ビルマ社会主義共和国

イラワジ川流域農業総合開発計画実施一次調査

現 地 報 告 書

昭 和 53 年 3 月

国 際 協 力 事 業 団

ビルマ連邦社会主義共和国

農林大臣　ウ エ ゴ ン　殿

拝　啓

イラワジ川流域農業総合開発計画実施一次調査現地報告書の提出について

私は，本件調査団の任務に基づいて行った「イラワジ川流域農業総合開発計画の実施一次調査現地報告書」（２０部）をここに提出致します。本報告書には，現地調査の結果判明したこと，マスタープラン作成方針に対する本件調査団の見解及び勧告等について，要約して述べてあります。

貴国と同じような環境にある他の国々における我々の経験からしても，マスタープランは非常に重要なものであると考えております。マスタープランを作成することによって，我々は，開発計画の内容と種々の開発段階に応じた妥当な優先順位を決定することができます。

本調査団は，早期に効果のあがる開発計画に対する貴国の強い希望に沿って，5ケ所のダムサイトについて現地調査を行いました。現地調査結果と関係資料に基づき，これらの灌がい計画地区のうちどの地区を最優先すべきかについて，ビルマ国政府と本件調査団は技術的な検討を重ねました。最終的には，貴農林大臣と在ビルマ日本国有田大使との間で総合的な検討が行われ，サウス ナウィン地域がフィジビリティ調査の最優先対象地区であることが確認されました。

私は本件調査団が貴国滞在中，貴下の関係当局から得ることのできた好意ある協力と助力に対して厚く感謝致します。

敬　具

イワラジ川流域農業総合開発計画実施一次調査団

団長　斉　藤　俊　樹

KEY MAP

30°

BURMA

PROME

Project Area

Bay of Bengal

RANGOON

10°

95°

GENERAL MAP

Mawin C.

PROME

Wetpot C.

Paungde

Kanthe

Kyangin

Bawbin C.

Gyobingauk

Myoung C.

IRRAWADDY RIVER

Minhla C.

Mokka C.

Kadin-bidin C.

Lepadan

Henzada

Tharrawaddy

Okkan C.

Okkan

Myitmaka

Taikki

Bawle R.

Hlaing

Panhlaing

Panhlaing C.

RANGOON

Maubin

Bassein

BAY OF BENGAL

18°

17°

93°

94°

95°

1 : 1,000,000

0 10 20 30 40 50 km

(1)

調 査 団 員 名 簿

団長	斉藤俊樹	地域開発	農林省九州農政局建設部 整備課課長補佐
団員	高橋政雄	水文	農林省構造改善局建設部 開発課
〃	白石英彦	水理解析	農林省農業土木試験場 水利部第三研究室室長
〃	伊藤喜一	排水	農林省農業土木試験場 水利部第三研究室
〃	山田和雄	林業	農林省林野庁業務部監査課 監査官
〃	堀井次雄	業務調整	国際協力事業団 農林業計画調査部
副団長	吉原平二郎	農業経済	㈱三祐コンサルタンツ 顧問
団員	高橋宏徳	水文	〃
〃	堀 徹郎	地質	〃 取締役
〃	雑賀忠蔵	栽培土壌	〃 顧問
〃	飯田将弘	測量	〃
〃	朝倉征雄	淡水漁業	〃 嘱託

カウンターパート名簿

U Ba Toke	Assistant General Manager Agriculture Corporation.
U Tha Tun Oo	Assistant General Manager Agriculture Corporation.
U Tin Win Latt	Deputy Assistant General Manager Agriculture Corporation.
U Ba Aye	Executive Engineer Survey Section Irrigation Department.

調　査　行　程

月	日		行　動　内　容
2	6	月	東京ーバンコック
	7	火	バンコックーラングーン
			日本大使館表敬訪問
	8	水	ビルマ政府表敬訪問
	9	木	関係機関表敬訪問，事情聴取・打合及び資料収集
	10	金	
	11	土	
	12	日	休日　団内会議
	13	月	資料収集
	14	火	踏査飛行　主に受益地並びに森林地域
	15	水	現地踏査　タイキー(Taikkyi)地域のダム，森林，農業，水文等の関係
	16	木	
	17	金	
	18	土	団内会議及び資料取まとめ
	19	日	休日　〃
	20	月	資料収集
	21	火	林業，農業及び地質の現地調査ープロム(Prome)附近
	22	水	同　上
	23	木	同　上
	24	金	林業の現地報告書とりまとめ，農業及び地質の現地踏査ープロム近辺
	25	土	山田(林業専門家)及び堀井団員ラングーンーバンコック
			農業及び地質　ラングーンへ帰る。
	26	日	休日　山田，堀井団員バンコックー東京
	27	月	団内会議　白石，伊藤団員　東京～バンコック
	28	火	白石，伊藤団員　バンコックーラングーン
			両団員大使館表敬訪門
3	1	水	水分解析の会議，資料収集
	2	木	水文解析の団員　イラワジ川の現地踏査，他団員資料整理　(祝日)
	3	金	同　上
	4	土	同　上
	5	日	休日　調査結果とりまとめ
	6	月	団内会議
	7	火	踏査飛行(イラワジ川及びミマカ川を中心に)

月	日		行　動　内　容
3	8	水	現地踏査（イラワジ川右岸の地質及び農業），資料収集
	9	木	同　上
	10	金	同上，及び灌がい局で水利解析の講義，排水関係の報告書作成
	11	土	白石，伊藤団員　ラングーン～バンコック 資料整理，朝倉団員　東京～バンコック
	12	日	休日，白石，伊藤団員　バンコック～東京 朝倉団員　バンコック～ラングーン
	13	月	雑賀団員　ビンマナ農事試験場へ資料収集，他団員は資料収集並びに整理
	14	火	同上，及び灌がい局と，F／S調査地区の協議，農業公社と打合及び協議
	15	水	駐ビルマ日本大使へ調査報告及びビンマナ農事試験場での資料収集，中間報告書草案取りまとめ
	16	木	ビルマ政府へ調査報告・協議，中間報告書草案取りまとめ
	17	金	モービー（Hmawbi）実験農場訪問及び事情聴取，中間報告書草案取りまとめ
	18	土	日本の灌がい排水事業紹介の映画会（於．日本大使館）中間報告書草案取りまとめ
	19	日	休日　中間報告書草案とりまとめ
	20	月	ヘンサダ（Henzada）附近の内水面漁業の視察及び調査，中間報告書草案作成
	21	火	内水面漁業調査イン イエジィ（In Yegyi）附近，オカン（Okkan）ダムサイト地区の調査，中間報告書草案をビルマ政府へ提出
	22	水	内水面漁業調査　タラワ（Tharrawa）附近，中間報告書の作成準備（和文及英文）
	23	木	祝日　中間報告書作成準備
	24	金	ラングーン近辺の内水面漁業の視察 中間報告書の作成（和文及英文）
	25	土	中間報告書の作成（和文及英文）
	26	日	休日　〃
	27	月	祝日　〃
	28	火	灌がい局でF／Sに必要な資料についての協議，帰国準備
	29	水	中間報告書提出及び農林省と協議・打合　帰国準備，大使館あいさつ
	30	木	全団員　ラングーン～バンコック
	31	金	バンコック～東京

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Report on the Master Plan Survey of the First Stage for
the Irrawaddy Basin Agriculture Infegrated Development Project

ABBREVIATIONS AND CONVERSION TABLE

AC	=	Agriculture Corporation, MAF
APS	=	Advance Purchase System
BKT	=	Basket(s)
DG	=	Director General
DY	=	Deputy
FC	=	Foreign Currency
GM	=	General Manager
GNP	=	Gross National Product
HP	=	Horsepower
HYV	=	High Yielding Variety (Paddy)
IBRD	=	International Bank for Reconstuction and Development
ID	=	Irrigation Department, MAF
IDA	=	International Development Association
LICA	=	Japan International Cooperation Agency
LC	=	Local Currency
LIV	=	Local Improved Variety
MAF	=	Ministry of Agriculture and Forests
MD	=	Managing Director
MPF	=	Ministry of Planning and Finance
PSD	=	Planning and Statistics Department, MAP
SD	=	Survey Department, MAF
TEM	=	Township Extension Manager

1 foot (ft)	=	30.48 centimeters (cm)
1 mile	=	1.609 kilometers (km)
1 acre (ac)	=	0.405 hectare (ha)
1 square mile (sq. mile)	=	2,590 square kilometers (sq. km)
1 cubic foot (cu. ft)	=	28.32 liters (l)
1 cubic yard (cu. ya)	=	0.765 cubic meters (cu.m)
1 acre-foot (ac-ft) (AF)	=	1,233.48 cu.m
1 cubic foot per second (cu.sec)	=	0.025 cubic meter per second (cu.m/sec)
1 long ton (lg ton)	=	1,016 kilograms (kg)
1 lac (lakh)	=	100,000
1 crore	=	10,000,000
1 viss	=	1.633 kg
1 pyi	=	2,127 kg
1 pound (lb)	=	0.4536 kg
1 basket paddy	=	20.9 kg
1 basket rice	=	34.0 kg
1 bag rice	=	75.6 kg
1 U.S.$	=	Kys 7.3

I 序　論

世界においてかって前例のなかった程の急激な人口の増加によって，より多くの食物を生産することが緊要のことになっている。このため，農業はすべての国において重要性を増しており，それぞれに，農業生産を高めるための技術の改良，新技術の開発に大きな努力を傾けている。ビルマ連邦社会主義共和国（ビルマ国）においては，十分な水資源がありながら乾季においては，広大な面積の農地が耕作されないままになっている。もし水及び土地資源が農業発展のために，有効に利用されるならば，ビルマの将来は非常に有望なものとなろう。

(1) 第1回マスタープラン作成調査団の派遣

イワラジ川流域農業総合開発計画のためのマスタープラン作成に対するビルマ政府の技術協力要請にこたえて，日本政府は，ビルマ政府当局との意見の交換及び必要な現地調査を行うために，第1回マスタープラン作成のための調査団を派遣した。

(2) 調査団の業務内容

a) 現地調査

b) 補足的な資料収集

c) 水文調査

d) 作物及び土壌調査

e) 林業に関する調査

f) 内陸漁業に関する調査

g) 農業経済調査

h) その他調査

II 計画地域

(1) 空中及び現地踏によって設定した計画地域は，前掲一般図に示されているように，北緯17° 15′と19° 20′の間で，アラカン（Arakan）とペグー（Pegu）山脈に囲まれた地域で，約250万haと見込まれる。

(2) 計画地域の境界は，下記の通りである。

(i) 東側及び西側境界

アラカン及びペグー両山脈の分水界

(ii) 北側境界

プロム（Prome）付近でイラワジ川流域を湿潤地帯と乾燥地帯に分ける境界

(iii) 南部境界

国際開発協会（通称第二世銀）の"下ビルマ稲作開発計画"の対象とみられる地域に接し，日本政府の援助による食糧増産計画及び豚家禽育種計画地域を含む大略北緯17°15′の線に沿った境界

Ⅲ マスタープラン作成方針に対する調査団の見解

マスタープランの必要性，目的及び基本方針については，事前調査団の中間報告書に述べられているのでこの報告書では重複をさけ，本件調査団の調査結果に基づいて，更に強調する必要のあるものに限って述べることとする。

(1) 計画地域の天然資源の中で，農業のために効率的に利用できる水資源は限られている。このため，マスタープランのそれぞれの計画地域の中で灌がい地域の選定には詳細な考慮が必要である。即ち，もし，ある地域の中で，下流部にポンドやポンプを利用した灌がいが技術的・経済的可能性があると判明すれば，貯水池から灌がいを行う地域はその上流部に選定すべきである。

(2) マスタープランの中で計画地域は次のように区分することができよう。

i) 灌がい施設の設置によって雨季と乾季の両季にわたって農地の改良が可能な地域

ii) 排水施設を設置することによって，農地にすることが可能な地域。

iii) 輪中の建設と排水施設の設置によって農地にすることが可能な地域。

iv) ミマカ（Myitmaka）川，イラワジ川などの洪水調節施設が設置されることによって農地とすることが可能となる地域。

(3) マスタープランを作成するためには，ミマカ川とイラワジ川の水文解析が非常に重要である。そのためには，かなりの量の調査用資機材が必要となると考えられる。

(4) 灌がい計画以外の農業開発事業，すなわち研究，普及及び農村開発事業等に関する計画もマスタープランの中で検討され，その中に取り入れる必要がある。

計画統計局や農業公社等の関係する政府機関並びに公社等の協力により，上述の農業開発事業を調査検討する必要があろう。

灌がい計画のF／S調査においても，農業開発に資する多岐に亘る分野，例えば高収量品種の導入，地域農業試験場や種子農場を含む研究組織や，普及の組織及び機能の強化，更には公共施設の改善等の分野を総合化することが重要である。

