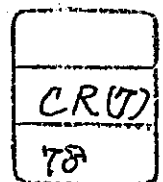


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REPORT
ON
PRELIMINARY SURVEY OF IRRAWADDY BASIN AGRICULTURAL
INTEGRATED DEVELOPMENT PROJECT
IN
THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

January, 1978

JAPAN INTERNATIONAL COOPERATION AGENCY



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ON
PRELIMINARY SURVEY OF IRRAWADDY BASIN AGRICULTURAL
INTEGRATED DEVELOPMENT PROJECT
IN
THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

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Foreword

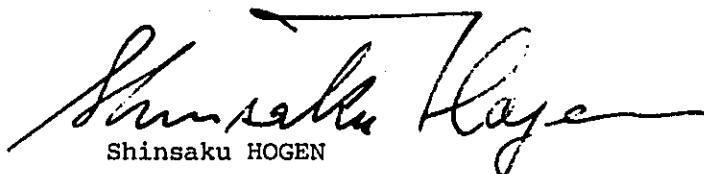
The Government of the Socialist Republic of the Union of Burma requested the Government of Japan for cooperation in the agriculture integrated development in the Irrawaddy River Basin.

In response to this request, the Japan International Cooperation Agency (JICA) dispatched, as part of its technical cooperations, a preliminary survey team headed by Mr. Minoru Ikeda, Deputy Director, Land Improvement and Consolidation Division, Agricultural Structure Improvement Bureau, Ministry of Agriculture and Forestry, for carrying out a 40-day survey (Sept. 20 - Oct. 10) in connection with the master plan study on the Irrawaddy Basin Agriculture Integrated Development Project.

The report contains the findings of the said preliminary survey team. I hope the report will prove to be useful for the coming full-scale survey.

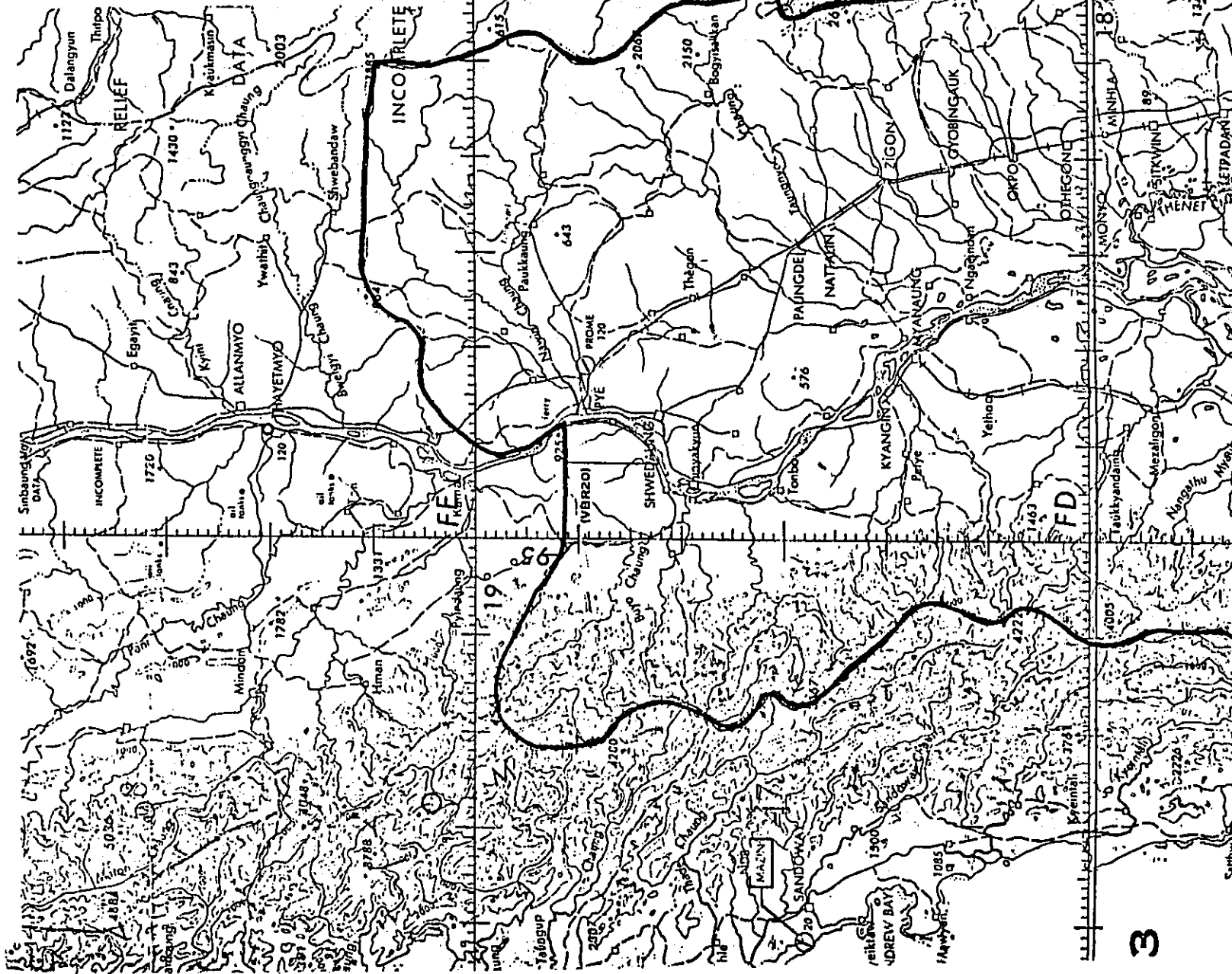
I wish to express my heartfelt appreciation to the Burmese Authorities concerned and to all those who have extended assistance to the survey team in preparing this report.

January, 1978



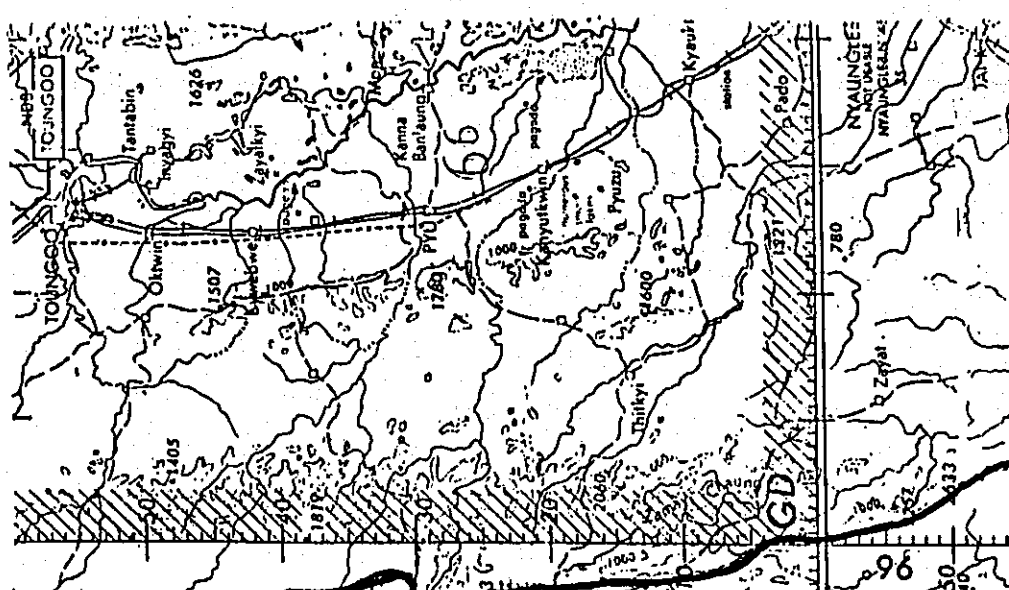
Shinsaku HOGEN

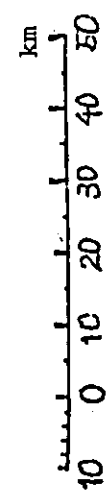
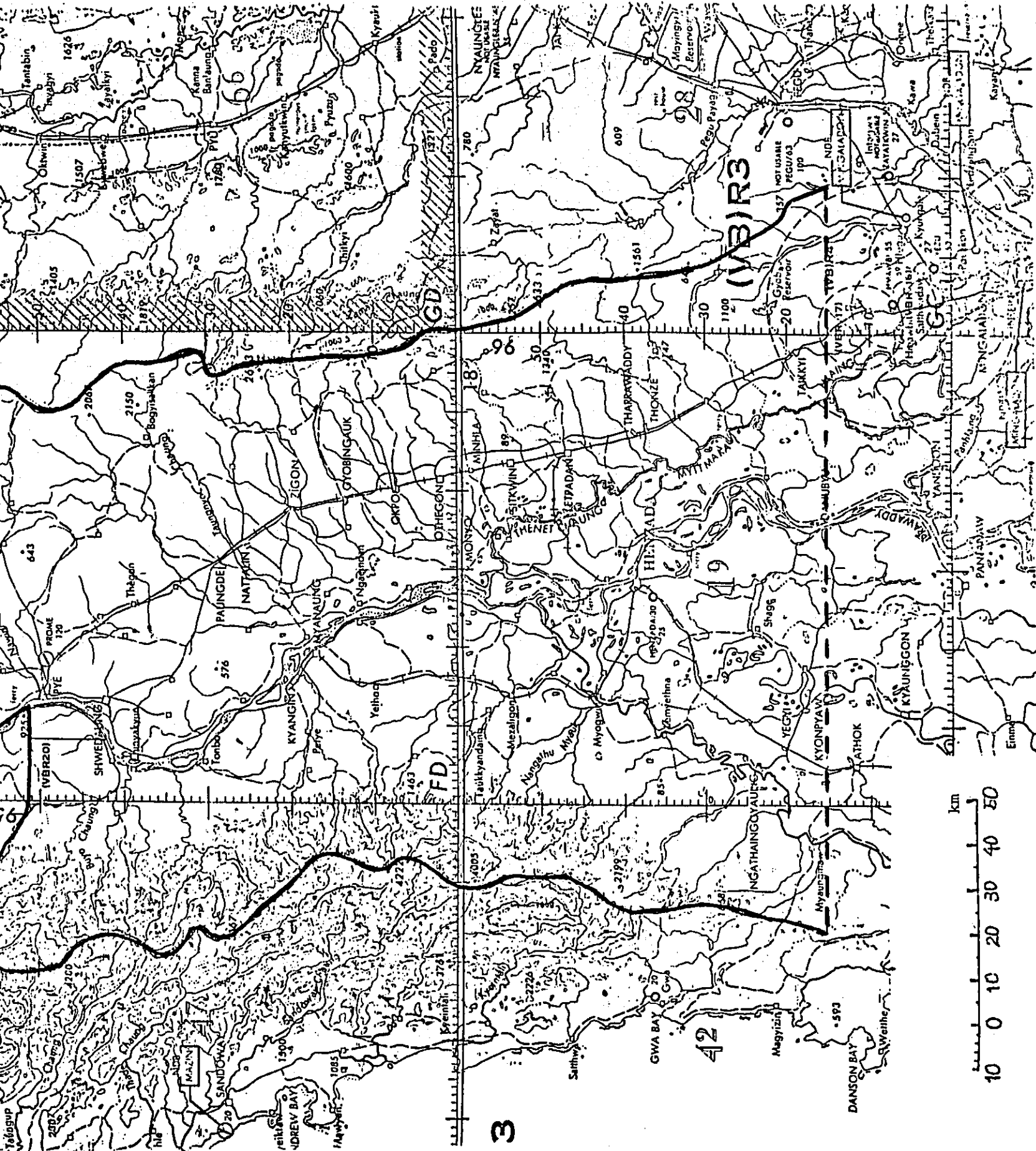
President
Japan International Cooperation Agency



Area

2.5 million ha
(6.2 million acres)





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Foreword

Location Map

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I. INTRODUCTION

I-1 Objective of Survey

The Irrawaddy River which has its origin far in the Himalayas advances southward flowing through the central part of Burma, joined by many tributaries such as the Magwe River and Numai Rivers and at the vicinity of Prome, diversifies into the Bassein River and a main stream of the Irrawaddy River then flows into the Andaman Sea.

A vast tract of fertile alluvial plain formed downstream by a large volume of sand and silt deposited by this great river, Irrawaddy and its tributaries with their catchment area of 400,000 km², performs a central role of agriculture with paddy field as the main constituent.

However, a fact that this fertile land of the Irrawaddy basin has not been fully utilized by lack of consolidation of infrastructures such as levees, irrigation and drainage facilities and roads. In order to fully exploit this potentials of the Irrawaddy basin, needless to state, various infrastructures must be consolidated. However, because of a fact that the basin is so vast and the matters to be consolidated are also so numerous that only by proceeding with individual consolidation plan carried fragmentarily comprehensive development of the district can not be achieved. Therefore, in order to achieve a real repayment from the investment on the district's comprehensive development, state of the Area should be clarified first and upon visualizing a state of the Area as it ought to be development plan for the whole Area should be conceived including not only agriculture but factors of other sectors and based on this basic direction respective plan should be promoted.

This survey is a preliminary survey to ensure a smooth survey for the drawing of basic plan to be implemented in future, and for that purpose a discussion with the officials concerned the Government of Burma, the reconnaissance survey of the Project Area and collection of the relevant materials have been carried out. And an effort has been made to clarify in general the followings:

- (1) Position to be given to this Development Plan and the content of the Burmese Government's request;
- (2) Correlation to the cooperation plans of international organizations such as the World Bank, the Asian Development Bank and other countries;
- (3) Tentative delineation of the Project Area;
- (4) Comprehension of the state of the Project Area by reconnaissance survey.

I-2 Survey Team Member

The survey team member comprised the following members;

Name	Assignment	Present Post
Minoru IKEKA	Leader	Deputy Director, Land Improvement & Consolidation Div., Construction Dept., Agricultural Structure Improvement Bureau, Ministry of Agriculture & Forestry
Isao HORIUCHI	Hydrology	Senior Officer of Agricultural Civil Engineering, Design Div., Construction Dept., KANTO Regional Administration Office, Ministry of Agriculture & Forestry
Sumio KONDO	Irrigation & Drainage	Senior Officer of Agricultural Civil Engineering, Design Div., Construction Dept., TOKAI Regional Administration Office, Ministry of Agriculture & Forestry
Akira SAKANE	Agronomy	Senior Officer, Genetics Div., Genetics & Physiology Dept. National Institute of Agricultural Science, Ministry of Agriculture and Forestry
Terushi EGASHIRA	Cooperation & Planning	Overseas Technical Cooperation Officer, International Cooperation Div., International Affairs Dept., Economic Affairs Bureau, Ministry of Agriculture & Forestry
Chikaichi TAKAHASHI	Agro-Economy	Agro-Economist, Agricultural Development Consulting Association
Hidetoshi YAOI	Coordination	Officer, Technical Affairs Div., Agricultural and Forestry Planning & Survey Dept., Japan International Cooperation Agency

I-3 Itinerary of Survey Team

No.	Date	Itinerary
1	Sept. 20 (Tue.)	Tokyo —→ Bangkok (KL 862)
2	21 (Wed.)	Bangkok —→ Rangoon (UB 222)
3	22 (Thu.)	Courtesy call to the Minister of Agriculture and Forests
4	23 (Fri.)	Courtesy call to the Director-General of the Overseas Economic Department, Planning and Finance Ministry and to the Director-General of the Planning and Statistics Department, Ministry of Agriculture and Forests. Consultation with the staffs of the Irrigation Department, Ministry of Agriculture and Forests
5	24 (Sat.)	Consultation with the staffs of the Irrigation Department, Ministry of Agriculture and Forests. Collection of reference materials
6	25 (Sun.)	Discussion among the Team members
7	26 (Mon.)	} Listening to the briefing of the staffs of Irrigation Department, Agricultural Corporation and related agencies. Collection of reference materials. (Preparation work for reconnaissance survey)
8	27 (Tue.)	
9	28 (Wed.)	
10	29 (Thu.)	Collection of reference Materials
11	30 (Fri.)	} Fly to the district (Twin Otter) Inspection of the Nawin Irrigation Plan. 1st reconnaissance survey Listening to the briefing of the related persons of each Township Inspection of the state of Irrawaddy River
12	Oct. 1 (Sat.)	
13	2 (Sun.)	
14	3 (Mon.)	
15	4 (Tue.)	
16	5 (Wed.)	Compilation of survey results and collected reference materials
17	6 (Thu.)	- do -

No.	Date	Itinerary				
18	Oct. 7 (Fri.)	Holding of joint meeting, report on the survey and discussion on the content				
19	8 (Sat.)	Compilation of the survey's content, consultation on the latter half's schedule				
20	9 (Sun.)	Two Team members, Egashira and Yaoi leave Rangoon				
21	10 (Mon.)	Meeting with the World Bank's representatives, two Team members arrive Tokyo				
22	11 (Tue.)	Observation of the proposed Thegaw dam site. Visit to the Taikkyi Agricultural Experiment Station				
23	12 (Wed.)	Discussion among the Team members. Consultation on the 2nd reconnaissance survey. Visit to related agencies				
24	13 (Thu.)	2nd reconnaissance survey <table style="display: inline-table; vertical-align: middle; margin-left: 20px;"> <tr> <td style="font-size: 2em; vertical-align: middle;">}</td> <td style="vertical-align: middle;">1st party --- Bassein district</td> </tr> <tr> <td style="font-size: 2em; vertical-align: middle;">}</td> <td style="vertical-align: middle;">2nd party --- Pyinmana Mandalay district</td> </tr> </table>	}	1st party --- Bassein district	}	2nd party --- Pyinmana Mandalay district
}	1st party --- Bassein district					
}	2nd party --- Pyinmana Mandalay district					
25	14 (Fri.)					
26	15 (Sat.)					
27	16 (Sun.)	Compilation of reconnaissance survey				
28	17 (Mon.)	Compilation work for reconnaissance report. Collection of reference materials				
29	18 (Tue.)					
30	19 (Wed.)					
31	20 (Thu.)	Holding of joint meeting				
32	21 (Fri.)	Submitting of a draft report of survey and explanation thereof				
33	22 (Sat.)	Discussion among the Team members. Compilation of reference materials				
34	23 (Sun.)	Drafting of survey's report, consultation on the content thereof and amendment work				
35	24 (Mon.)					
36	25 (Tue.)					
37	26 (Wed.)	Submitting of survey report. Collection of reference materials and data				

No.	Date	Itinerary
38	Oct. 27 (Thu.)	Compilation of reference materials and data
39	28 (Fri.)	- do -
40	29 (Sat.)	Ranggon → Tokyo

II. SUMMARY OF FINDINGS

II-1 Role of Agriculture

Agriculture plays a very important role in the economy of Burma.

The ratio of agriculture in GDP among agriculture, forestry and fisheries is, in the light of the 1969/70 price was 36.2% in 1974/75 and 36.3% or about one third in 1975/76.

