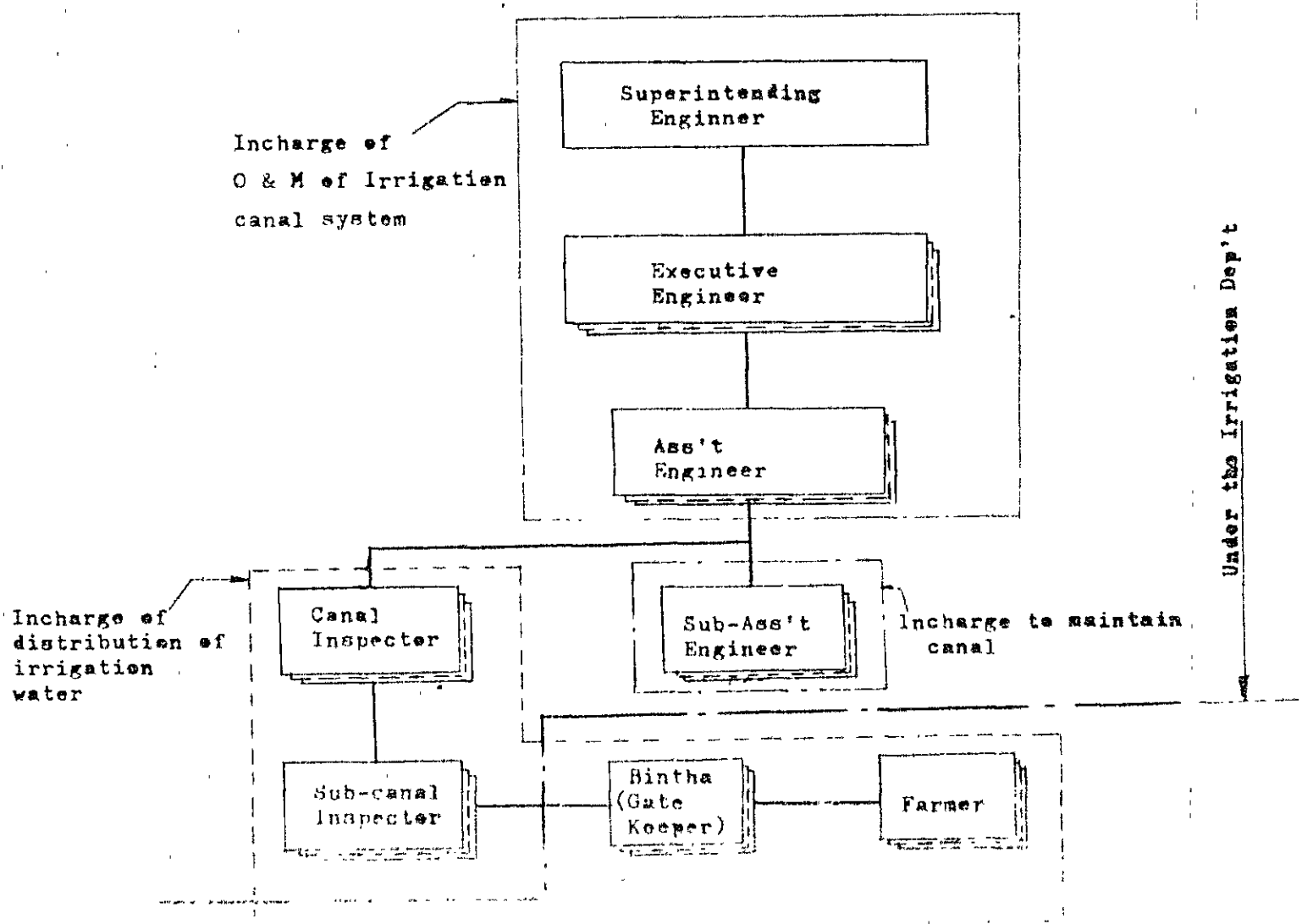
3.32 In the existing irrigation projects the flood irrigation method has been employed for paddy cropping and the fallow irrigation method for upland cropping. Water distribution has been executed in a manner that farmers' requirements gathered through gate keepers and canal inspectors is controlled and arranged by Assistant Engineer, who gives an operation instruction of the gate to the gate keeper. (See Fig. 3-11). In future, however when many irrigation projects are completed and the farmers have good understanding, on water management it will be required to establish an "Irrigator's Association" on the project basis through which the farmers can participate in the water management directly and independently.