Ⅳ 調 査 結 果

Ⅳ－1 気象および水文

(1) 気　象

気象観測は運輸通信省（Ministry of Transport and Communications）内の気象局（Meteorological Department）により行われている。

計画地域内にはプロム，タラワディ（Tharrawaddy），ヘンサダ（Henzada）の3つの観測所がある。その位置を計画地域周辺の観測点と合せて図－1及表－1に示す。

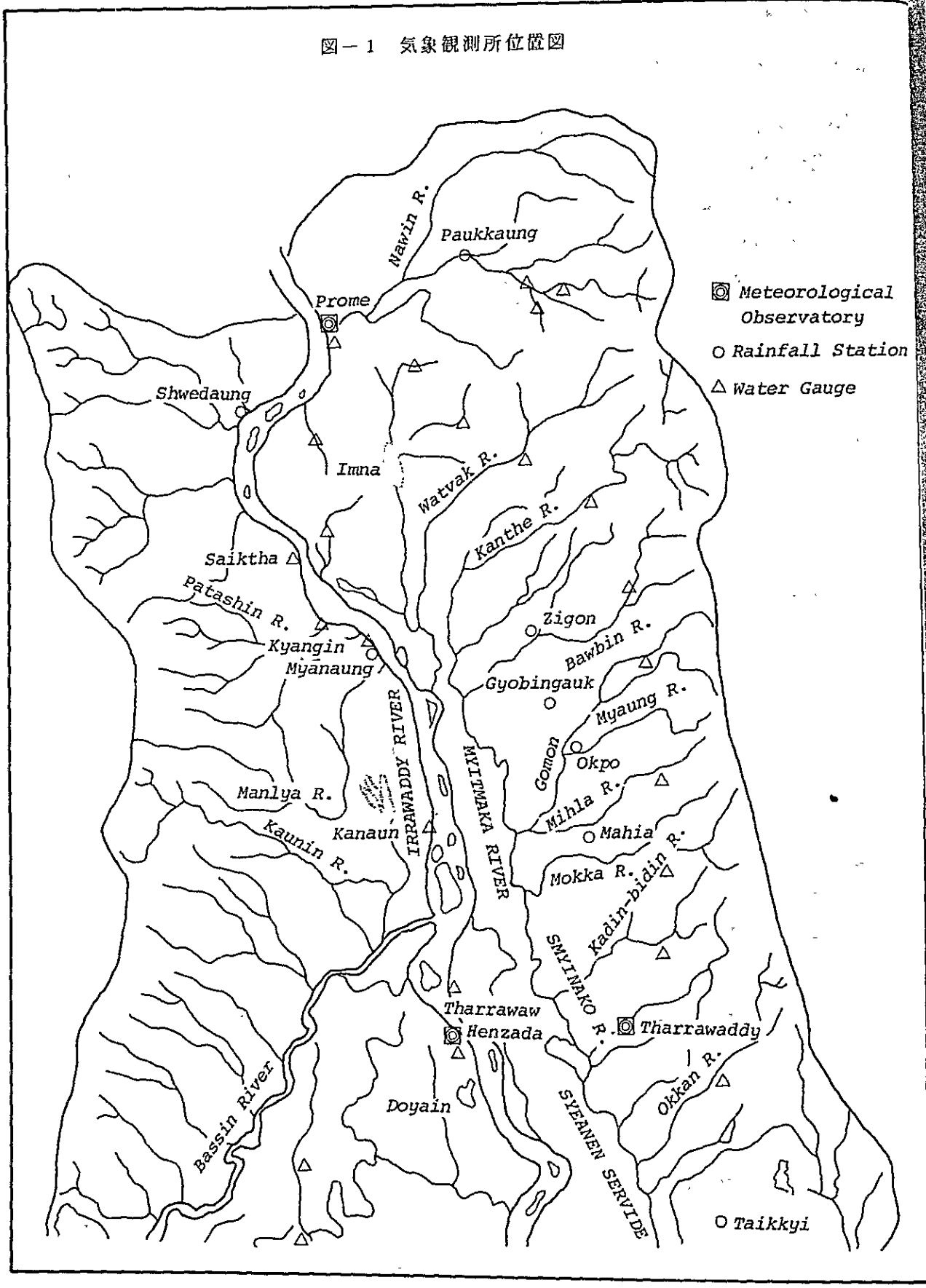
測定項目は，気温，降雨，気圧，湿度，風速，風向，蒸発，実日照時間等である。

これらの観測値の月平均を図－2～5に示す。

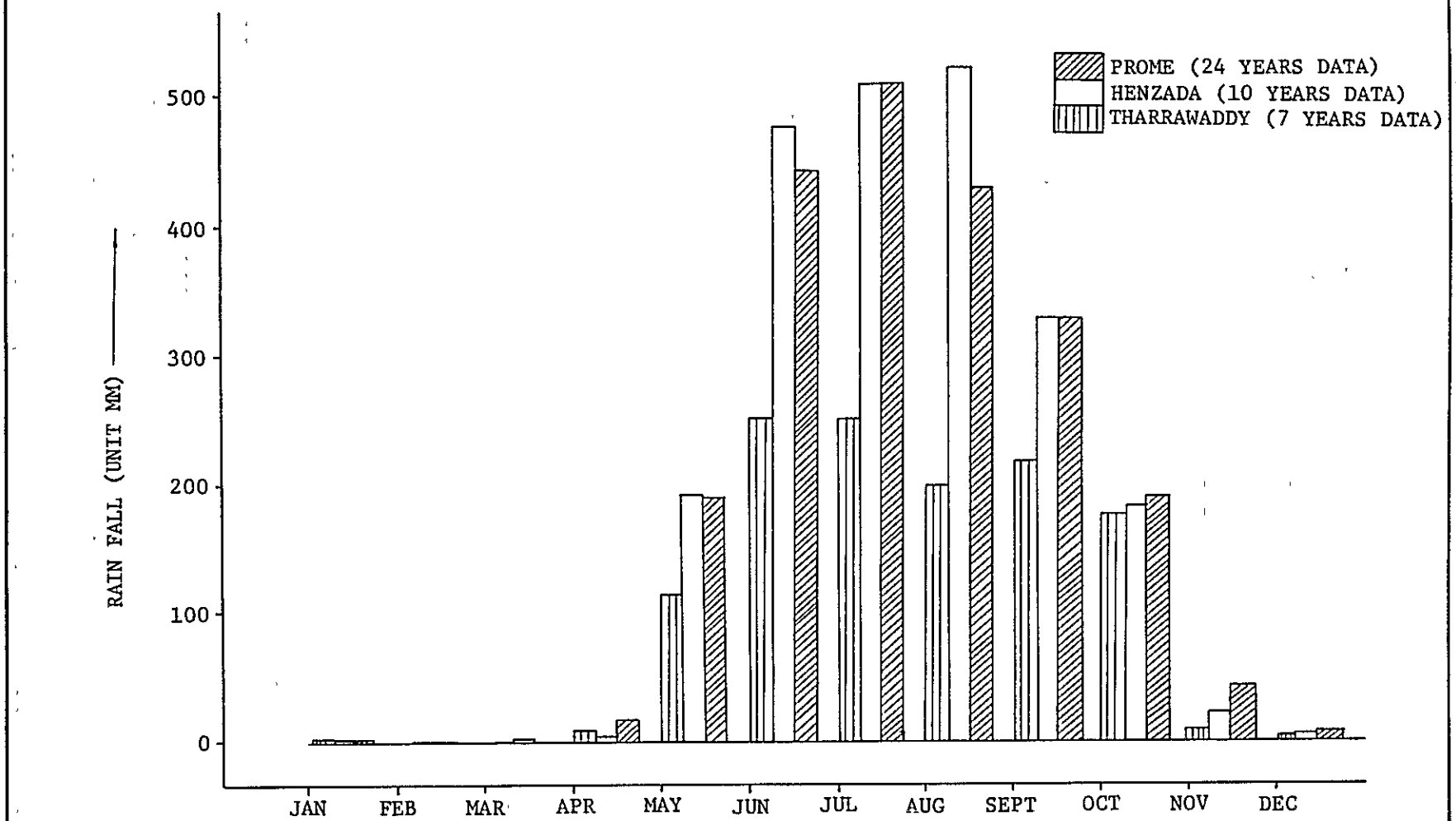
表－1　気象観測所の位置

STATION	LATITUDE(N)	LONGITUDE(E)
In the Project Area		
Prome	18° 48′	95° 13′
Henzada	17° 29′	95° 27′
Tharrawaddy	17° 38′	95° 48′
Near the Project Area		
Pegu	17° 20′	96° 30′
Bassein	16° 46′	94° 46′
Maubin	16° 44′	95° 39′
Pyinmana	19° 43′	96° 13′
Toungoo	18° 55′	96° 28′
Mingaladon	16° 54′	96° 11′
Rangoon	16° 46′	96° 10′
Minbu	0° 10′	94° 53′

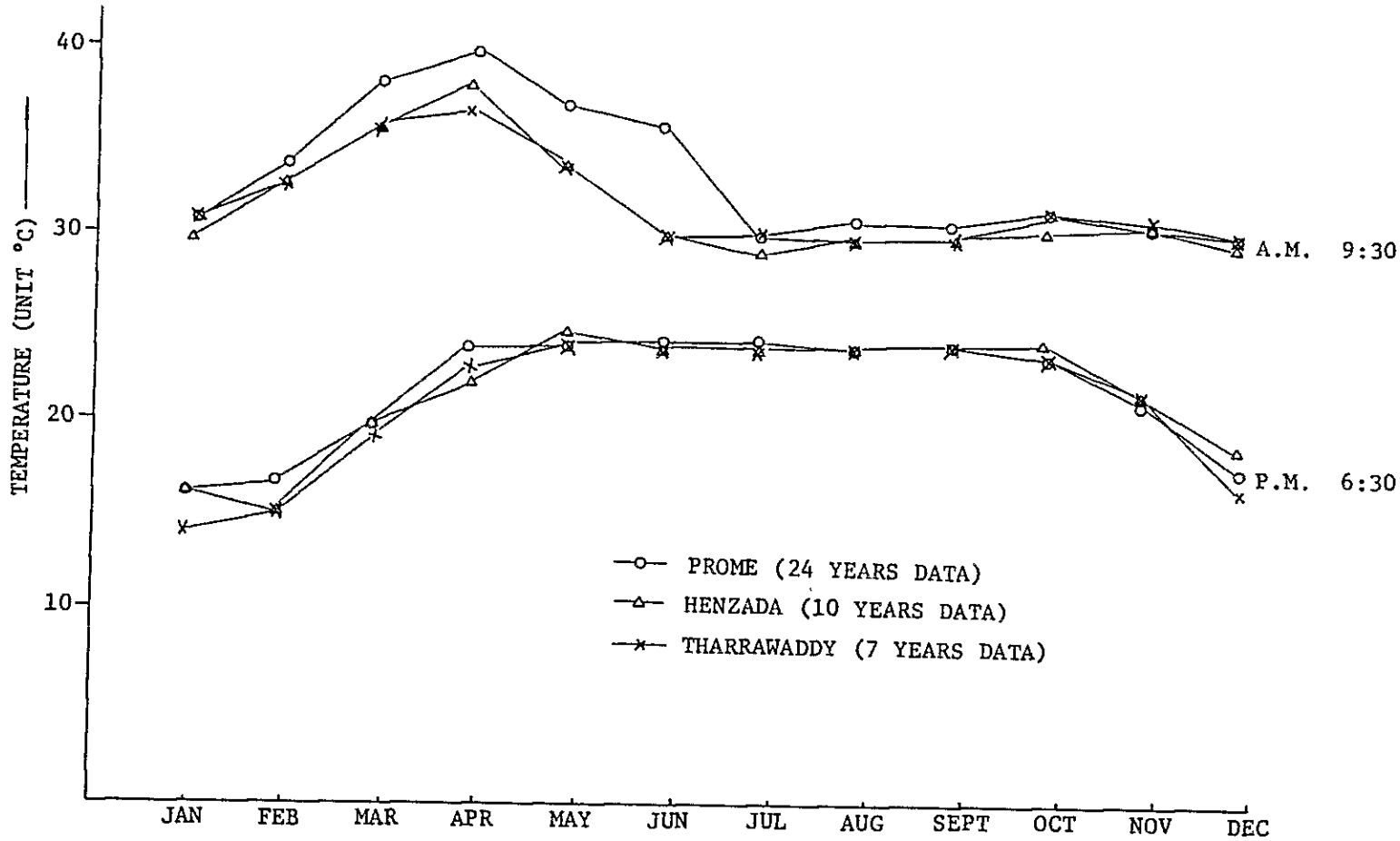
図－1　気象観測所位置図


Nawin R.
Paukkaung
Prome
Shwedaung
Imna
Watvak R.
Kanthe R.
Saiktha
Patashin R.
Kyangin
Myanaung
Zigon
Bawbin R.
Gyobingauk
Myaung R.
Gomon
Okpo
Mihla R.
Mahia
Mokka R.
Kadin-bidin R.
IRRAWADDY RIVER
MYITMAKA RIVER
Manlya R.
Kaunin R.
Kanaun
SMYINAKO R.
Tharrawaw
Henzada
Tharrawaddy
Okkan R.
Doyain
Bassin River
SYEANEN SERVIDE
Taikkyi
Meteorological Observatory
Rainfall Station
Water Gauge