The ratio occupied by the export of agricultural commodities in the total amount of export accounted for a very high share, witnessing 95% in 1961/62. This share has dipped to a low level of 70% in 1972/73 because of the stagnation in grain production with rice as its main constituent, but in 1973/74 it has regained 80% level.

Agricultural labor population has been estimated to be 1.193 million as of the end of March, 1976. It accounts for 66.4% of the total labor population.

On the other hand, the 20-years Economic Development Plan of the Burmese Government initiated in 1974/75 visualized increase rate of agricultural production at 4.8% a year and expected population increase rate of 2.3% which is an increase by two times, indicating positive posture toward agricultural production. Moreover, in the 1974/75, 1977/78 2nd 4-years Development Plan a high priority is given to agriculture sector in the Government investment.

II-2 Outline of the Project Area

2-1 Location of the Project Area

The Areas determines as the object of development plan, as shown in the map of location is a region of 2.5 million hectares surrounded by two mountain ranges of Arakan and Pegu along the line in north latitude 17°15' and 19°10'. The northern boundary is a line dividing the northern dry upland farming district and the southern wet paddy field district. And the east-west boundary is a watershed for the two mountain ranges of Arakan and Pegu. On the other hand, the southern boundary is the south delta district and it is a line established by adjusting with the projects under the World Bank.

2-2 The Project Area

The 2.5 million hectares total acreage can be classified into a million hectares of arable land, 850,000ha of forest and 650,000ha of devastated land. Annual rainfall ranges from 1,080, in the north to 2,420mm in the south. The district is comparatively a wet region and the soil is well suited for farming operation. The district's population is estimated to be about 3 million (out of which 2.1 million is farm population) and the population density is 120 persons/km² which is about 2.6 times of the national average of 46 persons/km², which means that required labor force for development is fully available.

And as the project Area is adjacent to a capital Rangoon which is also a terminal accumulating point of export agricultural commodities the Area is in a very advantageous position for the consumption and shipment of agricultural commodities.

2-3 Agriculture

Paddy rice is cultivated mainly in about a million hectares of the Area and beans, peanut, sesame and jute in upland and in paddy field as second crops of paddy rice.

Major portion of those arable land has no irrigation facilities that even in the rainy season some lands suffer from the water shortage. On the other hand, major portion of the lowland's arable land along the Irrawaddy River is inundated during the flood season and even at the latter part of the flood season the district is plagued by poor drainage because of no drainage facilities.

Needless to state, to improve the agricultural productivity in the Area the introduction of high-yielding varieties, increased application of fertilizer and expansion of double cropping are requisite. However, to ensure the effect of those measures the control of water under the consolidation of irrigation and drainage facilities is a matter of urgent need and indispensable.

II-3 Basic Direction of Development

3-1 Irrigation and Drainage

To control the water properly is the most important measure in promoting the Area's agricultural development. However, because of a fact that there are lowland and comparative highland, the methods of water control should be considered according to the conditions of lands.

During the rainy season the water required for crop growth is available with stability from the natural rainfall but in highland, particularly in the northern part of the Area supplementary irrigation is required

even in the rainy season. In such a district the construction of head works and dam at the tributaries of the Irrawaddy River can be conceived as countermeasure. On the other hand, in the lowland with excessive water the problem is how to remove the water, and that can be achieved by consolidating levees and drainage canals.

And during the dry season both highland and lowland confront water shortage. Fundamental water supply during this period is very difficult. There is a solution and that is, to construct a dam in the tributaries of the Irrawaddy River, which has comparatively a large catchment area, from which water can be supplied to some extent during the dry season.

Moreover, in the area where ground water level is comparatively a high along the river a possibility of small-scaled pump irrigation can be conceived.

3-2 Roads and Agricultural Installations

Because the Project Area is adjacent to a capital Rangoon roads are comparatively consolidated. But as the Irrawaddy River and its tributaries run through the Area from north to south and because rivers' water levels rise at the flood time the construction of roads and bridges requires large expense, thus main roads could not be said as being fully consolidated. Particularly, when it comes to branch roads and farm roads consolidation-level is very low. Because farmers have to spend so much time going to and from farm much labor has to be spend in transporting farm products causing a major bottleneck in agricultural production.

Because thereof, consolidation of farm roads, branch roads, main roads and bridges are urgent business, besides, in order to ensure a smooth marketing of agricultural products to market the consolidation of agricultural installations such as rice mill and storage facilities, etc. must be promoted.

3-3 Farm Management

To promote agricultural development of the Area, besides the consolidation of various infrastructures the framing of indefatigable direction in farm management phase is necessary.

Paddy rice is to be the mainstay of agricultural production in the Area and the expansion of double cropping system combined with paddy rice and upland crops and furthermore stabilized production and improved productivity under double cropping system should be the basic direction of farm management.

The reason for selecting a combination of paddy rice and upland crop is because from the standpoint of ecology, farming operation and water-economy the cultivation of paddy rice during the rainy season in combination with the cultivation of upland crop in the dry season is rational, and double cropping system under this combination has already been proven to be stabilized to a large extent.

Furthermore, based upon this fundamental cropping system breeding of superior varieties and improvement of cultivation technique must be planned. And in order to ensure that those improved varieties and techniques will be extended to and settled among farmers agricultural advisory service must be strengthened.

II-4 Hydrological Analysis

There are innumerable rivers, large and small in the Area besides the Irrawaddy River. Portion of lowland in which various rivers and streams flow, are void of levees, except in certain parts, and because of rivers' extreme small gradient the water level of each river and stream rise during the rainy season and inundate the whole lowland. Because thereof, hydrological analysis must precede in any program of agricultural development for the Area.

II-5 Cooperation from Japan

5-1 Necessity and Purpose of Master Plan

The acreage of the Project Area is so massive that to develop it all once is impossible from the financial phase. In the development of such a large tract of land, first basic development direction is determined upon visualizing a form as it should be in future and based on this basic direction, concrete implementation of project in the order of high priority of district should be carried out. Because thereof, in order to determine the development's basic plan of the Area the framing of a 'Master Plan' is necessary and indispensable.

5-2 Implementation of F/S (Feasibility Survey)

In certain part of the Area a district has already been designated as having a high priority for development without waiting for the drawing of Master Plan. Moreover, in certain portion of such districts the Burmese side has already implemented Pre-F/S because the country highly desires agricultural development of 'Quick-Return'. As for such district it might be possible to implement F/S study in parallel with the implementation of survey for Master Plan.

II-6 Recommendation

Because the object of this Plan is directed to a vast tract of land its objective is a comprehensive agricultural development, not only agriculture but forestry and fisheries, related authorities of the Burmese

side are expected to be numerous. So in order to ensure a smooth progress of this plan it is desirable the Burmese side institutes a joint committee composed of all related authorities and accepts Japanese experts as an integral part of the Plan.

III. THE PROJECT AREA

III-1 Delineation of the Project Area

1-1 Delineation of the Project Area

As stated above, the Area's acreage is a vast tract of land of the Irrawaddy basin, 2.5 million hectares (6.2 million acres), stretching about 130km east to west and about 190km north to south, sandwiched between the Arakan mountain range and Pegu mountain in between the north latitude 17°15' and 19°10'.

The east-to-west boundary has been assumed as respective water diversion peak. The northern boundary is the northernmost line of the Irrawaddy basin, which practically accords with administrative divisions. Besides, climatically it can be said as a changing point where central dry region of Burma lies. So the northern boundary has been set near the north latitude 19° line as shown in the map.

As for the southern boundary adjustment is to be made with the World Bank's project (Lower Burma Paddy Land Development Project) the north latitude 17°15' line has been set by leaving a margin of about 50km from the northern boundary of the development district already under construction. According to the Burmese Government the World Bank's project is now at a stage of appraisal. Following the 2nd Plan, the 3rd and the 4th Development Plans are to be promoted, but in promoting development plan of the said hydrological analysis of the Irrawaddy River by a British consultant, which is now underway, must be completed and because this analysis requires 4~5 years from now, for the time being, it is reasonable to assume the said north latitude 17°15' line as the southern boundary which can be assumed as to cause no hindrance.

Besides, in the suburbs of Rangoon various projects have already been started under the cooperation of the Japanese Government for food production increase, pig raising and poultry farming, thus the southern boundary should be corrected upon adjusting with those development plans and upon assuming that there might occur some change in future an allowance has been provided by indicating the said boundary by a dotted line.

1-2 Outline of the Project Area

The Area under this plan includes a portion of Pegu Division and the Irrawaddy Division with the Irrawaddy River in between and is composed of 24 Townships as shown in Fig. 1

Out of which, at the time of reconnaissance survey, informations on acreage, population and climate, etc. based on data obtained directly is as shown in Table 1 ~ 2 and Fig. 2 ~ 7.

Item	
1. Land Utilization	
Total area	6.2 million acres
Arable land	2.5 "
Forest	2.1 "
Uncultivated land & others	1.6 "
2. Crop Planted Area	
Paddy rice	74.9%
Pulses	8.1%
Peanut	5.2%
Sesame	4.7%
Jute	2.6%
Others	4.5%
3. Irrigated Area	101,000 acres
4. Double Cropping Area	286,000 "
5. Total Population	3 millions
6. Population Density	120 persons/km ²
7. Farm Population	2.1 millions
8. Annual Rainfall	1,082 ~ 2,423m/m
9. Temperature	
Mean Max.	32°C ~ 41°C
Mean Min.	11°C ~ 29°C

Fig. 1 Administrative division (Township)

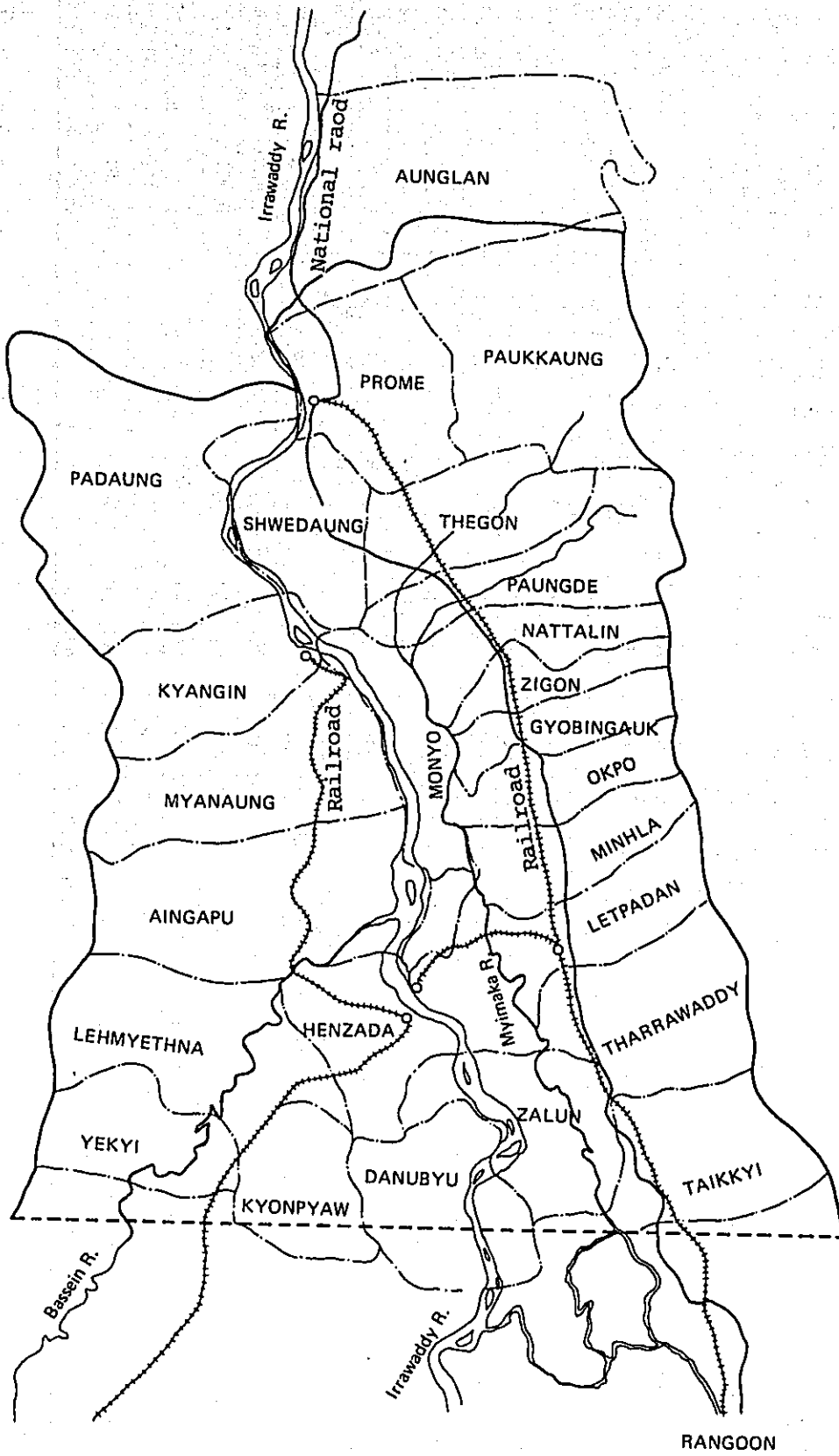


Table - 1 Township Descriptions

Township	Area (acre)			Population		Mean Annual Rainfall (m/m)	Temp (C)		Irrigated Area (acre)	Double Cropping Area (acre)
	Total	Arable Land	Forest	Total	Farm Pop.		Mean Max.	Mean Min.		
Paukkaung	417,370	65,044	226,756	73,397	61,615	1,283	37	26	7,808	3,777
Prome	194,820	86,092	26,398	151,362	61,616	1,207	41	13	11,586	3,966
Shwedaung	181,720	81,546	22,816	105,453	84,000	1,669	37	26	7,382	2,311
Thegon	191,917	99,908	46,643	104,000	80,000	1,082			20,595	4,515
Nattalin	337,883	107,943	178,462	133,489	106,792	1,374	33	22	-	17,001
Zigon	53,756	50,717	785	61,015	50,454	1,524			-	5,158
Cyobingauk	190,079	106,524	83,084	95,196	64,020	2,096	31	25	-	19,937
Monyo	158,076	84,760	-	104,644	66,496	2,436	37		-	8,372
Okpo	259,506	90,792	143,357	94,610	75,680	1,499	34	21	-	6,257
Minhla	165,320	85,460	55,278	99,128	60,625	2,250	33	21	-	8,092
Letpadan	367,413	118,065	174,560	140,133	112,106	2,337	33	22	-	7,941
Tharrawaddy	255,290	107,077	82,010	118,937	101,096	2,136	32	21	-	6,471
Padaung	619,509	57,956	361,844	107,252	40,440	1,499	37	26	5,108	2,021
Kyangin	284,537	50,261	164,554	72,224	55,311	1,720	31	11	-	279
Myanaung	383,561	160,266	161,158	189,942	61,897	1,156	39	16	666	5,441
Henzada	242,365	201,785	-	283,867	237,360	2,217	32	28	2,500	12,728
Yekyi	316,762	136,443	90,461	168,495	122,032	2,060			9,271	21,465
Kyonpyaw	204,648	160,474	-	175,278	141,996	1,941	41	29	4,443	14,926
Danubyu	185,184	107,522	-	142,638	114,110	1,969			5,179	54,885
Zajun	184,419	155,162	-	145,112	108,960	1,376			11,301	36,721
Total	5,248,135	2,113,797	1,818,166	2,566,172	1,806,606				85,839	242,264

Table - 2 Climate Conditions (Rainfall, Temp. Humidity)

Item	Year		Place			
	Average		Prome	Tharrawoddy	Hmawbi	Henzada
Annual Rainfall (m/m)	Average		1, 207	2, 213	2, 536	2, 161
	1970		1, 121	2, 258	2, 574	2, 133
	1971		1, 138	2, 208	2, 406	2, 447
	1972		816	1, 862	2, 298	1, 885
	1973		1, 759	2, 338	2, 942	2, 413
	1974		1, 576	2, 568	2, 939	2, 203
	1975					
Temp. (°C)	Daily Mean Max.	Average	33. 1	33. 5	-	32. 1
		1970	32. 6	32. 4	32. 2	32. 1
		1971	32. 4	31. 9	32. 0	32. 1
		1972	33. 1	32. 8	32. 4	32. 5
		1973	32. 9	32. 2	32. 1	32. 2
		1974	32. 1	31. 6	31. 7	31. 8
		1975				
	Daily Mean Min.	Average	21. 6	21. 4	-	22. 0
		1970	21. 7	21. 4	21. 6	21. 4
		1971	20. 9	20. 7	21. 1	20. 8
		1972	21. 6	21. 5	21. 7	21. 7
		1973	22. 1	21. 5	21. 5	21. 5
		1974	21. 6	20. 8	21. 2	-
		1975				
Mean Relative Humidity (%)	Average		71	78	-	75
	1970		72	74	74	77
	1971		71	74	74	79
	1972		67	74	75	77
	1973		70	76	78	76
	1974		72	76	76	78
	1975					

Fig. 2 Monthly temperature and rainfall at PROME (1973)

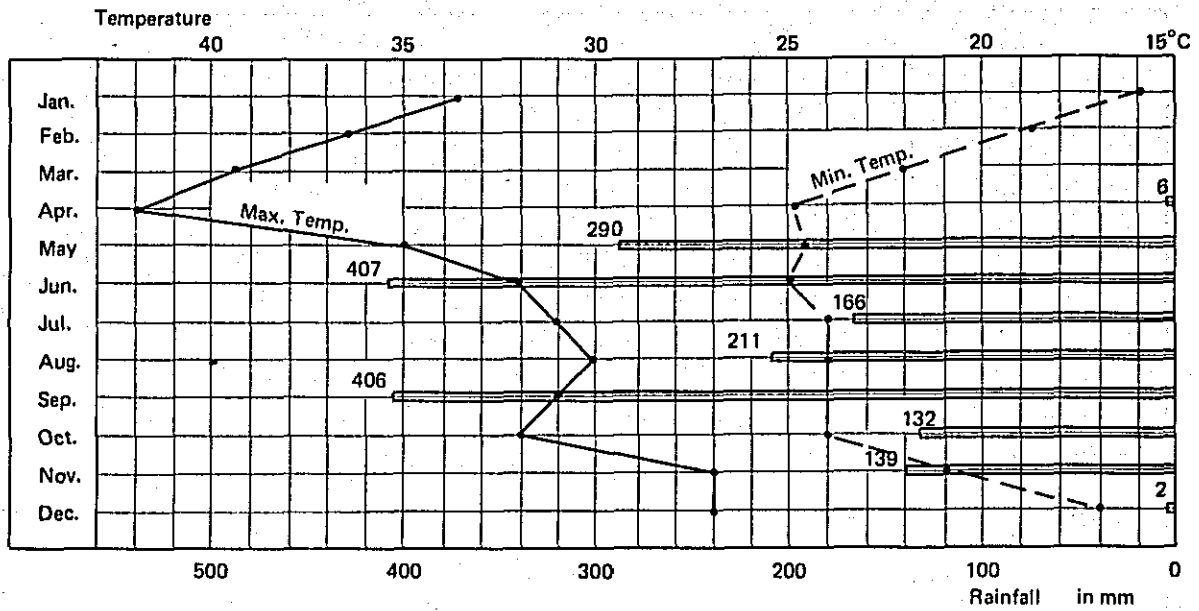


Fig. 3 Monthly temperature and rainfall at PROME (1974)