3.33 Water charges are currently collected in indirect manner as land tax. The amount of land tax without irrigation is Kyats 4-5/ac. After completion of irrigation projects, the land tax at Kyats 10-12/ac will be collected by Land Record Department.

Flood and Inundation

3.34 With the Irrawaddy, the Myitmaka and Bassein Rivers rising in their water level, inundation occurs over those basin areas which occupy more than half of the plain with elevation below 15m (50 ft.) of the Project Area. The flood protection works on the Irrawaddy River have been executed for a long time with embankment along the most part of both banks. The Myitmaka river, which was once a main stream of the Irrawaddy River, flows down through the lowest-lying areas of the Project Area. The inundation from the Myitmaka river has been caused by not only floodings from its own catchment area but over-flooding from the Irrawaddy River. The inundation lasts three months from June to August every year and the water reaches about 0.5m deep or 3.0m in the deepest. The inundation areas are estimated at about little less than 320,000 ha. For these areas, the

Fig. 3-11 Organisation Chart of Operation and Maintenance for Irrigation Project



Irrigation Department has been undertaking the embankment construction as Village Drainage Works [illegible] of these works, however, has been considerably behind schedule due to the same reasons of shortage in fund, heavy equipment as the irrigation projects.

Sediment Runoff

5.35 In the North Mawin Project, the sediment runoff is taken by 1350 cu.m/sq.km/year that is an actual value observed in the Thegaw river, because the specific feature of the catchment area of the project has similarity to that of the Thegaw, adjacent to the project area. The above value, 1350 cu.m/sq.km/year, is considered larger than that in general case. The sediment runoff of 452 cu.m/sq/km/y was observed in the Sedawgyi Project which has a mining site in the catchment area of the river. The observation has been started for the South Mawin river since 1973, and the results, anticipated to clarify the matter; for the time being the estimation is made by 500 cu.m/sq.km/year. The Arakan Yoma origin tributaries in the west bank of the Irrawaddy River seem to have less sediment runoff than that in the east bank of the Irrawaddy River judging from the forest condition of the Arakan Yoma.

Water Quality

5.36 The Irrawaddy and the Bassein rivers are the tidal rivers up to around Henzada, and the Myitmaka river is also the tidal river up to around Tharrawaddy. When the water of these rivers are used for irrigation, salinity concentration should be observed as well as the surface water intake gate should be taken into consideration. The allowable salinity concentration for paddy cropping is around 500 to 1,000 ppm though varying with growing stages of plant and irrigation methods.

3.37 No water analysis has been made yet qualitatively and quantitatively; however, the present water use in the river basins suggests that the waters in the basins will be available for irrigation. The water analysis will be inevitably required in those areas where factories or plants are to be constructed in the future. Furthermore, it is essential to analyse the water quality if the water is used not only for irrigation but domestic use.

Water Right

3.38 In the Project Area, there exists no water right for irrigation by the waters of rivers, lakes and ponds. The water resources development therefore, will bring about no trouble with regard to the water right, excepting for the fact that conflict of interest may take place against the inland fisheries when the waters of lakes and ponds are used in the dry season.

III.3 Socio-economic condition

Administrative division in the Project Area

3.39 The Project Area covers 14 townships out of total 28 in Pegu Division, three townships out of total 40 in Rangoon Division and nine townships out of total 27 in Irrawaddy Division. The following table shows the general description of the results obtained from the survey.

Division	Township	Number of Village Tract	Number of Village	Acreages (ha)
Pegu	Prome	40	272	78,842
	Paukkhaung	53	235	190,759
	Padaung	38	210	250,709
	Paungde	42	241	92,892
	Thegon	43	348	77,667
	Shwedaung	48	297	73,541
	Tharrawaddy	48	262	103,313
	Letpadan	49	330	148,683
	Minhla	55	247	66,903
	Okpo	54	243	105,019
	Zigon	20	132	24,518
	Nattalin	78	367	136,738
	Monyo	37	207	63,972
	Gyobingauk	49	271	76,923
	Total	654	3652	1490,484
Rangoon	Hmawbi	42	212	50,330
	Hlegu	73	206	178,812
	Taikkyi	69	426	172,706
	Total	184	844	401,848