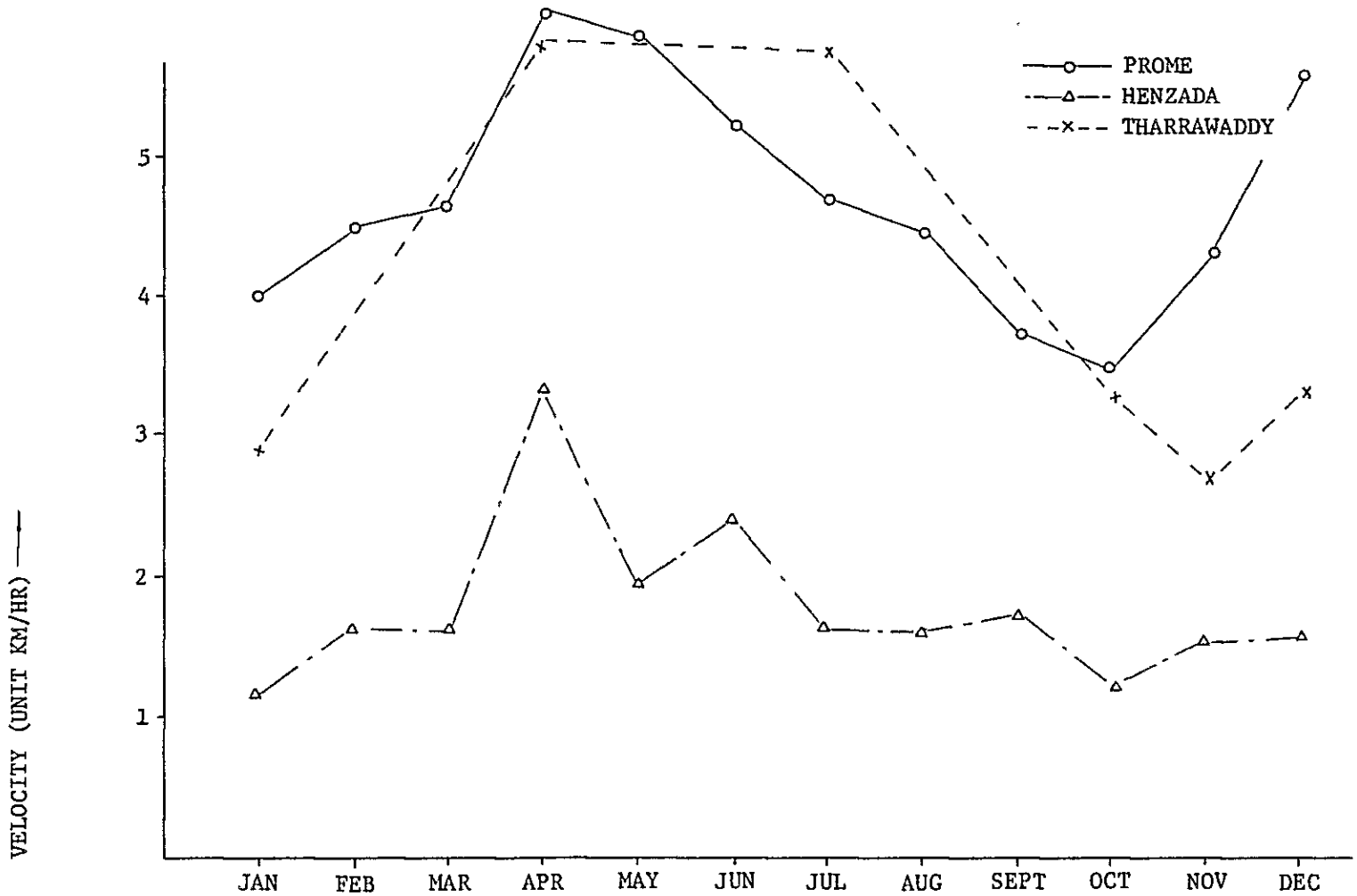
図－2　月平均降雨量


PROME (24 YEARS DATA)
HENZADA (10 YEARS DATA)
THARRAWADDY (7 YEARS DATA)
RAIN FALL (UNIT MM)
500
400
300
200
100
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEPT
OCT
NOV
DEC

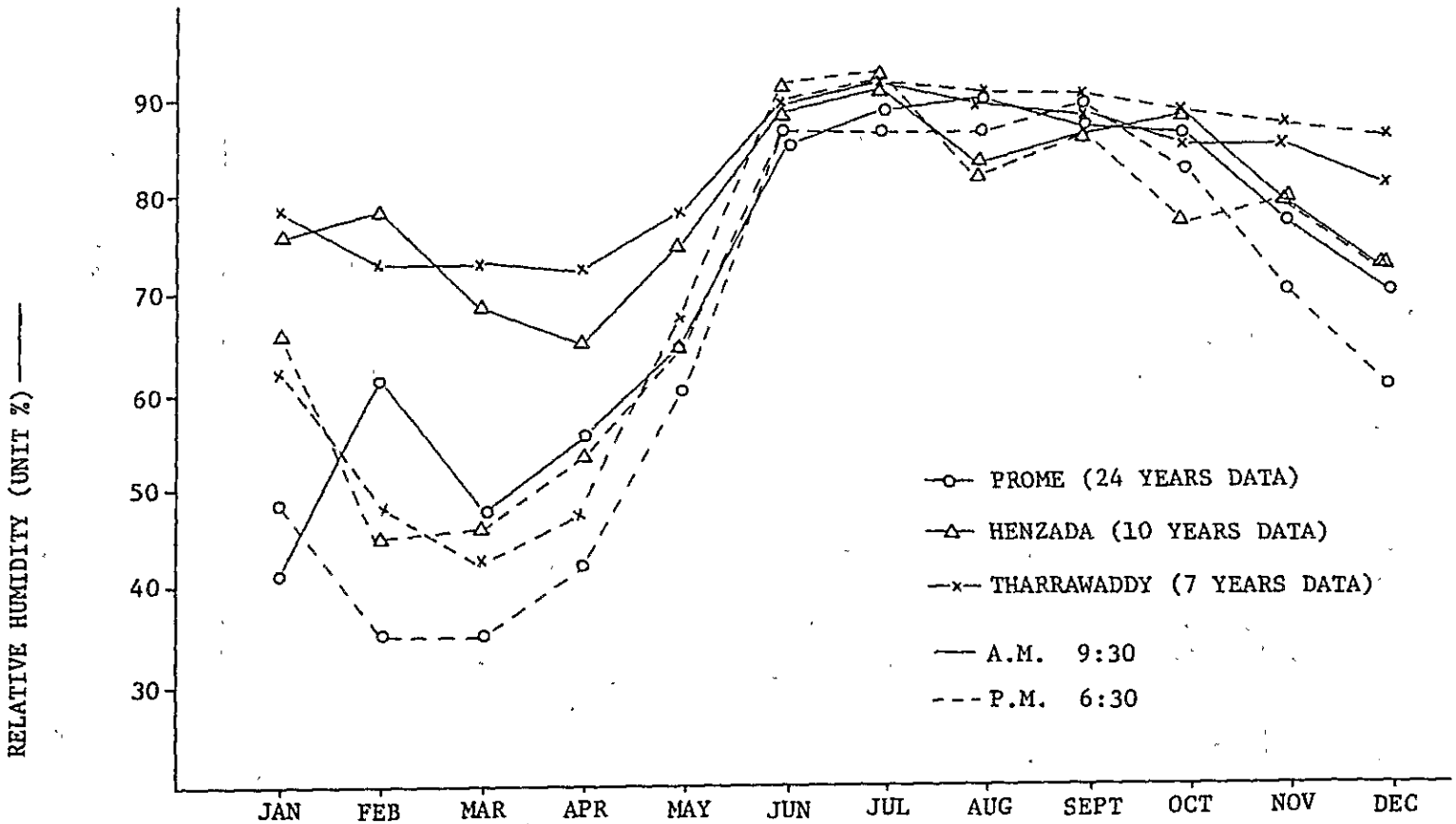
図－3　月平均気温


TEMPERATURE (UNIT °C)
40
30
20
10
A.M. 9:30
P.M. 6:30
PROME (24 YEARS DATA)
HENZADA (10 YEARS DATA)
THARRAWADDY (7 YEARS DATA)
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEPT
OCT
NOV
DEC

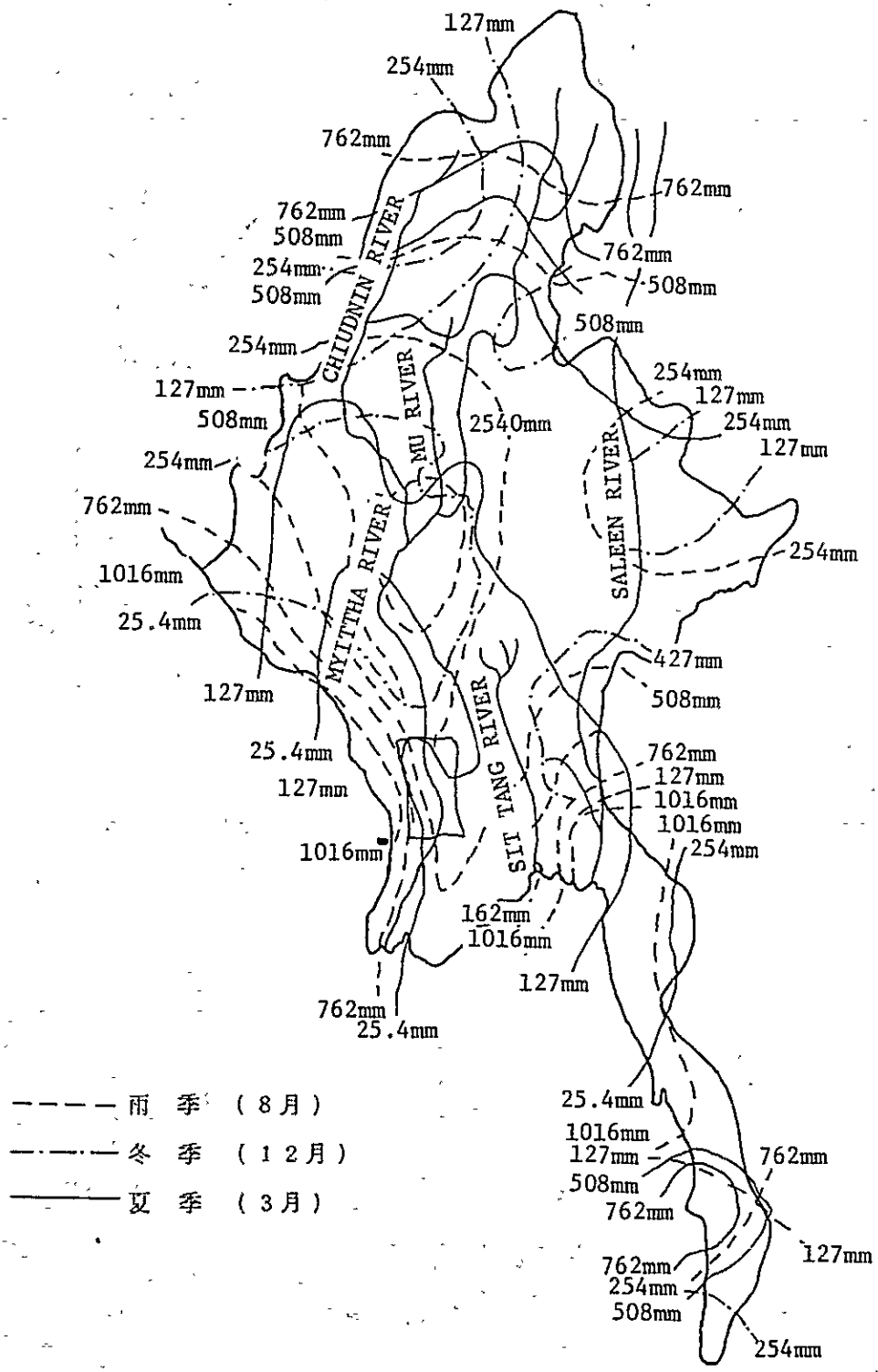
図－4　平均風速


PROME
HENZADA
THARRAWADDY
VELOCITY (UNIT KM/HR)
1
2
3
4
5
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEPT
OCT
NOV
DEC