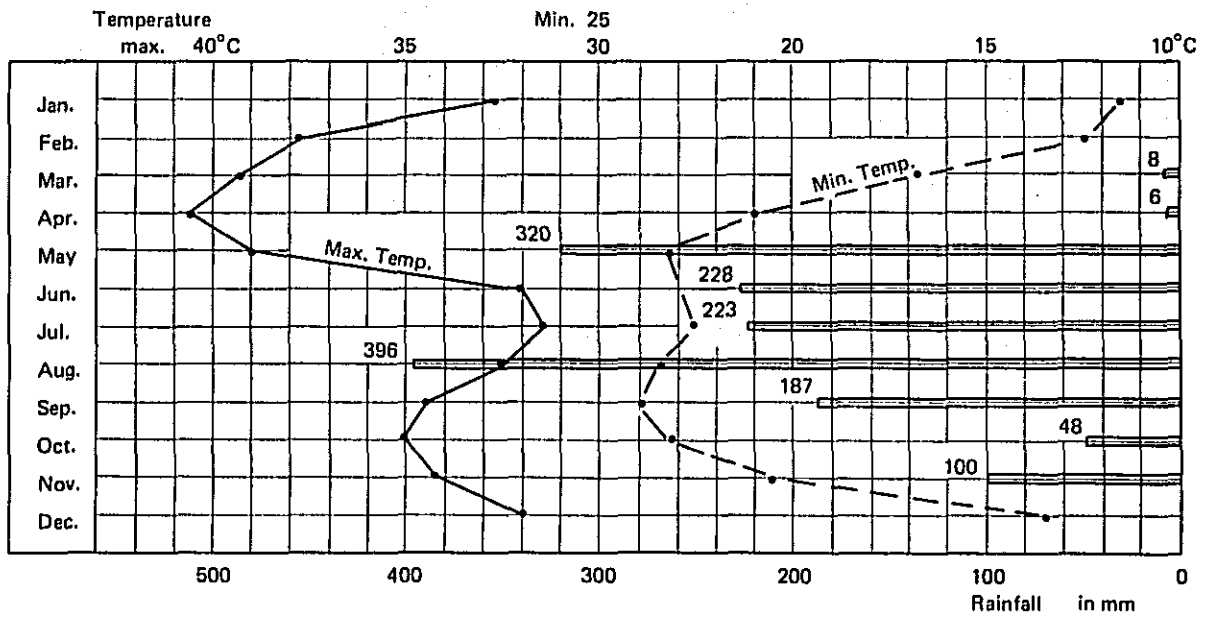


Fig. 4 Monthly temperature and rainfall at THARRAWADDY (1973)

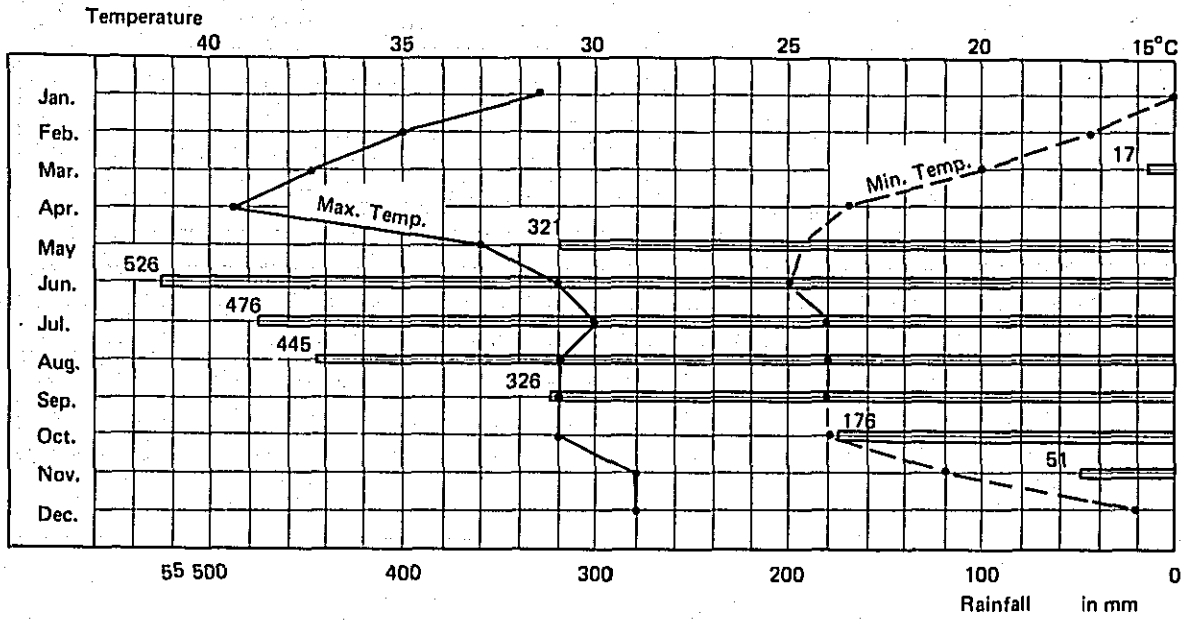


Fig. 5 Monthly temperature and rainfall at THARRAWADDY (1974)

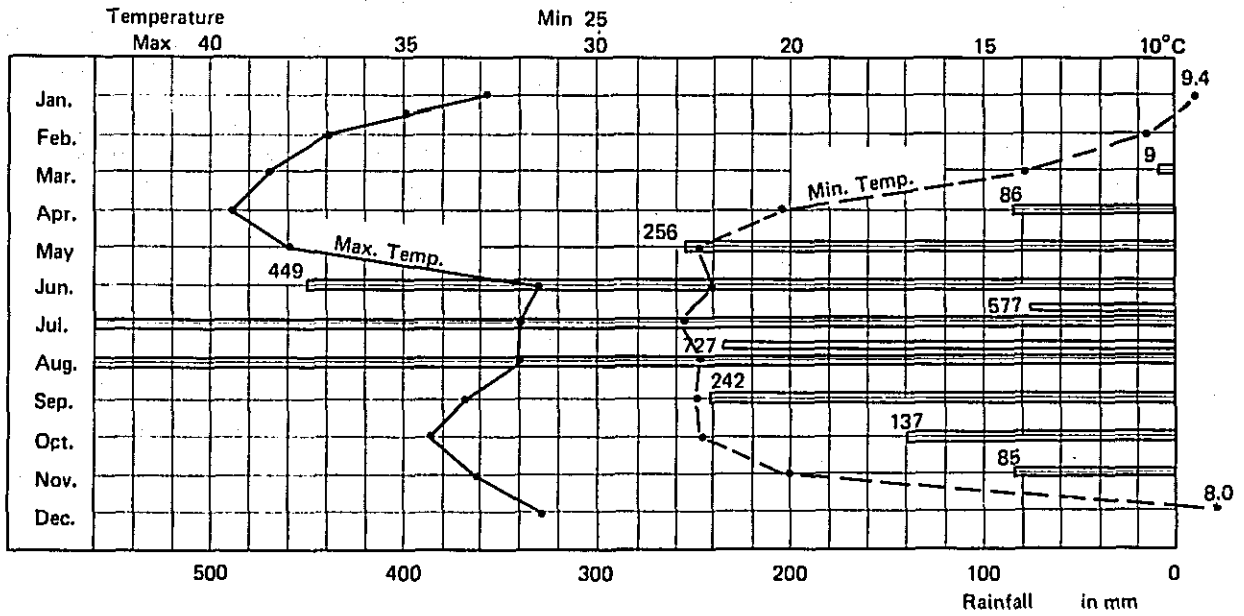


Fig. 6 Monthly temperature and rainfall at HENZADA (1973)

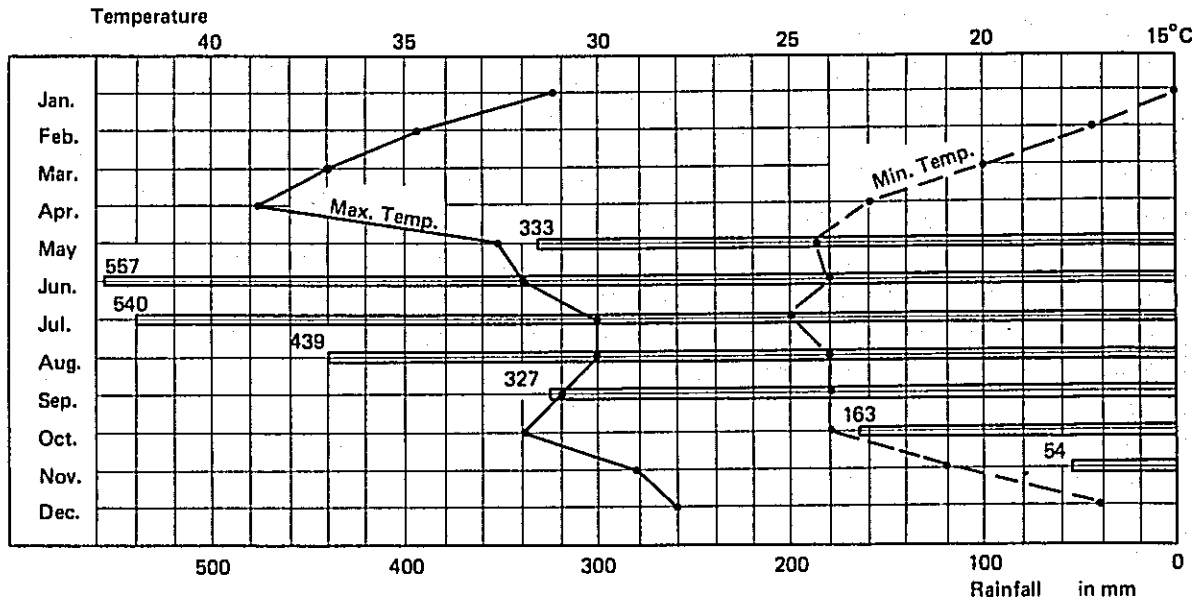
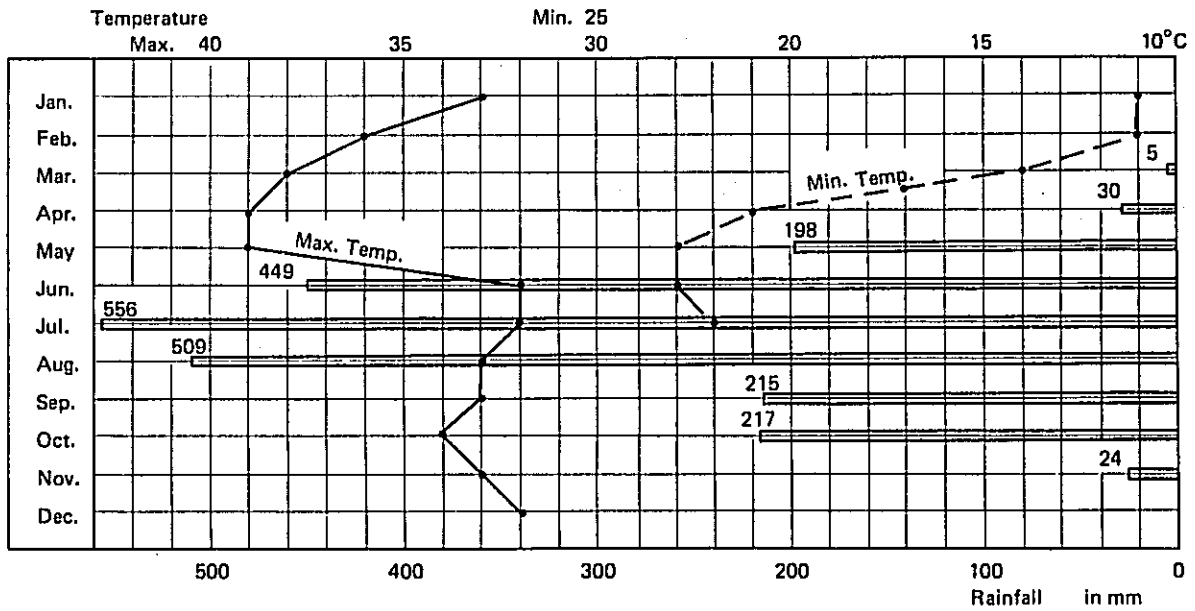


Fig. 7 Monthly temperature and rainfall at HENZADA (1974)



III-2 Natural Condition

2-1 Topography and Geological Features

A vast tract of the Irrawaddy Delta Plain which occupies the greater part of the Plan, spreads from north to south along a main stream of the Irrawaddy River at nearly $1/10,000 \sim 1/15,000$ gradient.

The Arakan Mountain range of the west side is comparatively steep at the elevation of 4,000 ~ 5,000ft., but the Pegu mountain land of the east side is a gentle undulating highland and the elevation is not so high at 2,000 ~ 2,500ft.

The Irrawaddy River main stream flows through the central part of this region and on the way at the west side the Bassein River branches off and at the east side the Myimaka River flows southward in parallel with the Irrawaddy River that during the flood season a portion of the flood of the Irrawaddy River main stream inflows into this Myimaka River.

The Irrawaddy main stream is equipped with river levees from the river mouth to the central stream but a portion with no levee is inundated creating a pond.

This alluvial plain is a deposit of clay, silt and sand at the thickness of 5,000 ~ 7,000ft. The surface layer is practically silt clay or clayish silt and the soil is fertile. However, during the rainy season it becomes muddy and in the dry season produces a large cracks.

The mountain land is practically formed of sandstone and shale of the Tertiary middle Cenozoic era or the latest Cenozoic era. The Arakan mountain side is characterized by sandstone and shale with lime stone in some parts.

On the other hand, in the Pegu mountain land a mixed layers of reddish clay and sand are distributed widely with the mixed layers of sandstone and shale. The rock characteristics in both cases is very soft.

The site of the Nawin Dam now under construction is formed of this soft rock layers and a group of dams of the Myimaka River system, the Planning of which is now being considered, will all be built on this stratum.

However, there is no particular problem in foundation rock in the construction of earth-filled dam of the height around 100ft. In the said Nawin Dam fault treatment is carried out only by cement grafting and the curtain grafting has been omitted.

Although many faults are found in the Area but practically non in proposed dam site, and faults' scale does not seem to be so large.

The ground water level fluctuates by season and place mostly within the limit of 6 ~ 12ft. from the top soil layer but according to a finding by interview water volume is not so large.

In the anticlinal places near Thegaw some flowing-well can be witnessed but because volume of spring water is not so large that much cannot be expected to use it for irrigation purpose.

2-2 Climate

The Area is characterized by tropical climate under the influence of Southwest Monsoon and the seasons can be classified into three categories:

Rainy season	---- May ~ October	---- 6-month duration
Winter season	---- November ~ January	---- 3-month duration
Dry season	---- February ~ April	---- 3-month duration

The annual rainfall concentrates in the rainy season. And the air temperature at the maximum is 32 ~ 33°C which is not so high but the humidity is mostly over 90%. During this period the daily range between the maximum and minimum air is small --- mostly around 6 ~ 8°C.

Upon the termination of the rainy season the climate becomes very similar to Japanese autumn and although the maximum temperature in daytime reaches over 30°C but at night temperature becomes 15°C or less so that temperature's range between day and night becomes 15° ~ 20°C and the humidity declines to 50 ~ 60%. This period is called a winter season.

Then a period before entering into the next rainy season from February air temperature rises as much as to 40°C or over in some places. The humidity further declines as much as to 40% and with practically no rain the humidity becomes similar to desert region.

(1) Rainfall

The Southwest Monsoon brings a large volume of rain on the west side of the Arakan mountain range -- 3,000 ~ 5,000mm a year, but in the west bank district of the Irrawaddy River beyond the Arakan mountain rainfall declines extremely, particularly in the vicinity of Prome to nearly 1,000mm.

On the other hand, many places in the southern delta district over 2,000mm is a normal, although there is a considerable difference within the Area. And besides, the monsoon rainfall is also brought about by local low-pressure from the east of the Thailand, but there is absolutely no rain from December to March.

(2) Air temperature

The air temperature changes to a continental climate gradually going away from the coast line accompanied with a larger range in daily temperature and annual temperature's range also becomes a larger.

The maximum air temperature during a year is in April as witnessed at the upstream vicinity of Prome 40~41°C and near Henzada, 37~39°C. The minimum air temperature occurs in January, around 12~13°C throughout the whole Area. In some year it becomes below 10°C.

Average daily temperatures are 32~33°C at the maximum and the same minimum at 21~22°C. And there is not much difference throughout the whole Area.

(3) Humidity

The humidity is somewhat low near Prome rising gradually going farther downstream. But even in the vicinity of Prome annual average value is around 70% and near Henzada, 75~80%. And although it is only natural, the humidity becomes very high during the rainy season, over 90%, but declines in the dry season to around 40%.

III-3 Population and Transport Facilities

3-1 Population

The Area is comparatively near to Rangoon and has been developed from the ancient time that population density of 120 persons/km² far exceeds the national average of 46 persons/km². As shown in III-1-2 against the total population of 3 million the farm populations accounts for 2.1 million or 70%. And an average number of family member is 5~6 persons.

3-2 Road and Transportation

On the east bank side of the Irrawaddy River main road runs from Rangoon to Prome reaching Mandalay through Magwe. It is a paved, two-lanes road (in part only one lane) that no obstacle is caused in transportation even during the rainy season. The roads on the west bank side of the Irrawaddy River get submerged often during the rainy season, thus traffic is not possible.

The consolidation of branch roads is very insufficient. Comparatively a large towns on the east bank side are connected by road network but there are a considerable number of small communities without road for

automobile traffics. And in the delta district at downstream and west bank side the roads are so poor that traffics of large-type vehicles is practically impossible.

Those roads were constructed several tens years ago under the construction standard that weight capacity of bridge was mostly 10 tons.

Under the World Bank loan full-scale reconstruction of main road is to be carried out, but as of now, the national budget which gives a priority to agricultural development, insufficient that it has not yet been inaugurated.

The construction and management of main roads are under the jurisdiction of the Construction Ministry but the same for local roads are delegated to respective Township's council. Table 3 gives a figure indicating the consolidating condition of national roads but because of budget shortage road consolidation program is not progressing very much.

On the upstream of the Irrawaddy River near Mandalay there is only one bridge and no bridge at all for the district. Accordingly, no road network exists to connect the both banks.

At present road construction plan is underway from Pinyinana through Prome over the Arakan mountain reaching Sandway of the western sea coast and as an integral segment thereof a bridge at Prome crossing the Irrawaddy River is being planned. However, at present a 111-mile road between Pinyinana and Prome is being built that bridge construction is most probably in a distant future.

Table 3 Union highways and main Roads
(Position at the end of the year)

Serial No.	Year	(Miles)		
		Union highways	Main roads	Total
1	2	3	4	5
1	1961-62	2284	4102	6386
2	1962-63	2394	4120	6514
3	1963-64	2452	4272	6724
4	1964-65	2452	4947	7399
5	1965-66	2452	5065	7517
6	1966-67	2452	5411	7863
7	1967-68	2452	5518	7970
8	1968-69	2452	5630	8082
9	1969-70	2452	5734	8186
10	1970-71	2452	5813	8265
11	1971-72	2452	6018	8470
12	1972-73	2452	10990	13442
13	1973-74	2452	11194	13646
14	1974-75 (Provisional Actuals)	2452	11318	13770
15	1975-76 (Provisional)	2452	11429	13881

NOTE.— Inclusive of all States' roads from 1972-73 onwards.

And the construction of a 600m bridge over the Flying River connecting Insein a suburb of Rangoon and Yandoon is to be inaugurated in near future, but there is a total absence of road which can be called 'farm road' in rural district. All transportations of agricultural product, fertilizer and other commodities are over the completely-dried paddy field surface during the dry season using two draft cattles. The use of automobile is very rare. Accordingly, upon the onset of rainy season there is absolutely no means of transporting commodities even within the communities.

3-3 Railroads

There are three single-lane railroads in the Area --- main railroad of about 240km on the east bank side between Rangoon and Prome --- about 23km in the west bank side between Bassein and Kyangin --- 40km branch railroad between Tharrawaw and Letpadan, connecting the railroads of the both banks which connects Henzada and Tharrawaw of the opposite side by ferry. Regular runs of train is several times a day with about two express trains. Railroad is a very important means of transporting agricultural products besides river boats. In fact, it is the only means of transportation in the west bank side during the rainy season.

3-4 River Boat Transportation

The Irrawaddy River together with the Bassein and Ranggon River are the most important means of transportation for man and commodities. Those rivers are navigable all the year round. Small streams and man-made canals which are connected to those rivers are also an important means of transportation.

The Irrawaddy River has a water level range of 20ft between the flood and draught seasons but no obstacle is caused in boat navigation. Practically all transportation of commodities and products in the whole district of the west bank side, in the environ of east bank side and in the delta district downstream of the Irrawaddy River are dependent on river boat. Moreover, there is an airport at Prome, but no regular service and no airway which can be used ordinarily.

III-4. Agriculture

The farmers are imposed with a system of being allocated with the planting of major crops and are obligated to sell to the Government the one third of his crop at official price. As for the state of farm management of the Area, although it has to wait for future survey, a national base as a reference is as shown in Table 4 and 5. The ratio of the number of farm household by management scale as of 1974/75 fiscal year, less-than-5-acre class accounts by far the largest share with 62.5%, 5~10 acres class, 24.1%, 10~20 acres class, 10.8% and 20~50 acres class, 2.6%. There is a very few management of over 50 acres. An average cultivation-right ownership's acreage is 5.4 acres.

The selection of settlers in newly reclaimed land is carried out by special committee. In general, many farmers strongly desire to increase their cultivating acreage but it might seem only few farmer desire to migrate to newly reclaimed land. And this fact may become a bottleneck in promoting agricultural development in remote land with few inhabitant.

Table 4 Total farm household by cultivating area

Area (acre)	Ratio (%)		Average (acre)
	Farm household	Cultivated land	
0 ~ 2	36	8	1.2
2 ~ 5	28	18	3.4
5 ~ 10	23	32	7.2
10 ~	13	42	17.2
Total	100	100	5.3

Source: Settlement and Land Records Dept., Ministry of Agriculture and Forests 1970/71

Table 5 Total farm household by kind of cultivated land

Item	Ratio (%)		Average (acre)
	Farm household	Cultivated land	
Paddy field	44.1	53.2	6.4
Upland	18.8	19.3	5.4
Paddy field & upland	8.7	11.9	7.3
Water-logged paddy field	8.1	4.6	3.0
Orchard	10.5	3.0	1.5
Rubber farm	0.4	1.0	12.4
Others	9.4	7.0	4.0
Total	100.0	100.0	5.3

4-2 Outline of Land

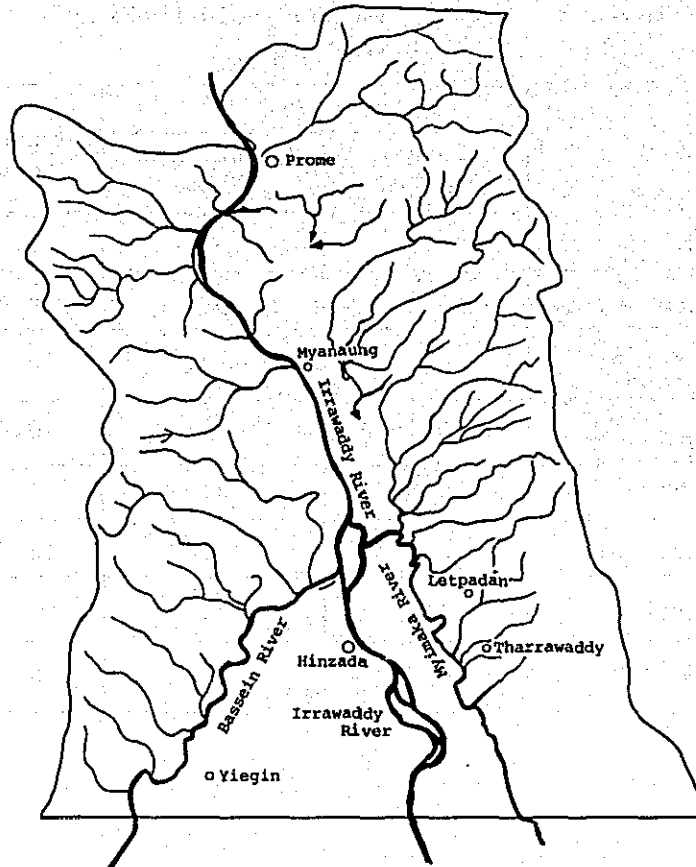
(Land condition in the rainy season)

The land condition in the rainy season is characterized by a considerable inundation by the rise in the water level of the rivers, Irrawaddy, Myimaka and Bassein. The Team was not able to make a full survey at this time on the condition of flooding but according to a finding by interview on-the-spot, the flood depth is estimated to be an average of 1 ~ 1.2m.

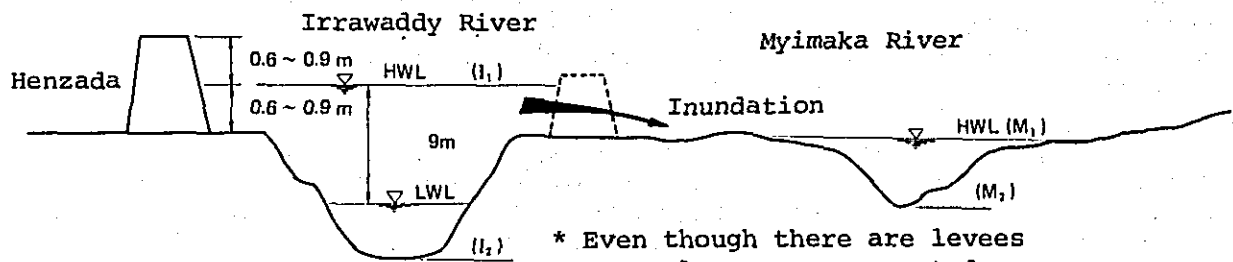
As for the triangle-shaped district centering around Henzada in between the two rivers of Irrawaddy and Bassein river the levees have been built some long ago and the same have been regarded as a strategic fortress to protect the downstream delta. Accordingly, the district rarely suffers by direct flooding and the flood which reaches dangerous water level is inflowed to the Myimaka River side on the left bank of the Irrawaddy River. If these relations are to be indicated conceptionally it is as shown in Fig. 8.

Those floods greatly jeopardize the high utilization of arable land, but on the other hand, they also serve as an important source of irrigation that in lowland paddy rice cultivation is carried out in the latter half of the rainy season in keeping pace with the lowering of flood water.

Fig. - 8. River's map



Irrawaddy and Myimaka Rivers
Height relation



* Even though there are levees
some places are excavated.

Height relation $I_1 > M_1$, $I_2 < M_2$

The same flooding condition is witnessed in downstream of small and medium rivers of the basins of the Myimaka and Bassein Rivers that swamp areas can be seen in some parts. So the most important problem of these district is the flood control measure.

(Land condition in the dry season)

The dry season's farming operation is difficult, in the middle and upper stream of the Myimaka basin's branch rivers. Even in a district where some planting is enforced, often it ends without yield.

4-3 Irrigation and Drainage Facilities

(Drainage facilities)

At present there is practically no man-made drainage facility that cultivation is carried out waiting the receding of flood water. Alluvial soil layer is distributed practically all over the major cultivating land of the Area. The soil is a fine-grained sandy loam but permeability is very little. At the time of on-the-spot survey, although it was toward the end of the rainy season, in the land along the river with river water level's difference of over 1.5m, flood water was visible in rugged land.

(Irrigation facilities)

As for the irrigation facilities there were only a few by systematic canals. Small-type pump seems to be the main source of irrigation. As for a plan now being carried out there is a Nawin Plan near Prome. This is to construct a dam at two places, North Nawin and South Nawin and canals are to be constructed. Out of which for North Nawin the construction has been inaugurated in 1970 and the work is near completion. The North Nawin plan is as follows in outline.

a. Earth Dam

Length of crest	-----	1620m
Dam height	-----	35m
Storage capacity	-----	359 million m ³
Catchment area	-----	592km ²
Embankment earth volume	-----	2.9 million m ³

b. Irrigation acreage

----- 39,170ha

c. Canal length

3 main canals	-----	72.4km
123 branch canals	-----	447.5km

d. Cost

----- 146 million kyat

As for the irrigation acreage according to an interview with Township's manager about 41,000ha is estimated to be available in 1976/77 which is only a 4.1% of the total acreage of about a million hectares, and as indicated in Table 1, in comparison to a 12.17% for the country in 1974/75 it is considerably a low rate.

Table 6 Irrigated Area in Burma

(unit: 1,000ha, %)

Year	Area planted	Irrigated area	Ratio
1961-62	7,161	536	7.48
1971-72	7,960	890	11.18
1972-73	7,882	889	11.28
1973-74	8,062	971	12.04
1974-75	8,101	987	12.17

(Notes on Agriculture in Burma 1976)

Table 7 Form of irrigation (whole country)

(unit: 1,000ha)

Year	Total irrigated area	Government sector		Private sector		Well	Other water resources
		Canal	Reservoir	Canal	Reservoir		
1936-37 1940-41	608	288	44	113	35	7	120
1965-66	753	315	31	216	35	9	146
1970-71	839	335	40	283	36	11	134
1971-72	890	343	44	291	37	11	164
1972-73	889	328	40	264	30	14	213
1973-74	971	339	51	285	46	12	238

According to the above statistics, against the average of 1936-1937, 1940-1941 the 1973-1974 irrigation acreage is 159.7%. Upon classifying the same irrigation acreage that which is under the Government work is 117.7% for canal and 115.9% for reservoir and 252.2% by private canal which can be interpreted to mean that farmers' effort is larger than that of the Government.

The Government is wrestling positively with irrigation plan in recent years and as mentioned in IV-1, a dam construction plan at 13 places in this Project Area is self-explanatory of the Government intention and as of now survey plan is being promoted.

4-4 Farm and Farm Roads

Farms in the Area are mostly over 10a acreage. However, even in the paddy field belt which continues as far as the eye can reach, practically no farm road is visible. The road density is certainly low. So going to and from farm and for transportation the ridges of levees are used and in case there is no water on upland and paddy field, the field becomes road.

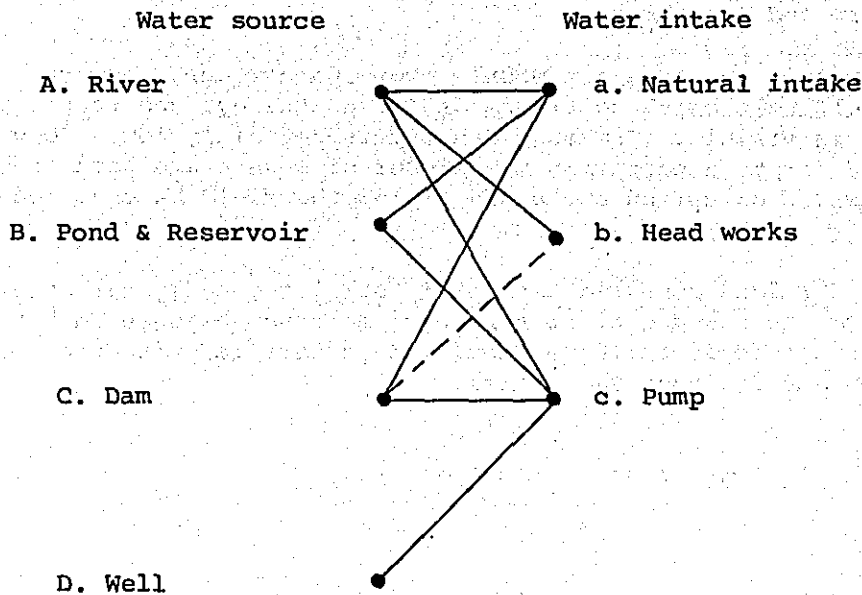
As for land consolidation it is still too early for general extension from the standpoint of farm equipment now being used but it is vitally important to consolidate farm road in parallel with the construction of irrigation and drainage facilities.

IV. BASIC DIRECTION OF DEVELOPMENT

IV-1 Irrigation and Drainage

1-1 Study of Irrigation Method

As a method of irrigation the following concept is generally accepted:



(Case where river is the water source)

The water intake from the rivers can be conceived as the most general method. But to obtain irrigation water from the three Rivers, Irrawaddy, Myimaka and Bassein there is a problem that a range in water level between the flood season and dry season is as much as 10m in some places. So intake water by using one of the three methods seems to be difficult. And as for the small and medium rivers other than those three rivers, within the sphere of survey at this time in dry season when the water is mostly needed, basal water volume was partially none that it has been judged that water-intake from river is impossible.

(Use of pond and reservoir)

Because of a fact that the major portion of cultivating land of the Area is composed of alluvial layers and the soil's permeability is small that even after the lowering of river water level some marsh lands remain. Some of those marshes are used in some part as source of irrigation water in the dry season even at present. On the other hand, because of poor drainage a high utilization of neighboring cultivating land is obstructed. Accordingly, as for the development and utilization of those ponds and reservoirs there is a considerable potentiality in development. So its potential should be studied in connection with the consolidation of drainage facilities and irrigation-use reservoir.

(Construction of dam)

The construction of irrigation dam in the mainstream of the three rivers, Irrawaddy, Myimaka and Bassein is inconceivable in the light of the rivers' scale and flood condition. But it is fully feasible in the tributaries of the Myimaka and Bassein Rivers, particularly in the tributaries of the Myimaka River where superior farm lands exist in the district.

(Well) From the nation-wide view point the ratio of well in irrigation is low at 1.2% and even in future development plan it is highly probable that well will not be important as water source for irrigation.

1-2 Irrigation Requirement

Paddy field requirement is assumed, in general to be around 10mm/day. In the Nawin Dam now under construction about 9mm/day is adopted in the light of various reasons. As to a decision on the requirement a concept of water requirement depth as used in Japan is not employed. Irrigation requirement computation formula as used in Burma is:

$$I_g = \frac{K(t \times p) - R_e}{E}$$

I_g : Monthly irrigation requirement (Inches)

K : Coefficient by crop for each month

t : Monthly mean temperature (°F)

P : Daytime-hour ratio of a month (%)

R_e : Effective rainfall (Inches)

E : Effective utilization rate
(Paddy rice; 65% and upland crop; 50%)

1-3 Dam Construction Plan

As stated above irrigation acreage rate of the Area according to interview from Townships' people is 4.1% which is much lower than the national average of 12.2% (1974/75). However, the Burmese Government is planning the construction of many dams as an integral segment of the 20-year Development Plan.

The Irrigation Department of the Ministry of Agriculture and Forests is now conducting a Pre-F/S study on the Okkan, Kadin Belin and Thegaw. Geology of those three proposed dam sites are very similar, mainly composed of sandstone and shale. And all of them will be earth dam. Runoff analysis has already been completed on the three dams and boring survey is now going on Thegaw.

The Burmese Government gives a high priority to these three dams among the dam-group of the Myimaka River's tributaries, particularly a first priority on the Okkan Dam.

As for the content of Pre-F/S of those three dams 'Medium-Size Reservoir Project' will serve as reference.

Table 8 Dam Construction Plan (Western Pegu Yoma Irrigation Project)

No.	Name	Area	Project Cost	Dam Height	Dam Crest	Catchment
1	TAUNG NYO	20,000 ^(ha)	750 (LAKHS)	30 ^(m)	900 ^(m)	551 ^(km²)
2	WEGYI	24,000	900	30	1,050	531
3	BAWBIN	24,000	900	18	1,500	261
4	OKKAN	10,000	375	24	1,350	313
5	NYAUNG GAING	1,000	37.5	18	750	91
6	KYUN	4,000	150	14	2,400	72
7	KYUN YAUNG	2,000	75	12	1,200	65
8	SHWE LE	1,000	37.5	14	1,050	75
9	THEGON	2,000	75	12	900	52
10	GAMON	8,000	300	18	1,200	96
11	MINHLA	8,000	300	15	900	78
12	KADIN BELIN	10,000	375	12	1,500	241
13	THEGAW	4,000	150	12	1,500	88

(From the Irrigation Department, Ministry of Agriculture and Forests)

Remark 1. Cost: 1 LAKHS = 100,000 Kyats 1 Kyats = about ¥40

2. As for three dams, No. 4 Okkan, No. 12 Kadin Belin and No. 13 Thegaw Pre-F/S work is already underway and as of now project construction cost and are being greatly revised.