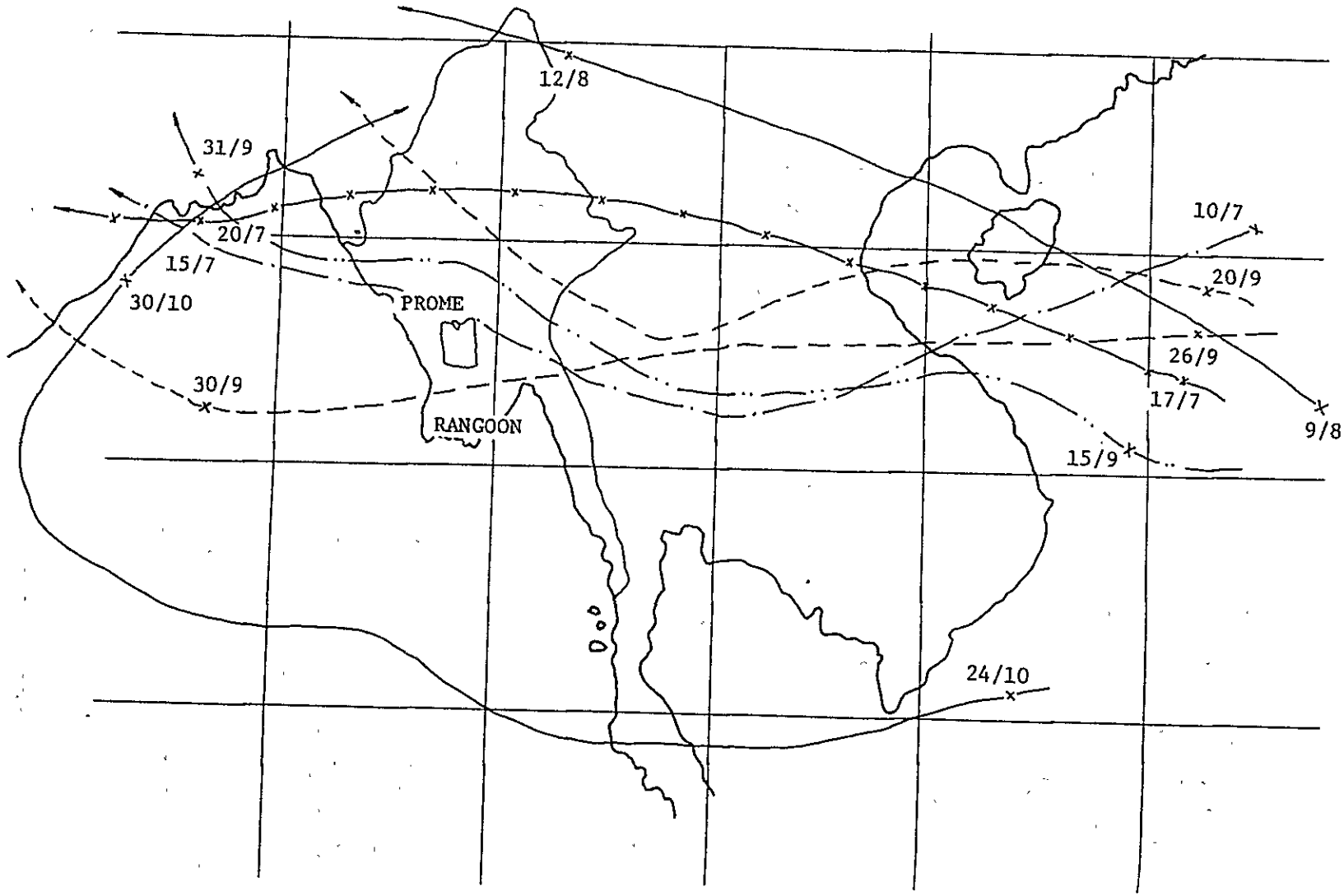
図－5　湿　　度


RELATIVE HUMIDITY (UNIT %)
90
80
70
60
50
40
30
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEPT
OCT
NOV
DEC
PROME (24 YEARS DATA)
HENZADA (10 YEARS DATA)
THARRAWADDY (7 YEARS DATA)
A.M. 9:30
P.M. 6:30

図－6　平均降雨量（1951－1961）



図－７　台風しゅう来経路図（１９６２）



この地区はモンスーンの影響を受けた熱帯性気候であり，次の３つの季節に大別される。すなわち，雨季，冬季，夏季の３つである。

雨季は５月中旬より１０月中旬までであり，プロムで平均1,279㎜，ヘンサダで2,287㎜の年間降雨量である。雨季の後に冬季が来て，１月まで続く。気温は１年中で最も低く，かつ湿度も少い。２月から４月までが夏季である。最も暑い季節であり最高気温はプロムやヘンサダで４０℃に達する。

(2) 水　文

日降雨量は図－１に示す観測所において次表－２に示す期間，観測が行われている。

表－２　日降雨観測所名及び観測期間

1)	Hmawbi	1954 ～ 1977
2)	Taikkyi	1947 ～ 〃
3)	Tharrawaddy	1947 ～ 〃
4)	Minhla	1959 ～ 〃
5)	Okpo	1972 ～ 〃
6)	Gyobingauk	1959 ～ 〃
7)	Zigon	1959 ～ 〃
8)	Prome	1947 ～ 〃
9)	Paukkaung	1966 ～ 〃
10)	Shwedaung	1948 ～ 〃
11)	Henzada	1947 ～ 〃

またイラワジ川左岸の１４の計画ダムのための流量観測は表３－１のとおりであり，日流出量が得られた。

表－３　水位観測所名及び観測期間

観測所	河川名	流域面積（Km²）	観測年
(1) Kyankpyintha	Okkan	313.4	1970～1976
(2) Koung-laung-tine	Thegoal	88.1	1971～1976
(3) Kwetma	Kadinbilin	240.9	1972～1976
(4) Chaung zauk	Gamon	80.3	1971～1976
(5) Bawbin	Bawbin	261.6	1970～1976
(6) Magyibin	Taungnyo	549.1	1972～1976
(7) Teme	Wegyi	538.7	1970～1975
(8) Yonbindet	Thegon	51.8	1971～1973
(9) Thapangaing	Shwele		1972～1973
(10) Myodaung	Dingyi	323.8	1973～1976
(11) Magwe	Alenawin	274.5	1973～1976
(12) Yatthit	South Nawin	639.7	1973～1976
(13) Kyidaing	Kyun Channg	72.5	1971～1973
(14) Kwinlyagyi	Kyun Yaung	64.8	1971～1973

イラワジ川の水位はプロムとヘンサダにおいて気象局により測定されている。このうち水位～流量曲線が得られているのはプロムだけであり，ヘンサダ地点では河道の変動が大きいため，水位－流量曲線は得られていない。この外に灌がい局（Irrigation Department）によりプロムとヘンサダ間の４つの観測所で水位観測が行われている。これらはセイタ（Seiktha），チャンギン（Kyangin），ミャアン（Myanaung），カナン（Kanaung）である。

観測データで不足しているものとしてイラワジ川左岸については山地部の降雨資料がある。この地区は現在１４のダムが計画されているので，この資料は精度の高い流出解析には欠く事ができない。

１年以上の降雨データが得られれば，過去数１０年間観測を行っている平地部のデータと相関を求める事により精度をあげる事が可能である。

イラワジ川右岸地区には降雨の観測所は河川沿いのみであり，平地部，山地部ともに降雨，流出の観測を行う必要がある。

得られた降雨資料をもとに，地点相関をとり降雨の地域特性を明らかにするとともに，降雨の自己相関を調べ雨の降り方を検討する事も必要である。

降雨から流出への変換解析には重回帰モデル，タンクモデル等が考えられる。いずれの方法を用いてもコンピュータによる解析が必要となろう。

Ⅳ－２　地質及び土壌

(1) 地　　質

計画地域は地質と密接に関連する平野部と丘陵部の２つの地形的要素から成り立っている。前者はイラワジ河道に沿った部分とイラワジデルタの北部に位置し，後者はアラカン及びペグー山脈の丘陵山岳地帯に位置している。

ラングーン（Rangoon）の鉱山局の１インチ４マイル縮尺の地質図によると，計画地域の基盤は第三紀の堆積岩より構成されており，層厚の変化する更新世から完新世の第四紀の沖積層により覆われている。この第四紀の堆積物はイラワジ川の両岸に広大な平野を形成している。

計画地域の基本的地質層序は表－４のとおりである。

表－4　基本的地質層序

時代			シリーズ	記述
第四紀		完新世		平野部，沖積層でイラワジ川の両岸に分布
		更新世		
第三紀	新第三紀	鮮新世	イラワジ	ほとんど砂岩で構成されペグー及びアラカン山脈の山麓丘陵に分布
		中新世	ペグー	砂岩完岩の互層でペグーとアラカン山脈の丘陵と山岳部に分布
	古第三紀	漸新世		
		始新世	ロンシャイ	頁岩に覆れ，アラカン山脈山麓部に分布
		暁新世		

計画地域は基本的に数種の地質シリーズに区分され，その各々の地質的特色は次のとおりである。

ロンシャイ（Lamgshay）シリーズは始新世に属し，アラカン山脈と沖積平野の漸変部に狭い帯状で南北方向に分布している。始新世の基盤は主として時々砂岩を含む礫岩から成るが，ロンシャイ頁岩と呼ばれる厚い頁岩に覆われている。

ペグーシリーズは中新世に属し，アラカンとペグー山脈周辺の不陸な丘陵地区及びプロムの南方の限定された地区に狭い帯状に分布している。ペグーシリーズは緑又は灰色の頁岩と砂岩で構成され各所で露頭が見受けられる。この岩は比較的軟かく又風化し，場所によって分布比率が変化する。

ダム建設予定地点はペグーシリーズに属する頁岩と砂岩の互層に位置している。

イラワジシリーズは鮮新世に属しアラカン及びペグー山脈山麓近くの丘陵部と沖積平野の漸変部でペグーシリーズの分布地区に隣接して分布する部分と，プロムの南方でイラワジ河沿いの限定された地域との２ケ所に見受けられる。イラワジシリーズはほとんど砂岩で構成され，珪化した木材の化石を含み，又，鉄分，石灰質又は珪質の凝固物とか，かなりの量の玉石が含まれている。

沖積平野部は計画地域の中心部を占めイラワジ川に沿って，広大な平野を構成している。この平野はアラカン及びペグー山脈からイラワジ川により運ばれた沖積堆積物で成り立っている。この平野部は地形と堆積物の点から二種に分類される。丘陵性の沖積平野はアラカンとペグー山脈の丘陵から沖積平野の中央部にかけての漸変部で沖積平野のほとんどを占る。この平野の堆積は主としてシルト又はロームを介在する粗い粒径の層から成るが，上層部は粘土の含有が大きくなる。この平野を流れる小河川に沿って多数の新しく粗い堆

積物が各所に見受けられる。この平野は農産物の生産に密接に関係し，ほとんどの灌がい計画地区はこの平野に存在する。

沖積平野の中央部はイラワジ川に沿って狭い帯状で南北方向に分布している。この平野は比較的均一な細粒の重組織の堆積で，丘陵からの多数の小河川によって分断されている。

この外に，小規模な蛇紋岩とか石灰岩地層の分布が，計画地域の北部の限定された部分に見受けられる。

前述の地質図によると，プロム近くの計画地域の北東部に三本の大きな平行断層が見受けられる。この断層は計画地域の境界を超えて北西方向に拡がっているので，各計画ダム地点に対する直接的な影響はない様に思われる。しかし，この大断層から派生する多数の小さな断層が計画地域の北部付近に存在するので，この付近に計画されるダムはこの影響の有無の調査が必要となろう。

(2) 地 下 水

地下水の挙動は，その地質構造と大いに関連する。第三紀層に達する頁岩と砂岩は夫々一般的に不透水性かあるいは，多少透水性であり，第四紀層は主としてシルト又はローム の層を介在する粗い粗径の層からなっているが，上層部は粘土分の含有が増加する。