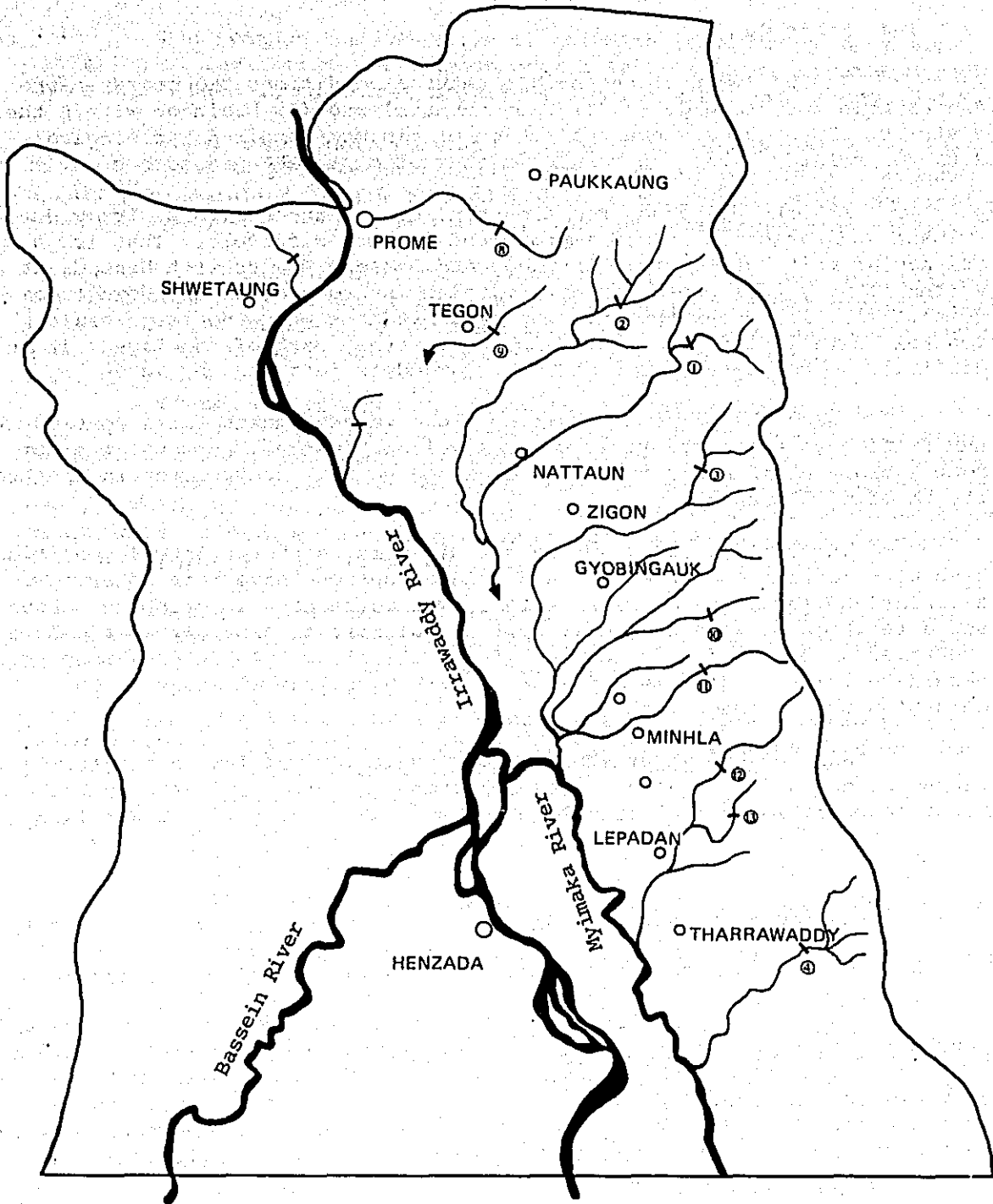


Fig. 9 Western Pegu Yoma Irrigation Plan

1-4 Drainage

In the light of the Area's natural conditions two measures are conceivable for drainage -- (1) Flood control and (2) Drainage within the district. In each case the collection of minimum-required hydrological data for related rivers and analysis thereof must take precedence.

At present stage, flood control of the three rivers, Irrawaddy, Myimaka and Bassein by river improvement is very difficult. That is, a triangular belt between the Irrawaddy and Bassein Rivers with Henzada at a vertex is very well protected as a vital point to protect the downstream delta. That is, under the existing circumstances where no large-scale control installation is provided in the upstream part of the River, it is difficult to completely protect the Irrawaddy's left bank by levee.

Under the present condition flood water remains for a considerable number of days after the river water level has lowered. Because thereof double cropping is obstructed. If drainage work is constructed in the Area its benefit will be great.

In carrying out a survey at this time, although actual conditions have been confirmed on-the-spot and related persons have been interviewed a variation (lowering) of river water level correlated to cropping season and a relation between the lower part of cultivating land within the Area and river water level have not been fully clarified. In future those points should be fully studied in combination with hydrological analysis to determine the drainage method.

And because water shortage occurs in low wet land along the river banks during the dry season the establishment of effective development plan might be possible by collectively studying the use of ponds in wet land.

IV-2 Marketing Systems and Roads

2-1 Collection and Shipment of Products and Processing facilities

The present facilities for the collection, shipment, storage and processing of products are mostly old-style that those facilities would not be able to accommodate the would-be increased production which will be inevitably brought about by agricultural development and modernization of agriculture. Accordingly, at the time of inaugurating agricultural development a study must be made on the improvement of those facilities as they ought to be upon the long-term prospect.

It is highly probable that modern highly efficient facilities equipped with full capacity will gradually be built but one fact should be kept in mind and that is, there are still many methods used here for which are well suited to the particular climate and custom of the Area, so those methods and facilities should be preserved to be combined with the newly built modern facilities.

And because the objective of the Plan is directed on so many varieties of facilities and extends over a large sphere, as to what and where one's hand is to be set should be studied with a fully calculated plan.

Furthermore, in case some small-scaled ones out of those facilities belonging to private individual, are to be alternated or abolished a full consideration should be rendered to a compensation for the right and facilities, as well as to the re-employment of persons working there.

It is only natural that those facilities should be built at the right place and at the right scale but also a full consideration should be given to the maintenance and management of the facilities and a system with extremely small trouble in operation should be selected.

As for the management operation of facilities it is most probable that large-scaled and important ones will be under the direct Government control and small and medium ones, by Township, but at that time as to whom and what is to be managed should be clarified beforehand. Moreover, a detailed program should be provided beforehand for management and maintenance on such matters as the number of employees, needed equipments, machines' parts and operating cost, etc.

Because those installations are closely related to roads and transportation methods of the next chapter, establishment of any plan should be made under mutual and close coordination.

And for agricultural products which require a treatment in the rainy season such installation which is capable to transport, store and process even during the rainy season should be provided.

2-2 Roads and Transportation Network

In the first place, consolidation of road network connecting major Townships should be expedited. Moreover, the same should be closely correlated to the consolidation of irrigation and drainage works and marketing organizations.

The present condition is such that land communication in the rainy season is practically suspended, except certain part. Therefore, road network to enable the communication in the rainy season is highly demanded.

The construction of this road network should start from the vicinity of Rangoon gradually expanding to other districts. The construction of new road will be connected to the newly-constructed main road and will probably manifest its effect immediately.

The width of main farm road should be 24ft. (7.32m) and that of branch road around 12ft. (3.66m). In order to save the maintenance and management cost it is desirable to pave the road.

The earth requirement for road construction is borrowed from the land adjacent to construction site, but the borrow pit left behind should be consolidated as to be usable as drainage ditch or canal navigable for small boat or sometimes make it into a fish pond for fish culture. At any rate borrow pit should be consolidated for later use.

Such road network on the east bank side of the Irrawaddy River can manifest an immediate benefit by connecting it to the existing road network but on the other hand, existing main road on the west bank side is insufficient that only the network of branch roads will not be much effective. Accordingly, road construction in such a district should be promoted under plan accompanied by the construction of a bridge crossing the Irrawaddy River.

Upon the completion of a network of main and branch roads the construction of farm road will be demanded from district in need of farm road. The width of such farm road has to be width enough to accommodate a large truck around 12 ft. (3.66m) but it needs not be paved and the embankment needs not be so high.

In case there is an area where land consolidation is being carried out in parallel with farm road construction, farm road should be connected directly to each farm.

Those farm roads can be classified into two kinds: one which can be used during the rainy season and that which can be used immediately after the recession of flood water even it is non-usable for several tens days during the flood season. And in the case of crossing small river and low wet land generally a bridge or culvert is a common practice but in case the water depth is shallow Irish-crossing should be employed to save expense.

IV-3 Present Condition and Development of Fisheries

Burma has a long seaside adjoining the Bengal Bay and the Andaman Sea, so she is blessed with sea fisheries. The country is also rich in fresh water fishery resource because of so many rivers and streams besides wet land and ponds created by the flood of many rivers including the Irrawaddy River. However, because of underdeveloped conditions in fishing boat and gears as well as in cold storage and processing installations. And from the non-consolidation of marketing facilities and system fisheries development both in sea and inland water are far behind the modern fisheries.

The Burmese Government in her 3rd 4-year Plan which will start from 1978 gives a very high priority to fisheries development to earn a highly needed foreign exchange by the export of fishery products as well as to secure protein for people by carrying out two measures: expansion of fry production and development of sea fisheries.

3-1 Government Organization

There are two agencies under the jurisdiction of the Ministry of Agriculture and Forests, namely, the Fisheries Department and the People's Pearl and Fishery Corporation. The Fisheries Department is in charge of fisheries administration, research, experiment, education and technical development as well as guidance and extension on improved fishing and fishery resource conservation. The number of employees in the Department is 190. The people's Pearl and Fishery Corporation is an operational Government organization, charged with domestic fishery production and export of pearl and other fishery products and has fishing boats, culture farms and freezing and processing facilities. The number of employees is about 8,000.

3-2 Present Condition of Fisheries

The statistics of the recent 5 years by the Department of Fisheries on catch, fisherman population, culture fishery and fishing boat are as shown in the following tables.

Table 9 Fish catch and production amount

	1972	1973	1974	1975	1976	'76/'72 (%)
Catch						
Fresh water	76,070	76,696	77,309	79,604	82,282	108
Sea water	201,512	207,061	188,365	217,479	224,855	112
Production amount						
Fresh water	79,014	79,911	80,744	169,312	183,467	232
Sea water	110,832	113,883	103,601	252,276	278,820	252

Catch: 1,000 Viss,
Production amount: 1,000 Kyat

Table 10 No. of fishermen

	1972	1973	1974	1975	1976	'76/'72 (%)
Fresh water						
Full-time	54,630	55,004	55,213	55,868	56,232	103
Part-time*	201,968*	201,968	201,968	201,968	201,968	-
Sea water						
Full-time	89,134	89,744	90,085	90,314	90,860	102
Part-time	-	-	-	-	-	-

* No investigation since 1972. Estimated as not much change.

Table 11 Culture fisheries

	1972	1973	1974	1975	1976	'76/'72 (%)
Production	1,178	1,285	1,374	1,383	1,438	122
Production amount	4,122	4,500	4,808	5,048	5,609	136

Production: 1,000 Viss

Production amount: 1,000 Kyat

Table 12 No. of fishing boat

	1972	1973	1974	1975	1976	'76/'72 (%)
Powered	3,738	3,790	3,820	3,905	3,993	107
Non-powered	69,663	70,313	70,663	73,194	75,795	109

The catch in fresh water fisheries in 1976 accounted for 27% of the total catch but the production amount accounted 40% of the total, which when compared with sea fisheries is advantageous in price phase. And although no statistic was available on culture fishery by fresh water and sea, the 1976 production of culture fisheries accounted for only 0.5% of the total catch, thus it was very small in volume. However, the recent 5-year production indicated a hike of 22%, exceeding the hike of the total catch and production amount's unit price (Kyat per Viss) of 3.9 was comparatively a higher than 1.5 of the total catch and 2.2 of fresh water fish.

There are only few full-time fishermen in inland fresh water fisheries, 80% being a part-time fishermen. Fishes whose habitats are ponds and marshland with flood and inundated water during the rainy season return to a main stream from October to November when the water begins to recede at a turn to dry season. And that is the time fish is caught by trap. And the fishing-right for this trap-fishing is sold by public tender each year. In the case of a highest successful bid in 1977 was 370,000 Kyat for 7-month duration.

The People's Pearl and Fishery Corporation owns 22 trawlers (15 steel boats and 7 wooden boats) and 42 wooden boats of 6-ft-class. In 1976/77 the catch by trawl fisheries was 7,840 tons with the production amount of 74 million Kyat. The export was 19 million Kyat. The 1977/78 plan visualizes an increase by two times of the previous year: 12,800 tons by sea fisheries, 2,200 tons by fresh water fisheries, production amount of 141 million Kyat and export earning of 36.5 million Kyat. Sea shrimp occupies the first place in the Corporation's fish export and shrimp's production increase is being planned.

The problem in export is a lack of freezing installation. Although there are a total of 108 transporting boats with a total tonnage of 1,440 but those boats are not equipped with freezing facilities. Fishes are transport under ice pack. Because thereof only 16.7% of catch landed at port is for table-use as fresh fish.

The culture of fresh water fish is performed at culture farms owned by the Corporation at 4 places --- 400 acres one near Rangoon and two small-scaled farms and 200-acres farm near Mandalay and two small-scaled ones nearby. The farms breed freed fry and raise adult fish. Culture fish is a native Burmese carp. 300 ~ 400 tons are produced annually at the price of 9,300 Kyat/ton (15 Kyat/Viss). Domestic demand for this species of carp is very high. With a prospect in export possibility foreign markets are now being investigated. And lease fisheries are being practiced in the Irrawaddy delta. The 1976/77 production record was 1,800 tons, and 3,000 tons are anticipated in 1977/78. There are about 20 ~ 30 fish species. Average fish price is low at 3,800 Kyat/ton and most of them are marketed for domestic consumption.

Table 13 Record of catch by the Corporation

	1974/75	1975/76	1976/77	1977/78
Catch	4660	6500	7840	15000
Production amount	-	46.4	74.0	141.0
Export amount	-	0.3	19.0	36.5

Catch: Ton, Production and export amount: a million Kyat.

Catch is mostly by trawl fisher.

1977/78 figures are plan.

The catch by private fisheries are marketed for domestic consumption with the exception of fresh water and sea shrimps. Those which are suited for export are sold to the Corporation. And the Corporation's catches other than export fishes are sold to wholesaler at the price to meet the catch's cost. The Government does not participate in domestic market of fishery products. There is no control and the marketing is a free business. There is a great need to consolidate marketing-related installation such as cold storage, transportation, processing and market as well as marketing system.

3-3 Issue in Fishery Development

The Burmese Government has a plan to build freezing plant at the coasts of Arakan Sea and Malay Peninsula. And in order to promote inland fresh water fisheries the construction of culture fish farm is being planned at 26 Townships in upper Burma under a loan from the Asian Development Bank. This project is to be inaugurated in April, 1978 under a budget of US\$9 million foreign currency and US\$27 million local currency. Fish species as object of this project is the above mentioned native Burmese carp which has a ready domestic market. Because its export is unreasonable geographically the carp will be marketed for domestic consumption. Those 26 Townships are not located in the Project Area under this Integrated Development Plan.

Fishery development of the Project Area is limited to the culture of fresh water fish. And in the pursuit of fish culture development it is necessary to study the following points:

(1) Fish species and culture technique:

The Department of Fisheries has been engaged in research of fish culture since 1952 and in the light of demand and fish growth the Department has decided that this native Burmese carp has the most potential, and the culture of fresh water fish of temperate zone such as crucian carp, Chinese carp and grass carp is difficult. And the Terapiya, a tropical fish species which is being imported by many countries for culture is easy in propagation but its growth volume is small, moreover, it has been recognized as injurious fish in Burma that it is now being controlled. Burmese carp grows 1kg/year by feeding rice bran, supplemented by peanut and sesame cakes. Since the visit of a FAO expert in 1976 culture technique has greatly been improved under his guidance. Culture is operated on good commercial base by removing eggs under the hormone treatment followed by hatching and fry production. Some species which are being cultured in some parts of Southwest Asian countries such as eel and snapping turtle are not conceivable as object of culture because of domestic demand.

(2) Marketing:

The Burmese Government has a definite and right direction on the species of fish for culture and culture technique. However, in studying planned culture of fresh water fish in this Project Area a problem of marketing must be further considered. That is, domestic demand for Burmese carp is high but prospect for export is still an unknown factor and when the Area is compared with the districts of upper Burma around Mandalay where local demand is active and where there is no competition from sea fish, this Area is blessed with favorable local condition of being within 200km of Rangoon and competition from sea fish is inevitable and because of non-consolidation of road and cold storage the transporting of

cultured fish into Rangoon by maintaining the freshness might be difficult. Another reason is that the Government does not participate in the marketing of fishery product, leaving it as a free enterprise.

Marketing-related installations such as cold storage, transportation and market as well as marketing system have not been consolidated, thus a large-scaled fresh water fish culture and marketing of product in this Area has no prospect.

IV-4 Present Condition and Development of Forestry

4-1 Outline of Forest Resource

Burma is also rich in forest resource. Out of the total national acreage of 676,000km², about 57% or 387,000km² is forest. Forest type is determined by atmospheric temperature, rainfall volume and soil but usually classified into the following 8 types.

1. Tidal forest;
2. Beach and dune forests;
3. Swamp forests;
4. Tropical evergreen forests;
5. Mixed deciduous forests;
6. Dry forests;
7. Deciduous diptero carp forests or indaing;
8. Subtropical and temperate evergreen forests.

Out of the above No. 5 mixed deciduous forest which widely distributes throughout the country harbors commercially important tree species, and is the most important forest resource. Those forests are found in the districts of 1,000 ~ 3,000mm annual rainfall. Such districts are also rich in many useful tree species like teak, pyikado, padank and know.

The next important ones are the No. 4 tropical evergreen forests and No. 7 deciduous dipteracarp forests or indaing, the both containing many useful tree species. No. 1 tidal forests are found in the Tenasserim district along the Arakan and Irrawaddy coastal regions, which serves as fuel source, and considerable bamboo forest exists in Arakan and Tenasserim district.

The forests of Burma are classified into 'reserved forest' and 'unreserved forest'. Reserved forest is strictly managed under the Burma Forest Act as a forest to be protected for timber production, maintenance of national asset and protection of basins. On the other hand, unreserved

forests are not subject to a strict regulation as reserved forest. As of 1975-1976 reserved forests account for 14.5% or 98,000km² of the total national land. The Government intends to increase that ratio to 25%.