計画地域内の地下水位は低くないが，雨季には地表面近くになり，乾季には地表から約３６ｍ位低下し，時期によって変動する。計画地域内の家庭用水はほとんど浅い井戸によっているが，乾季には，これらの井戸はしばしば干上がってしまう。計画地域内には地下水資源による組織的で大規模な灌がい地区は存在しない。

上述の地下水の状況から計画地域内で地下水資源による大規模な農業開発計画の可能性は地表水のそれに比較して明確に低いものと考えられる。

(3) 土　　壌

土壌の分化は地形と密接に関連している。

(i) 黄褐色森林土壌（Yellow Brown Forest Soils）は，森林植生の影響のもとで，排水の良い条件下で 生される。この土壌はペグー山脈，及びアラカン山脈の麓の丘陵地帯を覆っている。林地土壌として生産力が高い。

なお，水源涵養のため，森林として保存されるべきであろう。

(ii) 未発達岩屑土壌（Primitive Crushed Stone Soils）は，山頂部や急傾斜面に現われ，上記(i)の土壌にパッチ状に混在する。この土壌も材地として保存されるべきであろう。

(iii) ラテリテック土壌（Lateritic Soils）は，南部ペグー山脈の麓の丘陵地のゆるやかな斜面に発達しており，上記(i)の土壌が混在している。土壌断面の上部は軽い壌質で下

層は粘質となっている。現在は竹藪や密生した灌木林で覆われている。果樹園やゴム園に適した畑地になると考えられるが，表土が弱しようであるので，エロージョンを起し易い。

(Ⅳ) シナモン土壌（Cinnamon Soils）は，北部ペグー山脈の麓の沖洪積平地を占めている。この土壌の母材は場所により変化があり，それにつれて，土性が変化している。しかし軽い壌質土壌が多い。この土壌帯は，現在のところ，その大部分が生産力の低い森林で覆われているが，若しかんがいが出来るならば，ヤーランド（山添いの畑地）として，まずまずの地力があろう。

(Ⅴ) 草地土壌（Meadow Soils）は，計画地域の中央平野の東の部分を南北に帯状に広がった広い面積を覆っている。比較的水はけの良い土壌である。土性は中庸壌質から重粘土質にわたっている。現在は肥沃度中庸の水田として利用されており，裏作を行なうにも適している。

(Ⅵ) 草地グライ土壌（Meadow Gley Soils）は，上記(Ⅴ)の土壌帯の西側を南北に帯状に延びた広い面積を覆っている。この土壌は上述の草地土壌よりは湿潤な状態のもとで分化したものである。土性は植質壌土から粘度質土壌にわたり，シルト含量が多い。現在は最も肥沃な水田として全面的に利用されている。水稲作跡の裏作は可能ではあるが，播種期の選定とともに土壌水分の保持を心掛ける必要があろう。

(Ⅶ) 草地沖積土壌（Meadow Alluvial Soils） 新しい沖積土であり，イラワジ河およびミマカ川の蛇行地帯を覆っている。この土壌は地形に小起伏が多いため，場所により土，グライ化程度，湿　程度に変化がある。しかし，壌質土壌が多い。この地帯では，滞水のために，比較的位置の高い場所以外は一般に耕作されていない。しかし肥沃度は他の土壌よりも高い。したがって排水対策が行なわれれば，地力のあるカインランドとして畑作物栽培に適するであろう。

(Ⅷ) 草地湿潤土壌（Meadow Swampy Soils）は，草地沖積土壌が大部分を占めており，蛇行地帯の低地に在る。土壌のグライ化の程度は前者(Ⅶ)の土壌よりもはるかに進んでいる。土性は全般的に重粘質で透水性は非常に低い。肥料分や腐植か他の土壌よりは高いので，土地改良事業を行なうことにより，良質の水田となるであろう。

(Ⅸ) 湿潤グライ土壌（Swampy Gley Soils）は上記(Ⅷ)の土壌とよく似た条件で分化したものであるが，肥料養分および腐植の含有量は(Ⅷ)の土壌よりは少ない。

(Ⅹ) 沖積土壌（Alluvial Soils）はイラワジ川の川岸や中州に分布している。毎年おこる盛と堆積の繰返しで発達した土壌であり，肥沃度は未だ低い。

以上は１９５９年に発行された，プロム，タラワディ，インセイン（Insein）及びヘンサダ地区の"Soil and Land Use Survey"の報告書に基づいたものである。

Ⅳ－3　農業の概況

(1)　作物生産の指針

政府は，農産物の自給率を高めるとともに輸出を増加するため，稲の他に棉，ジュート，さとうきび，豆類及び落花生，ひまわりなどの油料作物の増産政策を実施中である。

この増産対策は，耕地の外延的拡大と，既存耕地の効率的利用すなわち，品種改良を含む耕種技術の改善と多毛作の拡大によって推進されつつある。

しかし，現時点では，雨季作水稲１作のみの農家が大部分を占め，関係当局の積極的な努力にもかかわらず，多毛作の進展ははかばかしくない。

表－５　年間総作付面積と多毛作率（全国）

単位：1,000Ha

年　　次	作付実面積 (1)	作付延面積 (2)	多毛作率 (2)／(1)
１９７０－７１年	7,896	9,040	1.15
１９７５－７６年	8,129	9,441	1.16
増加年率	0.58%	0.87%	

(2)　耕地の種類と作付体系

(a)　水　田：　水田は耕地面積の大部分を占めている。しかし灌がい施設が未整備なため，乾季にはその一部に落花生を中心にその他の豆類やとうがらし等が水稲後作として栽培されているに過ぎない。

なお，低地の溜り水や河川水の得られる小面積の耕地では，雨季前に播種する（前雨季作）ジュートが栽培されており，その収穫後に遅植えの水稲作が行なわれている。このジュートの播種時に灌がい出来ない水田の一部では，雨期はじめの雨を待って雨季作ジュートの播種が行なわれている。

ノース・ナウィン　ダム（North Nawin Dam）の完成により，１９８０～８１年には約３９,２００haに灌がいが実施される予定であるが，ここでは約３３,８００ha二毛作が計画されている。

(b)　カイン・ランド(Kaing Land)：　主としてイラワジ川沿いにある新しい沖積土の畑地であって，砂質土壌が多く，耕作が容易である。

雨季に一時的な湛水があるが，湛水期間の短かい所では，雨季前に播種する作物としてごまなどが洪水前に栽培収穫され，退水後に落花生，その他の豆類，とうがらしやビルマタバコ等の冬作が行なわれる。

当計画地域におけるカイン・ランドの面積は多くはないが，年々の洪水による肥料分の

流入沈積があるので，一般には無肥料栽培でも収量はそれ程悪くはない。

(c) ヤー・ランド（Ya Land）： 山麓の傾斜面や台地にある畑地である。排水が良好なため一般に雨季作だけが行なわれる。ごま・豆類・在来棉などの単一作や混作が行なわれるが，一部では早期栽培のごまの後作に豆類を栽培することがある。

開こん第1年目は収量がよいが，連作により地力が低下するため，切替畑方式が採用される場合がある。また，果樹など永年作物の栽培されている所もある。

主として，イラワジ川右岸に分布しているが，その面積は多くはない。

(3) 計画地域内における主要作物についての知見

(a) 水 稲： 天水栽培においては，計画地域北部の雨量程度では必ずしも十分とは云いがたい。また，雨季が10月に明けるので，登熟の途中で田面が乾燥し，登熟不良を起す可能性もある。これらの点についてもっと調査が必要となろう。

早生稲の場合には，登熟期が早いため，上記の危険が少ない。このため，高収量品種（HYV, High Yielding Variety）を栽培すればより高い収穫が得られるであろう。

精米における砕米率は高く，その原因は次のものであろう。

(1) 籾乾燥方法の不適切

(2) 籾の過熟

(3) 精米機の低性能

これらの点について今後の調査で十分検討し対策を講じることが望ましい。

難脱粒性の品種は，適期刈取をした場合には，在来の方法では脱穀が難かしいので，ややもすれば過熟になるまで置いてから刈取られることになりがちである。

政府はHYV又は在来改良品種（LIV, Local Improve Variety）の普及，及び施肥防除を含む耕種技術の改善により，水稲反収を上げるよう指導奨励している。後述するように，タイチイ・タウンシップ[注]内に5ケ所のハイ・イールド・センター（High Yield Canter）を設置し，濃厚な技術指導を行ない増産に成功している。これらのセンターがカバーしている74ケ村におけるHYV及びLIVの水稲作付総面積に占めるシェアーは，1977－78年には，夫々30パーセント及び38パーセントに達している。

しかし，隣接するタラワディ・タウンシップでは1978－79年から普及が始まる段階である。政府の積極的な指導と援助が行なわれれば，普及の進展は期待出来る。

(b) 落花生： 前雨季作（Pre-Monsoon Cropping），雨季作（Monsoon Cropping），晩雨季作（Late-Monsoon Cropping）及び冬作（Winter Cropping）の4作型があるが，計画地域では冬作が圧倒的に多い。落花生の冬作は，水稲後作が最も多いが，カイン・ラン

注）タウンシップ－日本の県と市町村の中間的規模の行政区。

ドに作付されているものもある。冬作の落花生は，これに灌がいをすれば生育はもっと良くなるであろう。

なお，リーフ・スポットの病害が至る所で発生しているので，耐病性品種を至急導入する必要があろう。

(4) 増産実施上の問題点

(a) 多毛作

多毛作の増加が停滞的である理由は，水利施設が不備のため水稲収穫後の冬作の作付が困難であり，且つその収穫が不安定であることである。

政府は，水稲収穫後，後作を出来る限り速かに播種するため，整地作業にトラクターを活用している。しかし，政府及び公社所有のトラクターは耐用年数を超えたものが多くしかも修理部品が不足している。他方役牛頭数の増加が速やかではない。

(b) 灌がいによる水稲の二期作

冬作水稲の収穫および調整が雨季に持込まれないように，品種を選定し，作付時期を決めねばならない。冬作に使用出来る現在の品種（HYV）の生育日数はほぼ125－135日程度と推定されるので，刈取後の降雨（次雨季の）や四月の高温時の農作業及び洪水時期を十分考慮して，作付時期を設定する必要があろう。

(c) 集約栽培

多毛作の強化と多収穫栽培の実施にともない，肥料の増投と耐病虫害性品種の導入および防除の強化が必要となる。それと同時に，栽培技術の改良及びその普及指導組織の強化が必要となろう。

以上の問題点の対策は種々あるが，今後の調査解析にて，この国に適した施策を見い出す必要があろう。

(5) 土地保有の形態

ビルマにおいては，全農地は，政府の所有である。農民は，農地を売買することはできない。この結果，農民が経営の最適規模を達成するため，自分の農地を拡大しようとしてもその可能性は非常に小さい。

他方，この土地保有判定はすべての農民に土地保有の安定性を保証しており，このことは農業発展のために基本的に重要なことである。数名の農民とのインタビューにおいても，彼らの間には自分達の土地保有についての不安はみられなかった。然し農民達には農地の改善のための投資，例えば小規模灌がい等の如きものについての強い意欲もあまりみられなかった。

道水路網が整備され圃場整備も行われる場合には，或る程度の土地の交換分合も必要と

なるかも知れない。この場合においては，現在の土地保有制度はすべての土地が政府所有であるため，そのたすけになるかも知れない。

(6) 土地保有規模

計画地域内のタウンシップから収集した一部の資料から，農家の土地保有規模は全国平均の約２２haに比べ若干小さいと思われる。

全国平均の一戸当り土地保有面積が約4 ha強（約１０エーカー）規模の農家数は１３％を占め，全耕地面積の４２％になる。残り８７％の農家は4 ha以下の農地を保有し全耕地の約５８％を占る。４０ha 以上の大規模農家が極僅かであるが見受けられる。

これ等のことから，土地配分は比較的均等に行なわれていると思われる。

(7) 米穀の集荷と前払金制度

米穀の強制集荷（供出割当制）及び前払金制度は，農業行政の主柱である。

輸送，精米，貯蔵についてはこれらの施設の改善のため，なすべきことは多い。これらの改善策は，より詳細には将来のマスタープラン及び提案されたかんがい事業計画の中で検討することとなろう。

割当量と供出価格は非常に重要なことであるが，又難かしい政策課題である。政府の施策によって，高収量品種が導入されたタウンシップでは，割当量が一年に５０％も増えている。この割当量の増加は非常に急激で，高収量品種の普及に好ましくない結果をもたらす恐れがあろう。