4-2 Forestry Production

Table 14 Changes in the production of teak and hardwood

(unit: m³)

	Production	
	Teak	Hardwood
1939-40	446,730	478,217
1972-73 (6-month)	307,436	1,007,035
1974-75 (Provision)	94,772	368,594
1975-76 (Provision)	257,806	859,869

Burma's forestry labor population in 1975/76 was about 153,000, accounting for 1.28% of the total. The ratio of forestry in GDP was 2.5% in 1974/75. Despite a fact that the country is so rich in forest resource a role of forestry in national economy is not so large. However, forestry is a very important sector of the nation's economy by being a very good foreign exchange earner, occupying a high share of 25% in the total export amount in 1974/75.

Teak is the most important forestry product. The production of 450,000m³ of 1939/40 declined to 260,000m³ in 1974/75, then further to 220,000m³ in 1975/76. The 20-year Economic Development Plan with 1974/75 as its first year sets a target for export hike rate of 10%. And to achieve the same export of teak together with rice will play an important role.

4-3 Issue in Forestry Development

The problem in the expansion of forestry production in Burma is the insufficiency of improved infrastructures for forestry such as road, etc. The consolidation of general road in Burma cannot be said as sufficient. Particularly because the Irrawaddy River and its tributaries run through the national land from north to south, yet there are very few road of east-to-west direction. And that is jeopardizing the timber transportation as timbers are transported mainly by rivers to destination during the rainy season from June to October. We have been told that a large loss is inevitable because of long-period-and-distance transportation.

The timberyard operations are performed by elephant, buffalo and tractor because of inadequacy in forestry road density and consequently timber collecting rate is low.

To increase forestry production in future, it is necessary to improve forestry road as well as felling and piling operations beside the consolidation of general road for timber transportation.

V. HYDROLOGICAL ANALYSIS

V-1 Outline of Observation Installations

The hydrological analysis of the two rivers, Irrawaddy and Myimaka, is a very important subject in the Irrawaddy Basin Agricultural Integrated Development Project. Enough information as to the location of observation installations and observation condition needed for the analysis of those rivers was not available by the survey of this time.

(1) Water level observation stations

Representative water level observation stations within the Project Area are as follows:

Table 15 Location of water level observation stations

		Irrawaddy Basin		Myimaka Basin	
		Locations	Rivers	Locations	Rivers
Main stream		Prome		(1) Kyaukpyi -	Okkan
"		Myanaung		(2) Kaung-laungtino	Thegaw
"		Henzada		(3) Kwetwa	Kadinbilui
"		Seiklba		(4) Tanbington	Myauna
"		Manbin		(5) Chaungzauk	Gamon
"		Others	51 places including delta	(6) Bawbin	Bawbin
Tributaries		(11) Myodaung	Dingyi	(7) Magyibin	Taunguy
"		(12) Magwe	Alenawing	(8) Theme	Wegyi
"		(13) Yattfit	South-Nawin	(9) Yonbendot	Thegon
"		(14) Kyidaing	Kyun	(10) Thapangaing	Shewelo
"		(15) Kwinlyagyai	Kyun-yaung		
Total		61 places		10 places	
				Total	

As the above table is self-explanatory there are 71 observation stations within the Area. As for the number of years for the observation of Myimaka basin it is only for 7 years from 1970 to 1976, and for the Irrawaddy basin, only few years since the establishment of observation. As a whole detailed data is lacking.

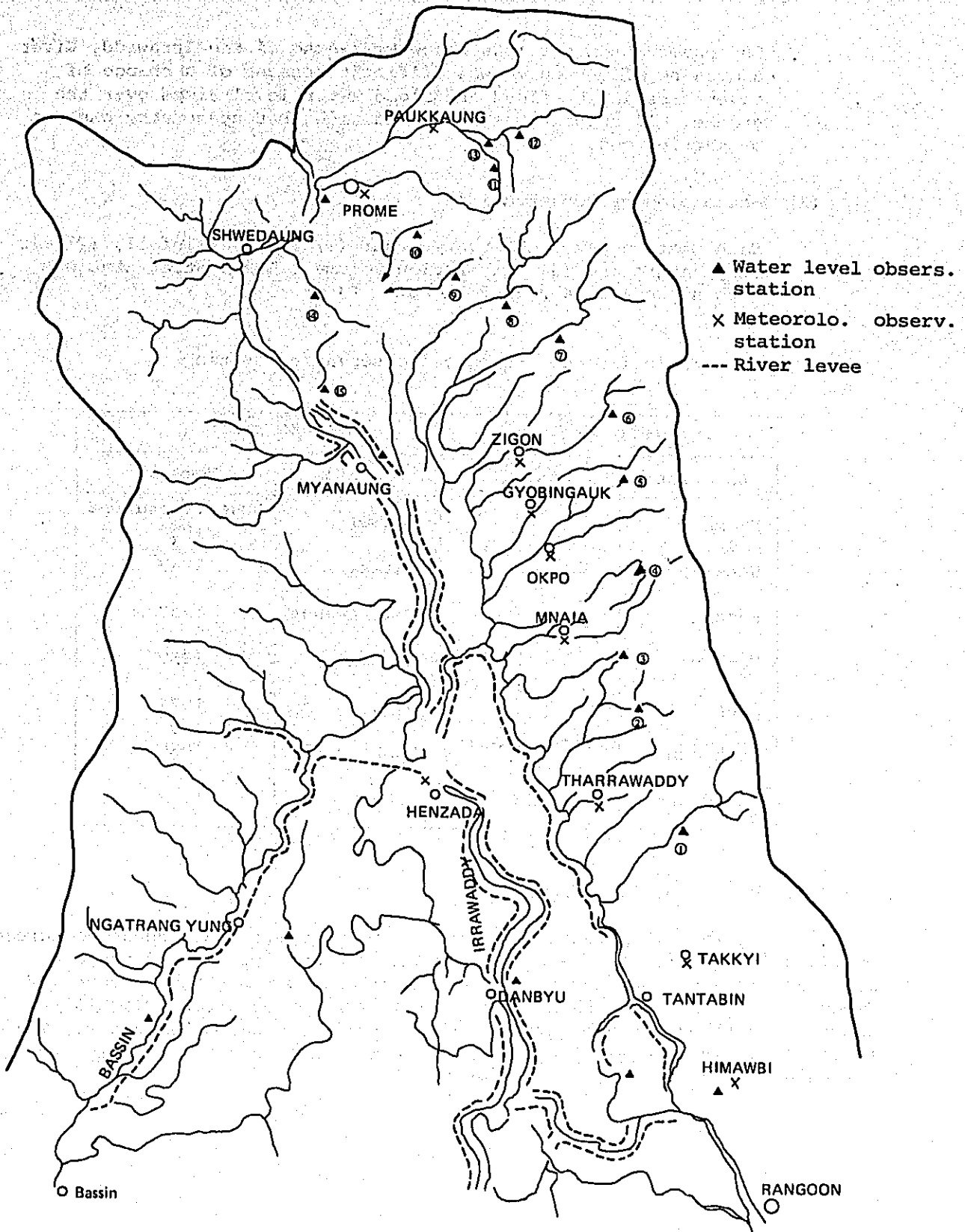


Fig.10 The locations of observation stations

The observation stations below Myan-Aung of the Irrawaddy River a drawing of Q-H curve was difficult because of a change of river crossing by flood and flood water level rises over the ground. As such it was in a condition that hydrometry can not be carried out.

(2) Meteorological observation

Each station makes observation on: (1) daily rainfall, (2) air temperature and (3) evaporation volume. Observation stations within the Area are as follows:

Table 16 Meteorological observation station

Irrawaddy basin		Myimaka basin	
Location	Remark	Location	Remark
Prome		Hmawbi	Observ. started 1954
Henzada		Taikki	1947
Bassin		Tharrawaddy	1947
Manbin		Minhla	1959
Pyapon		Okpo	1972
Pankkaung	Tribut. basin 1966	Gzobingang	1959
Shwedaung	1948	Zig-on	1959

V-2 Condition of Flood Damage

It was not possible to obtain data to comprehend inundated acreage by flood in the Project Area under the present survey. So reference material has been obtained from the Agricultural Corporation ('Survey of Flood Damage Acreage by Each Province and Division of Burma 1974 ~ 1976') under which flood acreage in the Project Area is as shown hereunder. The flood damage in 1974 was large and out of the whole country's damage the Irrawaddy water system accounts for 80%.

Table 17 Survey of damaged acreage on paddy rice and other crops by flood (ha)

Division	1974			1975			1976			Remark
	Rice	Others	Total	Rice	Others	Total	Rice	Others	Total	
Pegu	80,503	14,119	94,622	7,946	4,777	12,723	,858	4,170	31,028	Per. Jan. 1 to July 30
Rangoon	104,439	336	104,775	8,341	-	8,341	58,112	282	58,394	
Irrawaddy	167,091	1,779	163,270	3,104	1,063	4,167	83,572	581	84,153	
Total	352,033	16,234	368,267	19,391	5,340	25,231	168,542	5,033	173,575	
Union's Total	421,372	98,685	520,257	47,386	32,393	77,779	183,222	148,926	332,148	

V-3 Basic Concept of Analysis

3-1 Outline of Analysis

Hydrological analysis of the Project Area is classified into two river basins by the topography and river basins of the Area:

- a. Irrawaddy River Basin --- Flood analysis based on drainage plan
- b. Myimaka River Basin --- Hydrological analysis of drainage plan and irrigation installation (dam)

a. Irrawaddy River Basin

The Irrawaddy River's length is 1,500km with its origin in China and India attended by its basin's acreage of 4,000km². Out of which delta district accounts for 40,000km². The River's head is a heavy rain region of annual rainfall of about 4,000mm, and the midstream near Mandalay is a dry district with about 700mm. Delta district of the Irrawaddy River is about 2,000mm. Thus meteorological condition differs by region. And it is classified into rainy and dry seasons. With practically no rain in dry season.

Under such a meteorological condition this Project Area along the Irrawaddy River is greatly controlled by rainfall in the upstream and snow-thawed water.

The hydrological analysis of the Project Area at this time was directed to analyze a relation between flood volume and flood level (water level of the rivers and in the Area) based upon the present condition of the Irrawaddy River (Project Area's Irrawaddy portion has been equipped with flood control river levee), thereby, drainage plan of lowland of the Area is to be established. And because main stream's water level declines during the dry season, hydrological analysis required to establish irrigation plan for dry season shall be carried out.

b. Myimaka River

The Myimaka River is east of the Irrawaddy River and in comparison with the Irrawaddy River river-improvement area is small and the River flow slowly. And as the flood water of the Irrawaddy River inflows near the downstream of Myan-aung, coastal cultivated land sustains flood damage. Hydrological analysis is to be studied by a value which is obtained by adding discharge volume of the main stream of the Irrawaddy River to own basin, at the same time hydrological analysis will be made which is required in dam construction.

3-2 Classification of Analysis

The two basins shall be analyzed by classifying into the following four categories:

a. Irrawaddy upstream region

Hydrological analysis of the main stream up to Myan aung with Prome as base of operation

b. Irrawaddy downstream region

Hydrological analysis of delta district of the main stream below Myan aung, including also the analysis of discharge volume of the Myimaka River

c. Myithmaka Main stream

Flood of own basin by adding thereto the Irrawaddy River's discharge volume is to be analyzed.

d. Myithamaka's tributaries

Based on the development plan of Myithamaka basin various hydrological analysis shall be carried out which are needed in dam construction (Myithamaka tributaries, 10 rivers. Irrawaddy tributaries, 5 rivers).

3-3 Concept of Analysis

The Area under the development plan of this time covers a vast tract of land with downstream district of the Irrawaddy River becoming a delta and the Irrawaddy main stream branching off to several tributaries. And because of a fact that the River has a salient features in that the influence of tidal sea level reaches to a point 200km inland from the river mouth and because of a lack of observation data it is difficult to seek a detailed hydrological analysis, but an attempt shall be made to analyze the following matters:

- a. Computation of various probabilities by meteorological data;
- b. Analysis of the maximum flood discharge of the Irrawaddy and Myimaka River;
- c. Analysis of flood discharge of probability year;
- d. Analysis of the number of continuous days of flood;
- e. Analysis of the discharge volume from the Irrawaddy River to Myimaka River;

- f. Correlation between flood discharge and flood water level;
- g. Computation of probability year at the dam site of Myimaka basin;
- h. Analysis of flood volume

3-4 Data Required for Analysis and Its Scope

Information required for analysis and its scope are summarized as follows:

- a. Meteorological data --- Data from observation-completed data;
- b. Rivers' water levels --- Data from observation-completed data;
- c. Tributaries' rate flow; --- Data from observation-completed data;
- d. River traverse shape figur - Requires investigation (some information from observation-completed data)
- e. Upper limit of analysis --- Prome
- f. Lower limit of analysis --- Within a scope of the influence of tidal sea level;
 - (a) Irrawaddy --- at Danub
 - (b) Bassein --- at Ngataingyaung
 - (c) Myimaka --- at Tantabin
- g. Others

V-4 Countermeasures and Investigation

4-1 Runoff Ratio of Rivers

The runoff ratio will be pursued based upon a flood discharge data of each river by month for the Myimaka basin and Irrawaddy tributaries and runoff ratio at the vicinity of Tharrawaddy of the Myimaka basin and on the upstream region of Nawin River above Prome. The results are as shown in Table 18 and 19 and in Fig. 11 and 12.

Table 18 Runoff ratio of the Irrawaddy tributaries basin

Rivers	Year	Item	May	June	July	Aug.	Sept.	Oct.	Nov.
Dingyi	1973	Total rainfall mm.	93	130	53	68	-	42	44
		Total runoff	3	10	26	27	-	26	13
	1974	Rainfall mm.	102	92	71	-	60	15	32
		Runoff	0.4	12	17	-	21	8	5
	1975	Rainfall mm.	97	106	91	79	45	42	8
		Runoff	4	22	78	51	23	24	9
		Runoff ratio	2'	13'	56'	53'	42'	59'	32'
Alenawin	1973	Total rainfall mm.	79	110	45	57	-	36	11
		Total runoff	4	7	17	16	-	14	18
	1974	Rainfall mm.	87	78	60	-	51	13	27
		Runoff	2	14	15	-	22	12	11
	1975	Rainfall mm.	82	90	77	67	38	36	
		Runoff	2	21	31	64	29	20	
		Runoff ratio	3'	23'	35'	48'	57'	54'	55'
	Average runoff ratio	3'	18'	46'	51'	50'	57'	44'	

- Remarks: 1. Observation point, Prome
 2. Unit for the total runoff, $10^6 m^3$
 3. Runoff ration, %

Table 19 Runoff ratio of lower Myithmaya basin

Rivers	Year	Item	May	June	July	Aug.	Sept.	Oct.	Nov.
Okkan	1973	Total rainfall mm .	100	174	167	136	99	50	15
		Total runoff	16	19	83	106	71	50	4
	1974	Rainfall mm .	61	139	173	159	68	68	4
		Runoff	6	38	97	98	68	45	6
	1975	Rainfall mm .	96	134	102	182	-	-	-
		Runoff	60	70	58	80	-	-	-
		Runoff ratio	10'	19'	54'	60'	83'	81'	44'
Thegaw	1973	Rainfall mm .		48	46	38	28	14	5
		Runoff	1	3	7	9	9	8	1
	1974	Rainfall mm .	17	39	49	44	19	19	2
		Runoff	1	12	33	44	16	17	2
	1975	Rainfall mm .	24	35	29	51	19	27	4
		Runoff	1	12	21	40	19	14	1
		Runoff ratio	11'	22'	49'	70'	67'	65'	36'
	Average runoff ratio	14'	25'	52'	65'	75'	73'	40'	

- Rémarks: 1. Observation point, Henzada
 2. Unit for the total runoff, $10^6 m^3$
 3. Runoff ration, %

Table 20 Irrawaddy River flood discharge observation data

Year	Observ. date	Water level (cm)	Discharge (m ³ /sec.)	Remarks
1968	July, 28	2,912	47,398	1. Observation point; Prome 2. Danger water level; 2,900cm 3. Observation water level; 0 cm
	" 29	2,915	47,695	
	" 30	2,917	47,893	
	" 31	2,917	47,893	
1969	Aug., 2	2,805	39,120	
1970	Aug., 7	2,910	47,200	
1971	Sept., 1	2,923	48,515	
	" 2	2,948	51,220	
	" 3	2,954	51,869	
	" 4	2,942	50,570	
	" 5	2,912	47,590	
1972	Aug., 10	2,794	38,440	
1973	Aug., 13	2,901	46,480	
	" 14	2,925	48,731	
	" 15	2,941	50,462	
	" 16	2,950	51,436	
	" 17	2,950	51,436	
	" 18	2,943	50,679	
	" 19	2,926	48,839	
	" 20	2,909	47,120	
1974	Aug., 10	2,905	46,800	
	" 11	2,926	48,839	
	" 12	2,976	53,960	
	" 13	3,007	57,580	
	" 14	3,023	59,940	
	" 15	3,024	60,120	
	" 16	3,022	59,260	
	" 17	3,009	57,860	
	" 18	2,997	56,180	
	" 19	2,986	54,800	
	" 20	2,977	54,020	
	" 21	2,956	52,085	
" 22	2,927	48,947		

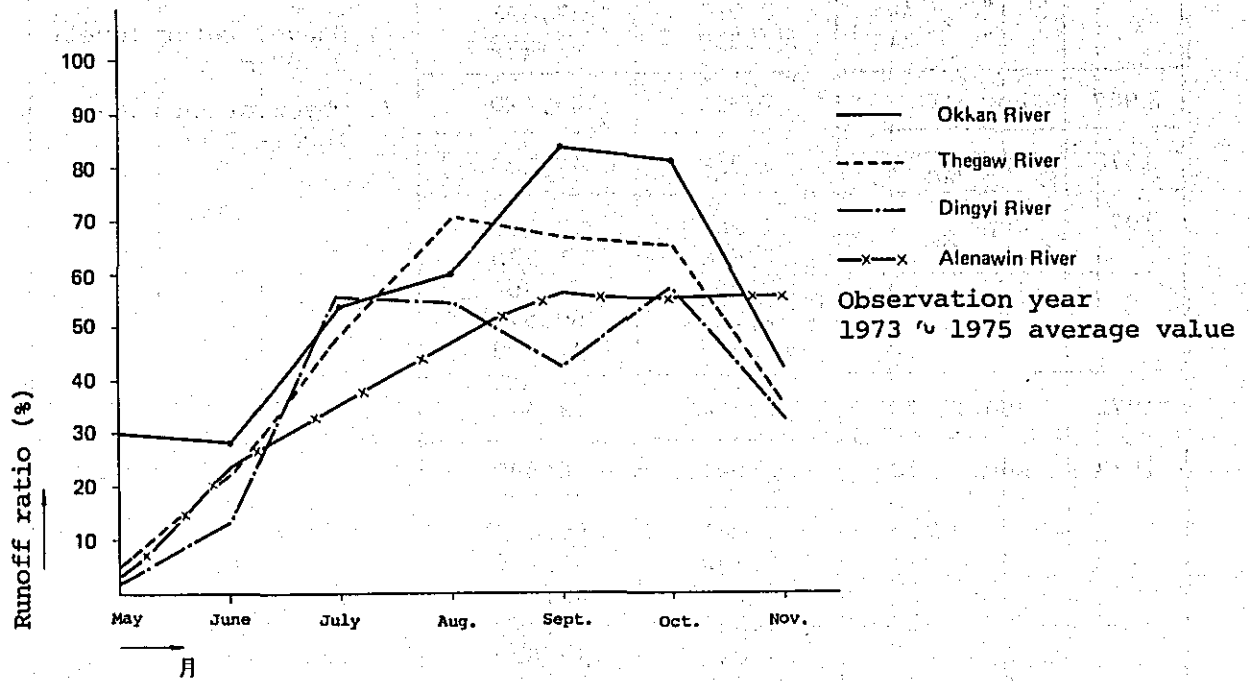


Fig. 11 Runoff ratio by point

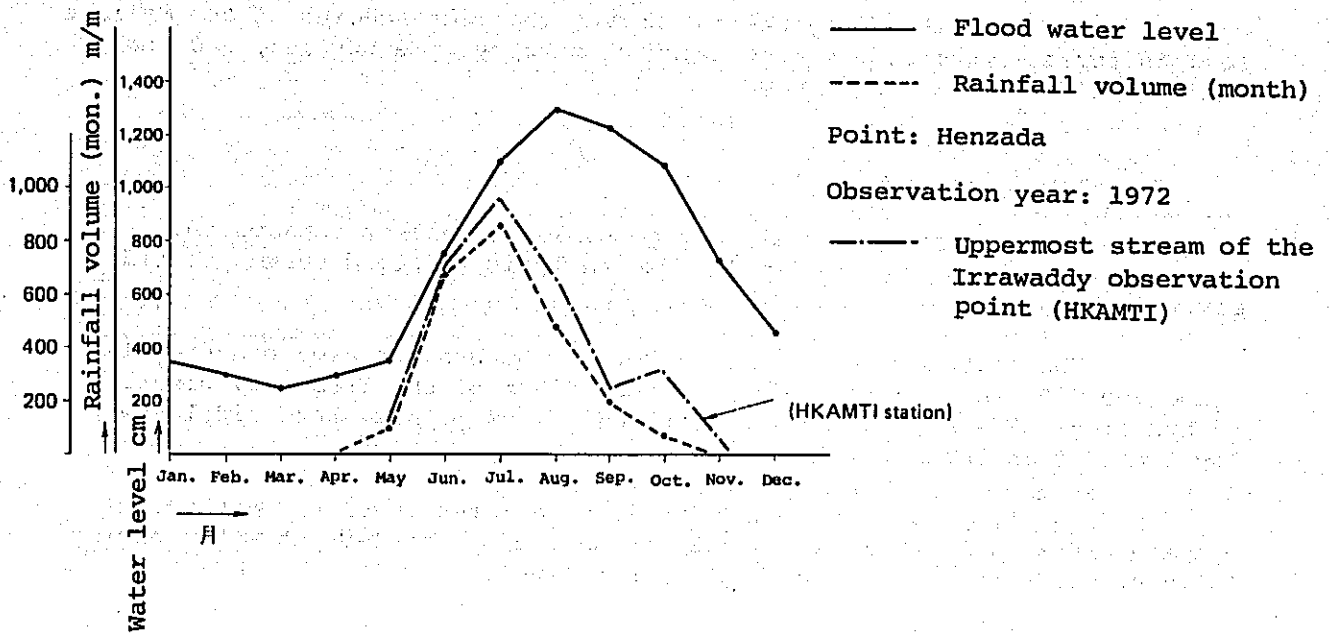


Fig. 12 Relation curve for flood water level and rainfall volume

As shown in Table 18 and 19 and in Fig. 11 and 12, the runoff ratio of the Project Area shows a high value at downstream district of the Myimaka River. As for a fluctuation in downstream and upstream it is related to the difference in rainfall volume besides the topography of land and forest type of river basins.

And both cases the highest runoff ratio is in September ~ October after the rainy season. This, perhaps is due to a fact that rainfall-volume-distribution-form is comparatively averaged and that runoff ratio becomes maximum in September ~ October from the relations among soil's rainfall-saturation-condition, rise in air temperature and evaporation volume.

As a result of on-the-spot survey the tree species of the Myimaka basin's forests were composed of dwarfish shrubby tree species, and the soil nature was silt-sandy loam.

4-2 Tidal Sea Level

The present survey was not possible to collect data on the Irrawaddy River's tidal sea level. The analysis of flood volume of tidal river is complicated.

The southernmost point, 17°20' of the Project Area practically coincides with the contact point of tidal river of the Irrawaddy River. So hydrological analysis shall be carried out at points where tidal sea level has no influence.

As for a data on the lower limit in water level at Danubyu, Ngataingyaunt and Tantabin an analysis should be carried out after having fully studied its relation with tidal sea level.

4-3 Flood Record of the Irrawaddy River

The flood record of the Irrawaddy River is as shown in Table 20.

VI. DEVELOPMENT STRATEGY AND SCHEDULE

VI-1 Development Strategy

This Project Area is, in the light of the condition of location, subdivided into three districts --- Myimaka River Basin, upstream delta district and Irrawaddy River west bank district. Accordingly, a long-term development concept has tentatively been decided to cope with the particular features of the location of each district.

1-1 Myimaka River Basin (Irrawaddy River left bank district)

Because this district is adjacent to Rangoon, main roads are consolidated, although not to the full extent, and forms a vast agricultural district as Burma's grain belt. By implementing flood control measure for the rainy season and irrigation for dry season and by introducing improved farming technique it has a great potential to increase agricultural production. Out of the three districts this district has the highest possibility for agricultural development with all favorable conditions in land, water and labor force.

1-2 Delta Upstream District

This district is a polder area formed by many tributaries of the Irrawaddy River. It easily sustains a flood damage, and despite its fertile soil, at the present stage, where flood control of the Irrawaddy River's main stream has not yet been achieved.

1-3 Right Bank District of the Irrawaddy River

The main constituent of this district is a table land ranged to the Arakan mountain range so from the standpoint of land and distribution of labor the district is in low level for development. Accordingly, for the time being, it is a district where the road development should precede initially.

1-4 Development Time Schedule

In long-term prospect even if the development of the whole Project Area is to be pursued, in the light of limited fund, cost performance and particular conditions of each district the order of priority should be the Myimaka River Basin, Delta's upstream district and the Irrawaddy River's west bank district. For that purpose development method and time schedule is as shown in Table 21.

V1-2 Cooperation's Set-up for Future Survey

To ensure a smooth progress in future survey it is desired that cooperation's pattern is proposed as shown hereunder.

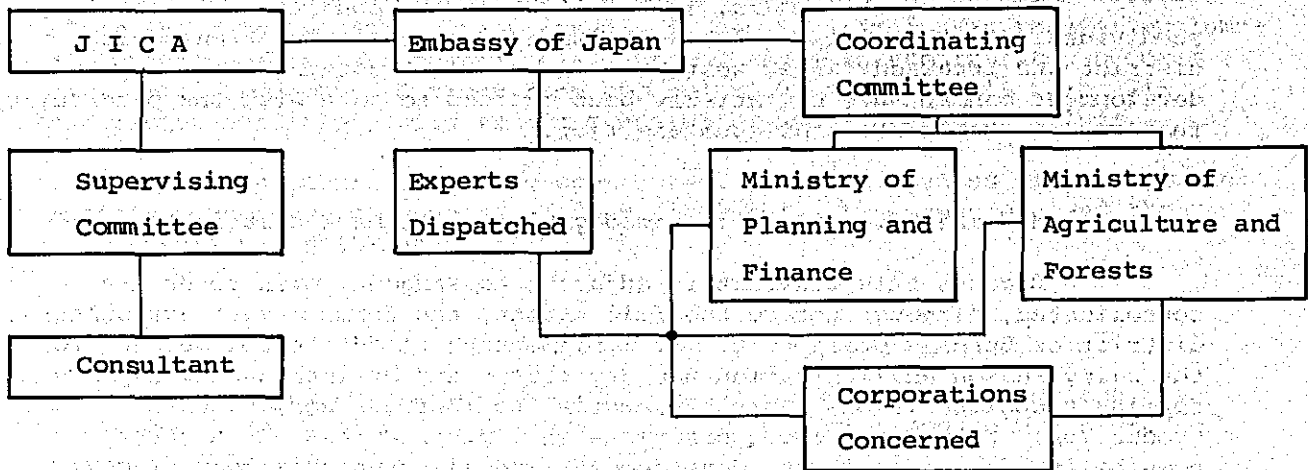


Table 21 Development Strategy

Order No.	District	Short-term	Mid-term	Long-term
1	Myimaka Basin	<ul style="list-style-type: none"> . Consolidation of irrigation installations . Development & extension of agriculture tech. (Fertile agr. chem. improvement) . Improvement of main farm & forestry road . Improvement of fish pond . Improvement of terminal canal . Improvement of farming tech. 	<ul style="list-style-type: none"> . Consolidation of maret-ting installation for agr. product . Introduction of farm machinery (1) (for plowing, threshing) 	<ul style="list-style-type: none"> . Improvement of rural infrastructure . Introduction of farm machinery (2) (Planting, harvesting)
2	Delta upstream district	<ul style="list-style-type: none"> . Drainage improvement . Improvement of farming tech. . Improvement of fish pond 	<ul style="list-style-type: none"> . Consolidation of irrigation facilities . Introduction of advanced agr. tech. 	<ul style="list-style-type: none"> . Consolidation of marketing facilities for agr. product
3	Irrawaddy River west bank district	<ul style="list-style-type: none"> . Road construction to invite development . Improvement of farming tech. . Improvement of fish pond 	<ul style="list-style-type: none"> . Consolidation of irrigation facilities . Introduction of advanced agr. tech. 	<ul style="list-style-type: none"> . Consolidation of marketing facilities for agr. product

(1) Coordinating Committee

It is desirable that Burmese side establishes a Coordinating Committee comprising of the Ministry of Planning and Finance, Ministry of Agriculture and Forests and related public corporations.

(2) Dispatched Experts

It is desirable to send long-term Japanese experts to ensure liaison and adjustment as well as to collect basic data required in the effort to establish this Development Plan. The experts, in the light the Project is a comprehensive plan for all sectors of agriculture, should be in regional development and hydrology to collect hydrological data.

(3) Supervising Committee

The establishment of a supervising Committee is desirable to supervise the work of consultant and to give technical advice, composed of experts from all sectors.

IV-3 Survey Schedule in Future

Prior to a full-scale survey for Master Plan the implementation of basic survey centering on on-the-spot survey is indispensable because of a shortage of existing reference material and data. And as for the development plan of Myimaka basin which the Burmese side highly desire as 'Quick-return project', if a formal request is received, it is desirable to cope therewith under the following schedule.

Further Work Schedule (Tentative)

	1977				1978												1979											
	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9			
1. Preliminary Survey	-----*																											
2. Pre-Master Plan Study																												
Scope of Work	•																											
Field Survey					-----																							
Home Work (Hydrological Analysis)					-----																							
3. Master Plan Study																												
Scope of Work																												
Field Survey					-----																							
Home Work					-----																							
Draft Report					-----																							
Draft Mission																	-----											
Final Report																	-----											
4. Feasibility Study																												
Scope of Work					-----																							
Field Survey					-----																							
Home Work					-----																							
Draft Report					-----																							
Draft Mission																	-----											
Final Report																	-----											

THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

INTERIM REPORT

ON

PRELIMINARY SURVEY OF IRRAWADDY BASIN

AGRICULTURAL INTEGRATED DEVELOPMENT PROJECT

OCTOBER 1977

JAPAN INTERNATIONAL COOPERATION AGENCY

[The page contains extremely faint and illegible text, likely due to low contrast or scanning quality. The text is arranged in several paragraphs across the page, but no specific words or phrases can be discerned.]

October 26, 1977

His Excellency U YE GOUNG
Ministry of Agriculture & Forests,
The Socialist Republic of the Union of Burma.

Dear Sir,

Re: Submission of Interim Report on
Preliminary Survey of Irrawaddy Basin
Agricultural Integrated Development Project.

I have a great pleasure to submit herewith 20 copies of Interim Report on Preliminary Survey of Irrawaddy Basin Agricultural Integrated Development Project, carried out by the Survey Mission dispatched by the Government of Japan.

The contents of the report are, however, tentative and subject to revision on the occasion of making the final report after our return to Japan.

I expect that the Government of Japan will make necessary actions and procedures for the next step of the project as soon as possible.

In this occasion, I would like to express you my hearty thanks for sincere cooperation, convenience and hospitality extended to us by you and your staff during our stay in Burma.

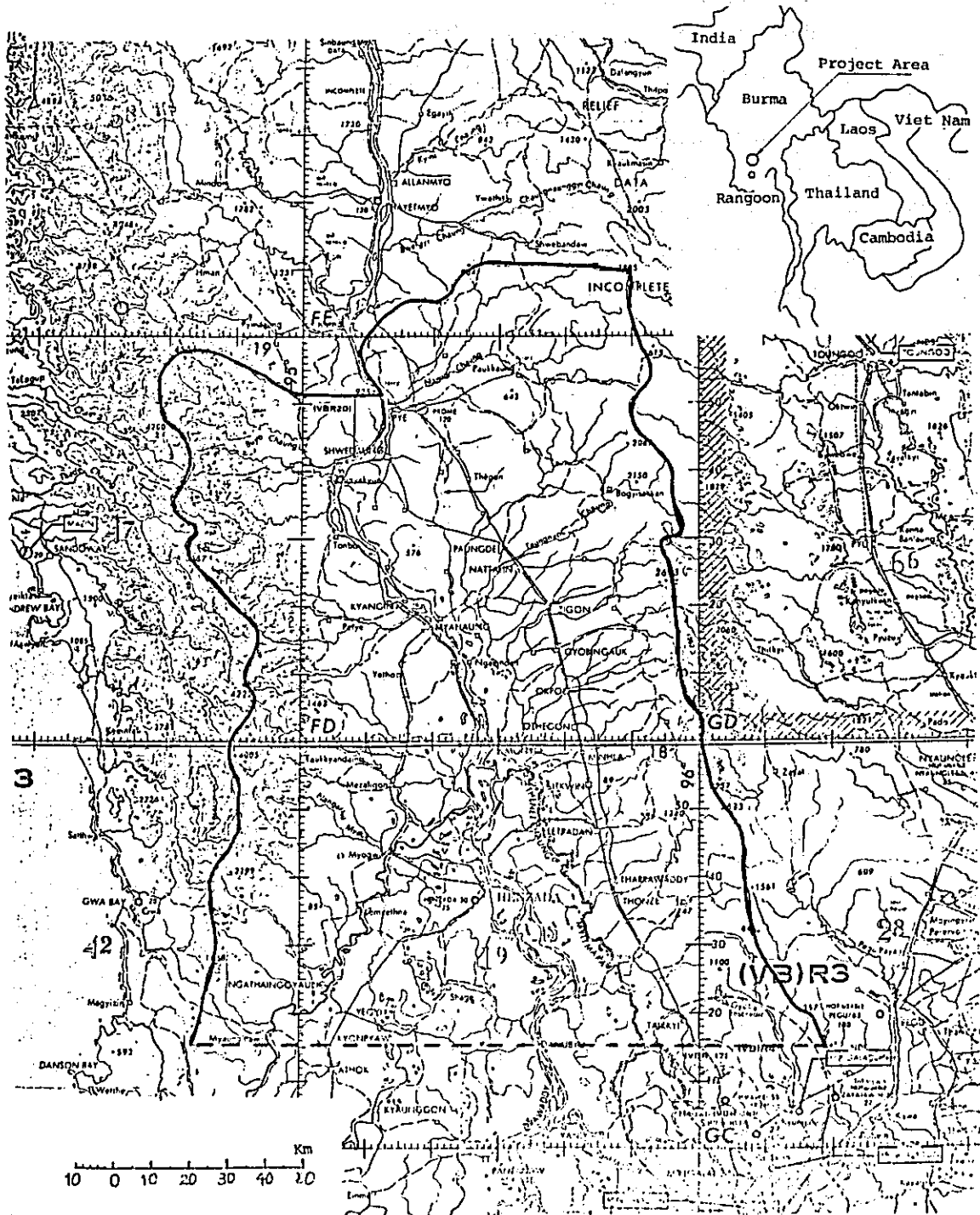
I remain,

Respectfully yours,

MINORU IKEDA
Team Leader,
Japanese Preliminary Survey Mission
for Irrawaddy Basin Agricultural
Integrated Development Project

Irrawaddy Basin Agricultural Integrated Development Project Area

2.5 million ha
(6.2 million acres)



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General Map

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1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that proper record-keeping is essential for transparency and accountability, particularly in the context of public administration and financial management. The text notes that without reliable data, it is difficult to assess performance, identify trends, and make informed decisions.

2. The second part of the document outlines the various methods and tools used for data collection and analysis. It mentions the use of spreadsheets, databases, and specialized software to organize and process large volumes of information. The author highlights the need for standardized procedures to ensure consistency and accuracy in the data being collected. Additionally, the text discusses the importance of regular audits and reviews to verify the integrity of the records.

3. The third part of the document focuses on the challenges associated with data management and the strategies to overcome them. It identifies common issues such as data redundancy, inconsistent formats, and limited access to information. The author suggests implementing data governance policies, which include defining roles and responsibilities, establishing data quality standards, and ensuring that only authorized personnel have access to sensitive information. The text also mentions the importance of investing in training and resources to support effective data management practices.

4. The final part of the document concludes by summarizing the key findings and providing recommendations for future actions. It reiterates that a robust data management system is crucial for the success of any organization, especially in the public sector. The author encourages the adoption of a proactive approach to data management, where potential issues are identified and addressed before they become major problems. The text ends with a call to action, urging stakeholders to work together to improve data management practices and ensure the highest level of transparency and accountability.

I. Introduction

In response to the request made by the Government of the Socialist Republic of the Union of Burma for exploring the possibility of the Agricultural Development of Irrawaddy Basin, the Government of Japan has decided to dispatch the Japanese Preliminary Survey Mission consisting of seven members from 21st September to 29th October.

The preliminary survey was carried out successfully as scheduled and consequently a note will be submitted herewith before their return, as an interim report.

II. Background of Agricultural Sector

1. Agricultural Production and GDP

Agriculture's share of GDP has been constantly high for the last 15 years, recorded 34.5% in 1961/62, 36.2% in 1974/75 and 36.3% in 1975/76 being measured in 1969/70 prices. These figures show that the agricultural sector (including fishery and forestry) plays very important role in the national economy.