(8) 稲作増産計画（タウンシップ全域の開発計画）

タイチータウンシップでは5つのキャンプを設置して，高収量品種の導入と改良農業技術の普及により稲作生産を増投する集中的施策を推進している。

特に肥料農薬の増投と普及員の増強が，この施策の主要な特徴である。

この計画は，１９７５年において非常に小面積から発足したが，１９７７年に到ってタウンシップ全域をカヴァーするに到った。

１９７７～７８年度には，この計画はタウンシップ全域で約１２.５百万キャット（Kyat）の純益を挙げた。このための投資増額分は4百万チャットでそのうち，3百万チャットは肥料その他の形で，農民の投資したものである。この計画は普及活動が果たすべき任務の重要性を非常によく示している例である。

普及員の増強と生産資材の増投によって，改良農業技術を農民に展示することが稲作生産の増強のために有効であることを立証した。

ビルマ政府は来年度は全ビルマで２１タウンシップにこの稲作増産計画と実施する計画を持っており，その中には，このマスタープランの計画地域内にあるオクポ（Okpo）ヘンサダ及びチョンピョウ（KYONPYAW）の３つのタウンシップも含まれている。

この種の普及強化策は研究の強化策とともに国際的な技術及び経済協力事業として討議の対象にとりあげるに適している。

(9) 資料収集

農業に関する統計資料で，公表されているものは全国又は州（Division又はState)の資料のみである。従って，この計画区域内の農業統計資料は新らたに収集する必要がある。この計画地域はラングーン州のタウンシップ１つ，ペグー州のタウンシップの一部（西部）１４とイラワジ州のタウンシップの一部９つで構成されている。これら２４のタウンシップの統計資料は現在，農業公社を通じて収集中であり，本調査時点では約３割程度の収集が出来たのみである。この農業統計資料は次回調査団において収集が完了され，補足調査並びに解析が行なわれるであろう。

この調査資料の調査項目は資料編－１に示す。

Ⅳ－４ 灌がい

(1) 現況の灌がい

灌がい局からの聞き取りと現地踏査によると，計画地域には現況の灌がい水田はなく，全て天水田である。今後灌がい用水がこれ等の水田に供給されれば，農業生産物の増産のために乾季における水稲，ごま，落花生等の栽培が可能となる。

(2) 灌がい事業計画

灌がい局はIrrawaddy川左岸地域に現在工事中の事業と１５の灌がい事業計画を持っている。前者はノース ナウィン灌がい事業[注)]でプロムの東方地域を受益地とし，関係タウンシップはプロム，パッコウン（Paukkaung）とテゴン（Thegon）で１９８１／８２年に全工事完成する予定である。事業内容は堤頂1.6㎞で，３６０百万㎥の総貯水量を持つアースダムと約３９千haの灌がい排水組織である。この事業が完成されれば，この受益水田を二期作又は二毛作可能な水田にならしめるであろう。

後者の事業計画が完成されれば，この受益面積はラングーン（首都）や受益地近郊の都市に農産物の安定供給に役立つであろう。

これ以外の灌がい事業としてはポンプ灌がい事業がイラワジ川の川岸沿いにある。しかし

注）事業の詳細は資料編２参照。

この事業はイラワジ川の雨季に於ける洪水による流芯の変動のためポンプ場の位置の選定等の問題が有り，将来に調査が充分行なわれる必要があろう。

Ⅳ－5　洪水および排水

計画地域内においてイラワジ川に沿ってほとんどの部分に堤防が設けられている。

イラワジ川の洪水は，しばしば堤防を越えることがあり，破堤するたびにその後方に築造された。堤防は道路として使用されており自然堤防の上に築かれた集落に連結している。

ミマカ川は旧イラワジ川本川であり地区内の最も標高の低いところを流れる。

ミマカ川沿いの湛水は自己流域からの流出とともにイラワジ川からの越流によるもので，一旦湛水してしまうと，標高差の関係でイラワジ川の水位が低下しても容易に排水されない。低平地では乾期においても湿原として残っている。この現況把握及び排水対策の検討のためにはミマカ川の縦横断図及び湛水地区の地形図が必要となろう。またミマカ川の必要地点で水位観測を行うとともに湛水実態調査を行う必要があろう。

この解析には，流出，湛水，排水システムの数理モデルを作成し，コンピュータシミュレーションを行う必要があろう。このシミュレーションには，現在計画されている１４のダムによる洪水調節の影響，あるいは考えられる堤防，遊水池，排水樋門等が取入れられ最も効果的な洪水対策が得られるであろう。

Ⅳ－6　道　　路

計画地域内の道路状態はイラワジ川左岸では，ラングーンよりマンダレーに至るまで二車線のアスファルト舗装道路が地区のほぼ中央を南北に走っている。しかしこの国道に接続するタウンシップ道路および農道等の道路網の密度は低く，整備も遅れている。

このため農産物の集出荷に多大な時間と労力を費しており，特に雨期においては道路が泥状化して車輌の通行が困難となり，社会生活活動にも制約が大きい。

一方右岸側において建設省（Ministry of Construction）はインセインよりトングワ（Thongwa），ヘンサダ，およびオクシピン（Okshipin）を経へ北に伸びる国道建設を着工している。またシュェボント（Shwebontho）よりアラカン山脈を越えサンダワ（Sandawa）に至る横断道路もすでに着工している。しかし農道の整備は遅れている。

従ってこれらの国道建設計画[注]とタウンシップ道路および農道を相互に関連づけて農業地域開発計画を策定する必要があろう。

計画地域内においてイラワジ川には橋梁がないため，生活物資や農業生産物はすべて舟によって運搬されている。従って両岸の住民の生活環境の改善のために適当な地点に橋梁を建設す

注）詳細は資料編３参照。

る必要がある。架橋地点の選定にあたっては生活環境の改善，農業生産物の流通の合理化の点より，利用効率の面やイラワジ川の河川特性を十分考慮すべきであろう。

Ⅳ－7　測　　量

ビルマ全土の地図は，測量局（Survey Department）で作成管理されており，現在，三種類の縮尺[1)]の図面がある。計画地域の図面は，上記いずれの図面も使用が可能であるが，これ等の図面の測量時点は１９４０年代と古い。又，縮尺もヤード単位で表わされている。同局は１９７２年に航空写真を撮り，これを基に河川や道路等の位置の修正を行ないつつある。

マスタープランの作成には，約１／250,000 の縮尺の図面が必要となろう。同局によれば，計画地域の図面の修正は例えば河川や道水路等，１９７８年度内には行なえると述べている。しかし，図化及修正作業はビルマ政府の図面の重要度に応じて，測量局で行なわれる。

1）三種の図面

Inch map	縮　尺	1 : 63,360
Half irch map	〃	1 : 126,700
Quarter inch map	〃	1 : 253,400

V 林　業

この地域の森林は，東のペグー山脈沿いと西のアラカン山脈沿いにあり，地域の約７０％を占めている。森林の殆んどはチークや有用広葉樹を多く有する常緑・落葉広葉樹の混交林であり，チークは丘陵地形のペグー山脈に多く，山岳地形のアラカン山脈には，その他の有用広葉樹が多い。

厳格な管理がなされている永続林は全森林の約３８％で，ビルマ全体の平均約２５％に比べると，森林の取り扱いはかなり慎重な地域である。

また全国土の森林面積に対する割合からみて，チーク材の生産量の比率は高く，またチーク以外の有用広葉樹の開発の可能性をもち林業的に重要な地域である。

(1) 調査結果

(i) チークやその他の有用広葉樹の生産を目的とした択伐作業の森林の林況は良好で，うっ閉された林相となっており，林地の中に地被物のない裸地は殆どなく林木によってよくカバーされている。

(ii) これは長い歴史を持つビルマ択伐作業がよく，その原則どおりに実行されてきたところによるものであり，ビルマ林業の技術と森林施業が適切であったことを示すものと思われる。

(iii) ダムサイトの予定される地点はこれらの良好な状態で保全された森林の地域の中にあり，その集水地は森林利水機能を十分に持った森林である。

(iv) 森林の更新はビルマ択伐作業による天然更新が主体であるが，森林蓄積の低い森林ではこれを補うため人工更新の手法として，造林を実施しており，これも長い歴史と，良い成績を持っている。樹種は主にチークとピンカドーであり，これらの造林によって更に森林の良好な状態は保全されるであろう。

(v) ダムサイト予定地のかなり下流の森林は自家用材の供給を目的とした森林に属しているが，この森林の蓄積はかなり低いようである。最近，早成樹種として，ユーカリの造林がすゝめられ，増大する地域の自家用材の需要に，対応しようとしているが，よい成績を示している。

(vi) したがって，以上のようなことから，今後とも，ダム予定地の集水地は勿論，流域全体の森林利水の機能は維持され，改善されて行くものと思われる。

(2) 森林計画制度

(i) 既に長い歴史を持つ森林調査の結果による林相，蓄積や成長量の把握の上に立って，森

林計画が樹立されてきており，これによって適切な森林経営がなされてきている。

(ii) 森林計画は各営林署区域毎に，１０ケ年計画が樹てられ，これは１０年毎に更新しながら永続して行くシステムとなっている。

(iii) これらのシステムや計画の内容，経営図，サンプリング方式による森林調査の採用等は日本における計画制度や森林調査方式と全く同じである。又森林計画は，地域の他の分野農業，工業等の発展，さらには地域全体の総合的な発展に大きな関係がある。

(3) 問題点

(i) 機械化のおくれと，機械集材技術の欠如

(ii) 林道網の未整備

(iii) 苗木生産施設の不備

(iv) 製材加工施設の老朽化と非能率

(v) 造林の機械化

上記諸問題を解決するためには，下記事項の調査，研究が有益と思われる。

(i) 計画地域の森林計画の検討

(ii) 苗木生産施設の改善

集中的モデル苗畑の設置によるスプリングラー方式及び外来早生樹種の導入を含む，苗木生産技術の改善と，技術者の訓練。

(iii) 木材の加工流通の合理化。

加工流通技術改善のためのモデル製材加工施設の設置。

(iv) 材道網の整備。

(v) 造林面積拡大のための機械化。

Ⅵ 漁　　業

現地調査によれば，内陸部において次の様な3つのタイプの漁業生産が行なわれている。

(1) 河川漁業

イラワジ川：　乾季にはヘンサダの船付き場で刺網漁が行なわれている。雨季（６～８月）には川の内で袋網により２種類のインド鯉の稚魚が採捕されている。植物プランクトンは豊富である。

ダカ（Daka）川：　チャンピオ（Kyanpyan）では投網が行なわれている。川の両岸にホテイアオイが繁茂している。

(2) リース漁業（年間リースの独占的漁業）

インイェジ（Inyegyi）湖：　湖は狭い水路でダカ川とつながっており，推定水面積約700 ha。人民真珠漁業公社は３ケ所の地点で刺網，ヤナ，投網により漁獲し販売まで行っている。インド鯉を主体に年間約６０トンの生産を上げている。この湖は植物プランクトンが多く，好漁場と思われた。

デュヤ（Duya）湖：　これは三日月湖である。漁業生産組合が年間約２５トンの生産を上げている。水生植物が厚く繁茂しているので投網，地曳網等の現在の漁具では大型魚が生息しているにもかかわらず，採るのがむずかしい。植物プランクトンが多く好漁場と思われる。

ラグウィンビン川：　ヤナ漁が９～１２月の間だけ行なわれている。

(3) 魚類養殖

カンズ村の養魚池：ここはインイェジ近くのカンズ村で経営しており推定水面積０６ ha。インイェジ湖で採れたインド鯉を放養（約５百kgの生産を上げている。米ヌカを補助的な餌として与えている。

ラングーン近郊の私営養魚池：　１１の池の推手総水面積は約1.2haである。雨季にインド鯉の稚魚を放し，２年後約２kgに成長した魚をラングーンの卸売業者に売っている。米ヌカと落下生糟を給餌している。飼育水は牛糞を使い施肥されている。年間生産量は約16トン。

河川漁業とリース漁業はこの国においては重要なものである。内水面で漁獲される魚はその地域住民の欠くべからざる蛋白源となって来た。漁業局によれば，毎年のイラワジ川の洪水は漁業生産の必須条件であると云われている。したがって，農業開発と漁業の調和を計る必要があろう。

漁業局は次の３つの課題解決の必要性を強調した。

ⅰ）漁場の改良，整備

ⅱ）ホテイアオイ駆除

iii) 稚魚の増産，特にインド鯉

このマスタープランで計画された農業用施設，例えばダムファームポンドや用水路等が築造後はこれ等を利用した魚類養殖の可能性も併せ検討する必要があろう。

現在の養魚施設や河川の水質調査が実施されたが，その結果によればこの地域内の水質には魚類養殖のための阻害要因は見当らない。水質測定資料は資料編4に示す。

Ⅶ　計画ダムの優先順位

計画地域内のダム建設に対するＦ／Ｓ調査の開始への優先順位の検討に対し，灌がい局で基本的優位性を考慮して１５ケ所のダム建設予定地点から選定された５ケ所のダムサイトを対象として現地調査が行われた。（ダム建設予定地点は図－８に示す。）