2. Export of Agricultural Products

Agricultural products share of the total export was also very high, accounting for 95.0% in 1961/62. Although this share decreased to 79.0% in 1972/73 because of decrease in crop production, mainly rice, it recovered the previous position in the total export, accounting for 89.3% in 1973/74, 83.2% in 1974/75. The export of agricultural products bears the important role of obtaining foreign currency.

3. Agricultural Active Labour Force

The total active labour force at the end of March in 1976 was estimated at 11.933 million of which 7.927 million or 66.4% was engaged in the agricultural sector.

4. National Development Plan and Agriculture

Burma has made the Twenty-Year Plan for Economic Development (1974/75 - 1993/94). In this plan, annual population growth rate is estimated at 2.3% on the other hand agricultural output is projected to increase 4.8% annually, more than twice of population growth.

Export is projected to increase at considerably high rate of 10.9% annually. Although the composition of the projected export is not explained, judging from the trend of the past years, the agricultural sector would be expected to perform important role in the export.

The agricultural sector was given high priority in the Second Four-Year Plan (1974/75 - 1977/78), and will also be given high priority in the Third Four-Year Plan.

From the point of view mentioned above, it can be concluded that the role of agriculture is very important in the national economy.

5. Agricultural Development Plan

Regarding the plan for Agricultural Development, there are on-going development projects such as Lower Burma Paddyland Development I Project in Lower Burma, Sedawgyi Multipurpose Dam Project in Mandalay Division (Upper Burma), etc., which were initiated and promoted by the World Bank Group (IDA), the Asian Development Bank, other bilateral governments, respectively. The area proposed by the such Japanese Preliminary Survey Mission is the only area which has no definite development plan among the principal plains.

In this stage, it is considered that an establishment of an agricultural integrated development plan will promote development of the proposed area intentionally, furthermore the plan will contribute to the comprehensive agricultural development in the whole Burma, coupled with the said development plans assisted by the international financing agency as well as the bilateral aid.

III. Project Area

1. Location

- 1) An area which is identified by the flight and field reconnaissance survey is located in the upper delta in between $17^{\circ} 15' \text{ NL}$ and $19^{\circ} 10' \text{ NL}$ and surrounded by two mountain ranges, namely Arakan and Pegu as shown in the general map attached. The area is estimated at around 2.5 million ha. (6.2 million ac.) as its total acreage.
- 2) The boundary of the project area is decided after consideration of factors mentioned below :
 - (1) East and West
Watersheds of Arakan mountain range and Pegu mountain range.
 - (2) North
Boundary line near Prome dividing Irrawaddy Basin into wet zone and dry zone.
 - (3) South
Approximate $17^{\circ} 15'$ line of north latitude which is presumed to be closed to the area of the Lower Burma Paddyland Development I Project investigated by IDA., and which also covers the areas of the Food Production Promotion Project as well as the Pig and poultry breeding project in the Rangoon Division assisted by the Japanese Government which are now under negotiation.

2. General Features of the Project Area

1) Summary of general features (based on informations provided to the Mission)

<u>Land Use</u>	(million acres)
Total Project Area	6.2
Cultivated Area	2.5
Forests	2.1
Waste Land and Others	1.6

<u>Cultivated Area</u>	(%)
Paddy	74.9
Pulses	8.1
Groundnuts	5.2
Sesamum	4.7
Jute	2.6

<u>Irrigated Area</u>	101 Thousand Acres
<u>Double Cropping Area</u>	286 Thousand Acres
<u>Population</u>	3.0 million
<u>Population Density</u>	120 persons/Km ²
<u>Agricultural Population</u>	2.1 million
<u>Annual Rain-fall</u>	69.4 inches (ranging 42.6 to 95.4 inches by township)
<u>Temperature</u>	
Mean Maximum	35°C
Mean Minimum	21°C

2) Physical and Social Condition of the Project Area

The proposed project area has annual rainfall ranging from 1,000 mm to 2,000 mm, and it is preliminary understood that the area is suitable for production various crops, especially paddy cultivation, subject to the detailed investigations in future.

Population of the area is estimated at about 3.0 million and its density is worked out at 120 persons per sq km which is about 2.7 times of the national average, about 45 persons per sq km. It can be said that the area is of advantage to obtain labour power to be required for the development works, because villages and settlements are well located surrounding the medium and small scale cities.

The proposed project area has an area of about 2.5 million ha (6.2 million acres) extending along the Irrawaddy river including the Myitmaka river basin at east side, which is covered by the sphere of about 200 km from Rangoon

and is favourable for marketing agricultural products.

At present the farm land is not intensively utilized because of floods and inundations along the main rivers as well as shortage of irrigation water at middle and upper part of the tributaries. Furthermore, density of facilities and road network for transporting of agricultural materials and marketing agricultural products is low.

3. Irrigation

In the proposed project area, most of all farmer cultivate crops relying on rainfall or flood water of the Irrawaddy river and its tributaries during the rainy season, and no large scale irrigation facility is available at present. While in the upper part of the area, mainly paddy field is irrigated by small scale intake facilities constructed by farmers, in the lower part, no irrigation facility is provided for paddy fields, but a part of upland fields is irrigated by a few small scale pumping facilities during the dry season.

4. Floods and Poor Drainage

All the rivers in the Irrawaddy river basin cause big damages to farm land by floods and inundation during the rainy season, which are, at the same time, utilized as an important and a valuable water resource for farm management. To prevent farm lands and towns from floods many embankments have been constructed, but in the lower area where no embankment is constructed, farmers cultivate crops after lowering flood water level in their farm land. In these area, it happens so often that is difficult for farmer to grow crops in their suitable period to cultivate and farmers cannot always maintain their stable farm management, because inundation water is not well drained out even after water level in the rivers goes down due to poor drainage systems.

5. Road

The present condition of the road network in the proposed project area is not sufficient and satisfactory. Especially, in the Irrawaddy delta area, traffic between the east and the west is interrupted by the rivers and sometimes by floods, because numberless rivers and creeks run from north to south in the delta. Additionally, the condition of secondary and farm roads is not also sufficient, and it is quite difficult to transport agricultural materials, to carry out agricultural products and to introduce agricultural machineries, effectively.

6. Forestry and Fishery

Study on above sectors will be made by the Mission and will be incorporated in the final report.

IV. The Project (Master Plan Study)

1. Necessity and Purpose of Master Plan

1) General

Generally speaking, a purpose of master plan is to fix a principle of development for an area which has a considerable expanse on the basis of the National Plan and the long term prospect, considering comprehensively such various factors as land, water, labor power, farm management, etc., and to aim at an efficient execution of each selected project in the area. A master plan would include various future development plans which can be divided into long term, medium term and short term plan.

<u>National plan</u>	<u>Master Plan</u>	Definite
	(long term)	Projects
	(medium term)	
	(short term)	

2) Relation with National Plan

The proposed project area covers the vast area of 2.5 million ha which can be considered to be one of important agricultural zones in Burma, however, no comprehensive development plan has been made on agricultural development.

The Burmese government is now promoting the 20 Year Development Plan which has started in 1974, and the Third Four Year Development Plan will start from 1978. Based on both the 20 Year and the Third Four Year Development Plans, the coming master plan study will conduct various investigations in detail in the proposed project area to realise the principles of the said plans, and establish a comprehensive development plan through thorough discussions and coordination with the agencies concerned, which contains not only such various component for the agricultural development as equipment of infrastructures (facilities to secure water resources, irrigation and drainage systems, road networks etc.), agricultural modernization, extension services and so forth, but also forestry and fishery developments.

2. Principle of Master Plan

Concerning with the acceleration of the regional development in the agricultural sector in the Project Area, the Mission has paid attention both to the direction of agricultural development and the necessary improvement to actualize the development.

1) Direction of agricultural development

The Mission considers that the expected desirable direction of agricultural development should aim to enlarge double cropping area by multiple crops coupled with stabilized increase of land/labor productivity. According to the following reasons, the cropping pattern, upland crops after or before paddy, should have higher priority compared with that of double cropping of paddy or upland crops.

- Increase and stabilization in income and selfsufficiency of farmers by the combination of paddy and cash crops.
- Existence of double cropping prevailing in the area, that is, paddy after jute and paddy before groundnuts or pulses, which can easily introduce the further technical improvement to farmers.
- Economical water usage, efficiency of farm management and physioecology of crops which require to set main vegetative growth period of paddy in rainy season and upland crops in dry season.

For the realization of enlargement of double cropping area and increase and stabilization of productivity on the double cropping, the most important and urgent one is to construct irrigation and drainage facilities.

2) Necessary Improvement for the Agricultural Development

In the project area, there exist both the vast low productivity farmland because of floods, inundation and lack of irrigation water and the big waste land because of lack of appropriate drainage system. The following measures are necessary to actualize the increase and stabilization of land productivity to the existing low productivity farmland and the utilization of waste land. At the same time, the improvement of infrastructures to increase the efficiency of work and transportation of farm products, should be required.

- Construction of irrigation and drainage facilities such as storage dam, embankment, canal, pumping station and drainage system.
- Construction and improvement of trunk road, secondary road and farm road
- Consolidation of farmland

Agricultural modernization, accompanied with the improvement on infrastructures, is indispensable to obtain higher and stable productivity.

- Breeding for improved varieties and sufficient distribution of the seed
- Strengthening of seed farm system and recommendation of seed renewing
- Improvement of farm management methods and extension of the improved methods
- Economic evaluation of cropping pattern and guidance to farmers based on the evaluation.
- *Investigation and study of mechanized farming and introduction of agricultural machineries.*

Extension work has the important role to transfer and to extend improved varieties and techniques to farmers. Further, strengthening and enlargement of the existing extension system is desirable.

- Demonstration and guidance of improved varieties and techniques.

- Training and guidance on agricultural techniques, management and economics.

The following terms are necessary for farmers to obtain and to utilize the production means more efficiently.

- Strengthening of agricultural credit system
- Increase of supply and effective delivery system of production means, seed of improved varieties, fertilizers, inputs etc.
- Effective system or organization to utilize agricultural machinery and transport means.
- Improvement on infrastructuresm road network, storage facilities, processing facilities.
- Systematization of transportation
- Improvement on market facilities and organization

3. Development Strategy

1) Improvement of Regional Disparities

At present, there exist regional differences in farm management due to the natural and the social conditions.

Though, judging from financial conditions and development potentials, it is considered to be quite difficult to raise level of farm management up to the same standard in the entire project area at the same time, the master plan will be formulated as its principle which aims to raise position of each region, to improve the regional disparities and to develop the entire project area well-balanced by spreading development policy over the entire project area.

2) Coordination with Definite Project

In the proposed project area, there are several definite projects which have been examined already. For these projects, they will have their definite position in the master plan study and the master plan will study these projects carefully whether they will harmonize with the principle of development in the area from the view points of water, land and labor power availability.

4. Development Schedule

The development schedule should be determined through careful and enough study because the proposed project area is quite vast. In defining the master plan, it would be necessary to study and to check characteristics of each project, i.e., there are some projects which will intentionally implemented over long term period, while those which will be accomplished within short term period.

The development schedule of this project area would depend on the financial backing, and on the basis of the master plan study, priority of the project(s) to be selected will be decided and the feasibility study will be initiated accordingly. In order to decide such priority, the following items should be thoroughly studied

and discussed.

The project(s) to be selected

- 1) should have enough effects and benefits
- 2) realizes its effects and benefits early
- 3) benefits not a limited people but majority of farmers
- 4) should be adjustable with such related project(s) as equipping the related facilities.
- 5) will be a model and have extending effects to the other area.

For the area(s) which is selected and has high priority as stated above, it is possible that the feasibility study will be carried out in parallel with the master plan study, if necessary. In this case, the selected area(s) should be decided through checking the following conditions;

- 1) The definite plan such as irrigation project has been established already and has a certain prospect for the implementation.
- 2) Benefits will be realized easily by extension of modernized agricultural techniques.
- 3) More effects and benefits could be expected in cooperation with fertilizers and agricultural chemicals.

5. Cooperation proposed by Japanese Government and Schedule

1) Preparation of Master Plan

On the basis of the results of the preliminary survey, the Japanese Government would execute an investigation for the purpose to prepare the Pre-Master Plan for the proposed project area by the end of EY 1977. Further, The Master Plan will be followed which aims an agricultural development for the entire project area. The coming master plan study will determine priority of development potentials in the proposed area, and accordingly select the feasibility study area(s).

On the other hand, for the area where the definite plan has been prepared by the Burmese Government (i.e. the specified area in the Myitmaka river basin), the feasibility study would be implemented in the early stage in parallel with the master plan study in order to realize its benefit earlier.

2) Scope of the Master Plan Study

- (1) Hydrological study and analysis in the proposed area
- (2) Preparation of guideline for the agricultural development in the proposed area.
- (3) Clarification of definite programs to be required for the agricultural development in the proposed area.

- To improve and to rationalize agricultural techniques and farm management, etc.
 - To equip marketing facilities for agricultural products as well as road.
 - To equip infrastructures for rural living
 - Others
- (the agricultural development would include forestry and fishery)

V Recommendation

The proposed project is a large scale agricultural integrated development plan in the upper delta, and the further schedule as stated above should be implemented smoothly, so that it is inevitable to realize the following two items;

1) Establishment of Coordination Committee

It is recommended to establish the coordination committee which is composed of representatives at least from Planning and Statistics Department, Irrigation Department, Agricultural Corporation, Forestry Department, Fishery Department, among which many governmental agencies are concerned.

2) Implementation of Basic Investigation

Prior to dispatchment of the Japanese Mission for the master plan study, it is necessary to implement basic investigation on the following aspects so as to collect basic data and informations and to contribute to the regular investigation.

- (1) Collection of hydrological data and their analysis
- (2) Farm survey by Township concerned (including forestry and fishery aspects)

(Irrawaddy Basin Agricultural Integrated Project)

(October 25 1977)

Further Work Schedule (Tentative)

	1977			1978												1979												
	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9			
1. Preliminary Survey		-----	*																									
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Scope of Work																												
Field Survey																												
Home Work																												
Draft Report																												
Draft Mission																												
Final Report																												
5. Appraisal (O.E.C.F.)																												

THE MINUTES OF MEETING, HELD AT THE MEETING ROOM
THE AGRICULTURE & FORESTS MINISTRY
ON OCTOBER 24th, 1977 AT 1000 HOURS

Participants

- | | | |
|-----|------------------|---|
| 1. | Dr. Bo Lay | - Deputy Minister, Agriculture & Forests Ministry |
| 2. | U Khin Mg Latt | - Director General, Planning & Statistic Dept.,
Agriculture & Forests Ministry |
| 3. | U Hla Moe | - Director, Planning & Statistic Dept.,
Agriculture & Forests Ministry |
| 4. | U Khin Maung | - Managing Director, Agriculture Corporation |
| 5. | U Aung Ba | - Director General, Irrigation Dept. |
| 6. | U Tin Hlaing | - Director General, Fisheries Dept. |
| 7. | U Tha Tun San | - Director, Forest Dept. |
| 8. | U Khin Win | - General Manager (Extension), Agriculture Corporation |
| 9. | U Thein Tun | - Deputy Director, Irrigation Dept. |
| 10. | U Ba Aye | - Asst. Director (Hydrology), Irrigation Dept. |
| 11. | U Ba Toke | - Asst. General Manager, Agriculture Corporation |
| 12. | U Khin Mg Thaung | - Deputy Director, Agriculture & Forests Ministry |
| 13. | U Tha Tun Oo | - Asst. General Manager, Agriculture Corporation |
| 14. | Mr. N. Hara | - First Secretary, Japanese Embassy, Rangoon. |
| 15. | Mr. M. Ikeda | - Leader, JICA Preliminary Survey Mission |
| 16. | Mr. I Horiuchi | - Member " " " " |
| 17. | Mr. S. Kondo | - Member " " " " |
| 18. | Mr. A. Nakane | - Member " " " " |
| 19. | Mr. C. Takahashi | - Member " " " " |
| 20. | Mr. Y. Miyanishi | - Member " " " " |

1. The meeting was started at 1000 hrs. Mr. Ikeda, the leader of the JICA Mission presented the draft interim preliminary report of the Mission that had been distributed to the participants concerned and requested for the comments and suggestions concerning the points mentioned in the Report.

2. Dr. Bo Lay, the Deputy Minister generally agreed the draft Preliminary Report, but expressed his wishes that the Mission give first priority to the development of Myitmaka area under short term projects, while they are drawing the Master Plan of the main project which will include short term, mid-term and long terms projects so that quick returns could be

obtained from the Myitmaka project to fit into the 3rd 4 year economic plan of the Burmese Government in the Financial Year 1979-80.

3. The leader of the Mission said that the Deputy Minister's wishes will be given first priority recommendation in drawing up the Master Plan, which will be submitted to the Japanese Government for approval. Mr. Ikeda explained that two Experts, one Agronomist and one Hydrologist would be necessary to come and work for longer period in Burma for collection of more relevant data and to work as coordinators between the two countries, for the success of the Projects. He suggested that these experts could be requested from the Japanese Colombo Plan aid.

4. Director General U Khin Mg Latt and Director U Hla Moe said that it would be better if those experts could be sent direct under JICA fund rather than under Colombo Plan, just for the sake of simplicity in arranging things.

5. Mr. Hara and Mr. Ikeda said that they will try to get those experts from JICA with the consent of the Japanese Ambassador and the Japanese Government. In addition, they requested that the Burmese Government give the same facilities to those two experts such as the Colombo Plan experts enjoy in Burma, and also to cooperate and help the Master Plan Study Team and Feasibility Study Team, which are scheduled to arrive at the middle of next year.

6. U Khin Mg Latt said that, that request could be arranged and suggested the Mission to draw up a new further work schedule to shorten the survey periods, in accordance with the Deputy Minister's wishes.

7. The Mission leader agreed to submit a modified further work schedule (tentative) which is attached herewith.

8. The meeting was adjourned at 1200 hours.

Abstracts of the main points discussed and agreed in the meeting

- i) The Mission will recommend to the Japanese Government to consider that the short term Development Plan of the Myitnaka area will be given first priority in the course of the Master Plan.
- ii) The Mission will make necessary arrangements to send two experts, one Agronomist and one Hydrologist, under JICA aid.
- iii) The Agriculture & Forests Ministry will make necessary arrangements for the two experts to be able to enjoy the facilities as rendered to the Colombo Plan experts by the Burmese Government.
- iv) The Agriculture & Forests Ministry will also make necessary arrangements for the incoming incoming Master Plan and Feasibility Survey Teams, to be able to carry out their work smoothly like the present Preliminary Survey Mission.

Recorded by,

(HLA MOE)

For all the Participants of the meeting.

Letter No. Oosii 4/241/77 (2640/77)

Date 2nd November, 1977.