Ⅶ－1　現地調査結果

現地調査が行われたダムサイトに関し，地形地質及び築堤材料は非常に良く似た条件であり，概要は次のとおりである。

建設予定ダムサイトは丘陵性台地に位置し，良く開けた不陸を伴う高台が発達している。

河川は丘陵地帯を蛇行しながら基盤を開さくして比較的狭い谷間を形成しており，両岸の河床からの高さは最大で４０ｍ程度である。

ダム地点の基盤は後期中新世から鮮新世の頁岩と砂岩の互層で構成され，夫々の岩の分布は場所により異なっている。

ダム地点の基盤の岩領はほとんどが細粒で中硬から軟質で比較的均質で亀裂が少ない。

ダム地点は大きな断層はなく，小数の大きな節理が存在するだけなので基礎岩盤の透水係数はかなり低くｎ×10^{-5} cm／sec オーダーで，ほぼ不透水性に近い。

ダム地点の卓越した地層の走向傾斜は夫々南北方向と２０°～３０°下流方向へ傾いている。

築堤材料に関しては，頁岩の現位置風化した粘性土で構成される適当な土取場がダム地点の近くに存在し，量的にも豊富で不透水性材料として盛土に使用される。しかしながら，透水性材料とかコンクリート骨材はダム地点近くには分布しない。

均等粒径の細かい砂岩の風化した砂質系材料は液状化と浮砂現象をさけるため築堤材料として好ましくない。

上述の事項から，計画ダム地点におけるダムタイプは均一型が最高と考えられる。この場合地形及び築堤材料の土質力学的性質から堤高は最大３５ｍ程度に制限されるであろう。

計画ダム地点の基礎岩盤は堤高約３５ｍ以下のフイルダムの建設に対して十分な支持力とセン断抵抗を有する。又特別な個所を除いて貯水池からの漏水に対しては特別な対策を構ずる必要はない。

現地調査が行われた各ダムサイトに対する要綱は以下の通りである。

オカン（Okkan），カデンビリン（Kadin-Bilin）ダムを除く他の３ダムに対する地質詳細は灌がい局の地質技師によって作製された収集資料を参照されたい。）

No 4　オカンダムサイト（オカン川，流域面積 207.2 Km²）

オカンダムサイトはオカン川とダト（Dat）川の合流点から約３００ｍ下流のオカン川

に位置し，比較的狭い河谷が，基盤の頁岩を開さくされて形成されている。地形測量と地質調査が１９７８年２月時点でダムサイトに於いて実施されており，最終的には１０本のボーリング（総延長約１３５ｍ）がダム軸付近で実施される予定である。ダム地点における河床巾は約２０ｍで両岸の勾配は右岸で約３０°，反面左岸は約１５°である。両岸はほゞ同一の高さで河床から約３５ｍであり，頂部は平坦となる。しかしながら右岸にはやせた鞍部があり，小さな副堤を建設する必要がある。平坦部は砂岩と頁岩の互層の風化した粘性土に覆われており，厚さは場所により変化する。ダムサイト付近での河床の堆積物は一般にまれである。オカンダムサイトはベグーシリーズに属する成層な頁岩でほとんどが構成されている。頁岩の露頭は河床部と右岸側アバットの大部分に見受けられる。左岸側の風化帯の厚さはそれ程厚くないと考えられる。このサイトに於ける卓越した地層の傾斜は下流方向に約３０°である。頁岩層は比較的硬く均質で亀裂も少なく一般的に不透水性であり，河床部分の圧力透水試験の結果によると透水係数はｎ×１０　cm／secと比較的低い値である。上記の事実から，このダムサイトの頁岩は堤高約３０ｍのコンクリート及びフイルダムの建設に対して支持力，セン断抵抗とも十分な岩質であり，同様に貯水池からの漏水に対しても特別な対策は必要ないものと思われる。築堤材料に関しては不透水性材料に対する量的にも十分な土取場がダムサイト付近に存在する。同様に斜面保護材料としての岩石材料はダムサイト上流２Km付近の場所に分布するが，フイルター及びコンクリート用資材はダムサイトの付近には分布しない。

ダムサイトの地形及び堤体への流用材料の観点から，均一型のアースフイルダムがこのダムサイトに最も適したタイプと思われる。

No１３　テゴウ（Thegaw）ダムサイト（カデンビリン川の支流，テゴウ川，流域面積90.7 Km²）

テゴウダムサイトは小河川のシャドン（Shadon）川とハミャ（Hmya）川の合流点から約２５０ｍ下流で沖積平野に隣接する丘陵部に位置しており，河谷の形状は河道にそって良く開さくされている。

地形測量，地質調査及び土質試験が１９７５年から１９７７年にかけて実施され，１０本のボーリング（総延長約２７０ｍ）がダムサイト付近で透水試験と同時に実施された。ダムサイトにおける川巾は約１５ｍであり，両岸の勾配は約１５°で非常に緩かである。両岸の同床からの高さはほゞ２０～２２ｍ位で頂上は不陸を伴う平坦部となる。

ダムサイト付近は残積砂質土で種々な厚さで覆われ，比較的密な植生である。河床堆積は一般に小規模で河道に沿って点在している。基礎岩盤はベグーシリーズに属する頁岩と砂岩とで構成されている。露頭は河床に分布するが，両岸の斜面と平坦部には約２０ｍの堤高に比較してかなり厚い風化帯が分布している。このサイトにおいて卓越する。地層傾斜は下流向きで約２０°程度である。

細粒で中硬岩から軟岩の青い砂岩がこのサイトでは優勢であるが，その中には頁岩とか，

硬質な石灰質砂岩の介在が見受けられる。このサイトでは少数の大きな節理と小さな亀裂が見受けられるが，基盤の透水性は風化砂岩の部分をのぞいて通常不透水性である。両アバットが風化した砂岩層で構成されているので，不透水性のカーテン基盤内に設けるためカーテングラウチングが考慮されねばならない。透水試験の結果によると風化岩層で 6.1×10^{-4}～8.0×10^{-5} cm／sec と比較的高く，新鮮な岩盤層では 3.3×10^{-5} cm／sec 以下である。

築堤材料に関しては統一分類法によるCLグループの不透水性材料の土取場がダムサイトから約2Km運搬距離の地点に大量に分布している。しかしながら，透水性盛土材料とかコンクリート骨材はダムサイト近傍には分布していない。

地形及び築堤材料の分布からこのダムサイトに最適なダムタイプは疑いもなく均一型となる。

No.14　カデンビリンダムサイト　（カデンビリン川，流域面積 155.4 Km²）

現地調査の結果，ナッタミ（Natthami）村とカデンビリン川とガピョウドン(Ngapyawdon)川の合流点間では堤高約35m以上のダムを築造可能なサイトを見出すことは困難なように思われる。しかしながら，ナッタミ村の上流で堤高約30m位のダムと建設するに適当なサイトは現地調査に於いて見出し得た。このサイトにダム建設の高い優先順位を与える場合には最適なダムサイトを選ぶため簡単な地形測量が実施されるべきであろう。

従って以下の記述はカデンビリン川とガピョウドン川の合流点から約1.3Km下流に位置する新たに発見されたダムサイトに対するものである。このダムサイトは沖積平野に隣接する丘陵性台地に位置し，比較的狭い河谷が基盤の砂岩と頁岩の互層を開さくしている。

このダムサイトに対する地形測量及び地質調査は実施されていない。河床巾は約20m程度であり，両アバットは相互急勾配で約40°近くである。両岸は河道から約30m位の高さで平坦となっている。この平坦面は残留粘性土で覆われているが余り植生は良くない。河道に沿う河床堆積物はダムサイト付近では一般にまれである。カデンビリンダムサイトの基礎岩盤はペグーシリーズに属する頁岩と砂岩の互層から成り立っている。これらの露頭は河床及び両岸に見受けられるが両アバットの斜面の上位部及び平坦な台地では風化深さは少し厚い様に思われる。このサイトにおける卓越した地層の傾斜は下流に向って約2°である。

細粒で比較的硬い灰色の砂岩がこのサイトでは優生であり，この砂岩は均質で節理も少なくかなり不透水性である。しかしながら河谷の上部はかなり厚い頁岩と砂岩層の風化帯が分布するので貯水池からの漏水に対し，なんらかの対策が必要となるであろう。

築堤材料に関しては，頁岩の風化した残留粘性土の適当な土取場がダムサイト近くに存在し量的にも問題がなく不透水性用土として堤体へ流用される。しかしながら透水性材料及びコンクリート骨材はダムサイトの近くには分布していない。

均一型のアースダムがダムサイトの地形的堤高の制約，築堤材料の質と量の観点から最適

なダムタイプと考えられる。しかしながら前記のダムタイプは堤高が約３０ｍ以下に於いてのみ適用されるべきであり，もし堤高が約３５ｍ以上となる場合にはゾーン型タイプのフィルダムが間隙圧の影響の排除と築堤量を減少するために考慮されるべきである。

No. 15 サウス ナウィン（South Nawin）ダムサイト （中ナウィン（Middle Nawin）川，流域面積 642.3 Km²）

サウス ナウィンダムはディンジィ（Dingyi）川とアレナウィン（Alenawin）川の合流点から下流約１００ｍの中ナウィン川に位置し，比較的広い河谷が砂岩と頁岩の互層を開さくしている。

地形測量，地質調査及び土質試験が１９７４年から１９７６年にわたり行われ，３５本のボーリング（総延長 1,020ｍ）が透水試験を含めてダム軸にそって行われた。又８試料の土質試験材料が土取場から採取され，溝がい局の土質試験室においてテストが実施された。現地調査の結果，既に計画されたダム軸のうち河谷部において，左岸側河谷部の限定された範囲に分布する砂礫層の透水性の改良が非常に困難なことを考慮してダム軸を約２００ｍ下流へ下げることが望ましい。これにより砂礫層の透水性の改良はさけることが可能となる。河床幅は約４０ｍで，左岸側の斜面勾配は約４５°と非常に急であるが，反面右岸側は３０°程度である。河床から両岸の高さは約３０～３５ｍ程度で頂部は不陸な平坦部となる。

ダムサイト周辺は比較的薄い厚さの異なる残積風化土のシルト質砂質土によって覆われ，木やかん木の比較的粗い植生に覆われている。浅い深さで河床部には河川堆積物が見受けられる。しかしながら河谷に近い左岸側には最大厚２５ｍの礫と粗い砂の古い堆積物が基礎部に分布する。幸にこの礫層は小規模で限定された範囲となっている。サウス ナウィンダムサイトの基礎岩盤はペグーシリーズに属する砂岩と頁岩の互層で構成されているが，ダムサイトの西方１２Km地点には軟質なイラワジシリーズに属する砂岩が露頭している。

ペグーシリーズに属する基盤の露頭はダム軸上流の河床の限られた範囲にのみ分布し，他の部分は１～６ｍ厚の残留シルト質砂質土で覆われている。このサイトに於ける卓越した地層の傾斜はほゞ２０°で下流向きである。

細～中粒でほとんど軟質な砂岩がこのサイトでは優勢であり，この砂岩中には 1.5～4ｍ厚の頁岩層を挟在している。この砂岩の圧縮強度は相当低く１０～２０Km／cm² である。砂岩中の亀裂は 1.5～３ｍにおいて減少し，３ｍ以下では亀裂がほとんどなくなる。左岸のアバットは砂岩の風化帯が分布するので，浅いカーテングラウチングが基礎岩盤中に不透水性のカーテンを造るため必要となるであろう。透水試験結果によると，砂岩の透水係数は風化度によって変化し 4.8×10 ～3.9×10 cm／secの範囲を示している。

ダム軸に沿う地質縦断図によると，左岸側で作用水頭の非常に低い部分において２ケの小さな向斜と背斜構造の摺曲線が推定されている。この様な場所では貯水地からの漏水の問題

が生ずるように思われるので適当な対策が考慮されるべきである。

築堤材料に関しては，ダムサイトの近くで不透水性用土に対する適当な土取場があり，量的には問題はない。

8試料の土質試験用サンプルが滝がい局の試験室へ搬入され物理試験と力学試験が行われた。一方，透水性材料及びコンクリート用骨材はこのサイトの近くには分布しない。

地形，地質及び築提材料の分布状況から，このサイトに最適なダムタイプは疑いもなく均一型である。

No. 2 ウエジィ（Wegyi）ダムサイト （シュエル（Shwele）川の支流マジィ（Magyi）川とシャバン（Shabaung）川流域面積 531.0 Km²）

ウエジィダムサイトは壮年期の地形をなす丘陵部で，マジィ川とシャバン川の合流点から約３００ｍ上流に位置し，河川は蛇行した河道に沿ってU字型の河谷で良く開さくされている。ダム軸は右岸側にマジィ川，左岸側にシャバン川の２つの支流にまたがっている。

地形測量，地質調査及び土質試験が１９７２年から１９７４年にわたり行われ，１４本のボーリング（総延長６４５ｍ）が透水試験と併行してダム軸にそって実施された。ダムサイト周辺の地形は一般に砂岩の平行した同斜谷をなし，この複雑な地形は主として強烈な造陸活動及び基盤の異なった岩質と物性に起因している。

マジィ川の河床幅は約４０ｍ位で，右岸側は相当緩い斜面であり最大厚約９ｍの洪水堆積段丘が見受けられる。一方左岸側は非常に急峻であり段丘堆積物は存在しない。

シャバン川の河床幅は約１０ｍ程度で狭く両岸とも比較的緩い斜面を形成している。

ダムサイト周辺は沖積又は残留堆積の粘土又はシルト値で厚さの変化する土壌で覆われているので，露頭は河床又は両岸の２，３の限られた場所に見受けられる。丘陵の表面は砂岩と頁岩の互層の風化した残留粘性土で約３～１４ｍの厚さで覆われている。２本の河川に挟まれた部分は少し高い台地をなし約７ｍ厚の主としてシルト質砂で覆われている。

ウエジィダムサイトの基礎岩盤はペグーシリーズに属する頁岩と砂岩の互層で構成されている。基礎岩盤の上位部は薄い頁岩層を伴うシルト質砂岩で成り立ち，砂岩は少し硬く締っている。一般に上位部の層理と節理面は良く締っているが，風化深さは時々約１６ｍに達することもあり，岩は軟質となる。基盤の低位部は少数の砂岩層を含む粘土質の頁岩であり，開口節理亀裂幅は狭くほとんどが粘土質材料によって填充されている。小さな摺曲と場所的な地層の傾斜角が４～５ケ所基盤内で見受けられるが，ダムサイト周辺において大きな断層が存在する徴候は見当らない。しかし，多くの直線状摺曲が見受けられる。このサイトに於ける卓越した地層の傾斜は下流に向って約２０°～４０°である。

透水試験の結果によると風化岩の透水係数は風化度合に応じて 8.4×10^{-4}～2.9×10^{-5} cm/sec と比較的高い値を示すが，新鮮な岩盤では 1.9×10^{-5} cm/sec 以下の値である。一般にこのダ

ムサイトの新鮮又は少し風化した岩盤は事実上不　水性層と見做すことができる。しかしながら，両アバットと両方の川に挟まれた部分には砂岩の風化帯が分布するので，止水を計るため置き換え又は注入工法など適当な対策が考慮されねばならない。

築堤材料に対しては，統一分類法でＣＬ又はＭＬグループに区分される不透水性盛土材料の適当な土取場がダムサイト近くに分布し量的にも十分である。しかし，透水性の材料及びコンクリート骨材はダムサイト近くには分布していない。

ダムサイト付近の盛土材料，地形から考え，このサイトに最適なダムタイプは均一型となる。

Ⅳ－2　経済評価

計画地域内に建設されるダムに対する可能性調査の優先順位を決めるための経済評価について，農業用水供給の観点に立脚した基本的検討が灌がい局によって行われている。

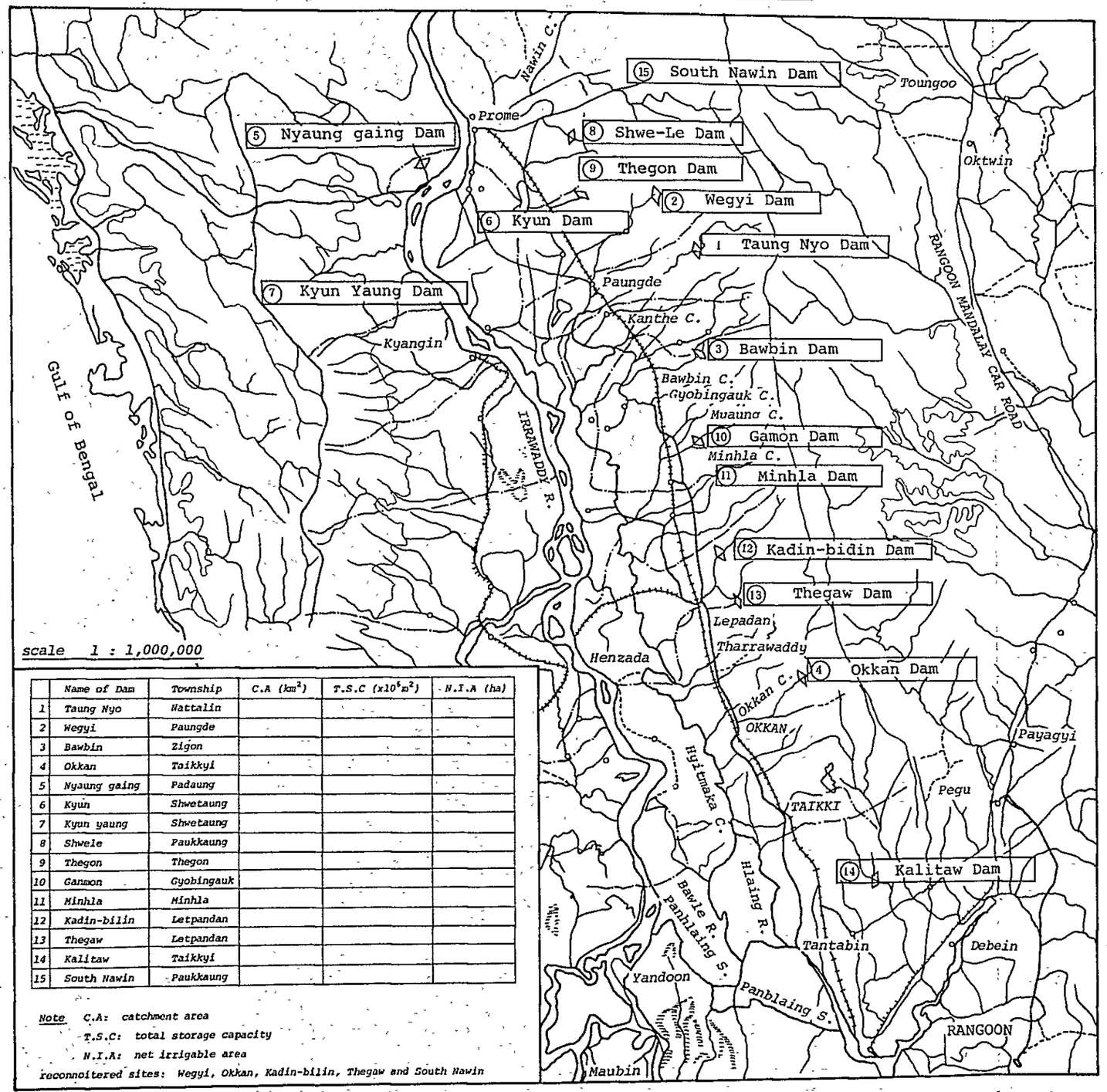
現地調査が行われたダムサイトに対しては地質的観点から見て，計画ダム地点にダムを建設することについて大きな問題はない。

従って，優先順位の評価は主として基本的検討にもとづく貯水量灌がい面積，事業費，経済評価（Ｂ／Ｃ比率及びＩＲＲ）の項目により農業用水供給の面のみを考慮して行った。

評価に関連する結果を表６に示した。

上記に述べた表から，高い優先順位を与えられるのはNo.４ オカン，No.15 サウス ナウィンとNo.２. ウエジィの３ダムと思われる。そしてこの結論は現在建設が開始されたノーウ　ナウィン，セドジィ（Sedawgyi）とナウジャ（Nyaunggyat）ダムに比較して妥当なものと思われる。

図－8 LOCATION OF POTENTIAL DAM SITE



scale 1 : 1,000,000

	Name of Dam	Township	C.A (km^2)	T.S.C ($x10^6 m^3$)	N.I.A (ha)
1	Taung Nyo	Nattalin			
2	Wegyi	Paungde			
3	Bawbin	Zigon			
4	Okkan	Taikkyi			
5	Nyaung gaing	Padaung			
6	Kyun	Shwetaung			
7	Kyun yaung	Shwetaung			
8	Shwele	Paukkaung			
9	Thegon	Thegon			
10	Ganmon	Gyobingauk			
11	Minhla	Minhla			
12	Kadin-bilin	Letpandan			
13	Thegaw	Letpandan			
14	Kalitaw	Taikkyi			
15	South Nawin	Paukkaung			

Note C.A: catchment area
T.S.C: total storage capacity
N.I.A: net irrigable area
reconnoitered sites: Wegyi, Okkan, Kadin-bilin, Thegaw and South Nawin

表－6 EVALUATION TABLE OF PRIORITY FOR PROPOSED DAMS

Dam Name	Location		Catchment Area (Km^2)	Total storage capacity Million Cum	Net Irrigable Area (ha)	Dam Dimension			Project cost (XIDUS$)	Net agricultural Benefit (XIDUS$/Year)	Economical Evaluation			Technical Judgement	Remarks
	Division	Township				Height (m)	Length (m)	Volume			B.C. Ratio	IRR (%)	Unit costs (US$/ha)		
1. Taung Nyo	2) Pegu	Nattalin	551.7		20,250	30.5	914		10.71						
2. Wgyi	2) Pegu	Paungde	531.0		24,300	30.5	1,067		12.86					C	Reconnoitered Higher Priority
3. Bawbin	2) Pegu	Zigon	261.6		24,300	18.3	1,524		12.86						
4. Okkan	1) Pegu	Taikkyi	207.2	204.42	17,820	25.9	701	387.1	12.89	6.89	9.50	24.5	723.1	A	Reconnoitered Higher Priority
5. Nyaunggaing	2) Pegu	Padaung	90.7		1,013	18.3	762		0.54						
6. Kyan	2) Pegu	Shwedaung	72.5		4,050	13.7	2,434		2.14						
7. Kyung Yaung	2) Pegu	Shwedaung	64.8		2,025	12.2	1,219		1.07						
8. Chwe-Le	2) Pegu	Paukkaung	75.1		1,013	13.7	1,067		0.54						
9. Thegon	2) Pegu	Thegon	51.8		2,025	12.2	914		1.07						
10. Gamon	2) Pegu	Gyobingauk	95.8		8,100	18.3	1,219		4.29						
11. Minhla	2) Pegu	Minhla	27.7		8,100	15.2	914		4.29						
12. Kadin Bilin	1) Pegu	Lepadan	155.4	175.78	17,010	38.4	265	392.9	12.47	6.58	9.40	24.3	733.2	C	Reconnoitered
13. Thegon	2) Pegu	Lepadan	90.7	82.09	7,290	21.7	1,646	343.3	6.37	2.82	7.99	19.0	901.4	B	Reconnoitered
14. Kalitaw	2) Pegu	Taikkyi	51.8		2,025	10.7	1,981		1.07						
15. South Nawin	3) Pegu	Paukkaung	642.3		32,400	31.2	3,050		34.29				1058.2	B	Reconnoitered
North Nawin	4) Pegu	Prome	592.1	358.95	39,178	35.1	6,616		35.71				911.6		Under construction
Sedawgyi	5) Mandalay	Madaya													Commenced construction
Nyaunggyat	6) Mandalay	Kyaukse													Under construction

Ⅷ 勧　　告

計画地域内で，他事業との整合性があり，技術的経済的緊急度が高く，受益農民の事業参加意欲の高い事業は，Ｆ／Ｓ調査結果に基づき早期着手事業として取り上げる必要があろう。サウスナウィン地区は他の灌がい排水事業との競合がなく，またイラワジ川中流域への穀物供給基地となり住民意欲も高い。また，ビルマ政府の要請と建設が予定されるダムに対する経済的，技術的評価の結果を考慮して，ダム建設を含むサウスナウィン事業に対してＦ／Ｓ調査の開始につき，最優先の順位を与えることを勧告する。

マスタープランの技術的，経済的精度を上げるため，計画地域内で次に述べる基本的資料の収集が実施されるべきである。

(1) 計画地域に対する航空写真からの図化

(2) 計画地域に対する土壌図と土地利用図

(3) 山岳部と丘陵部からの流出に対する水文資料

(4) イラワジ川の影響を含む水没地区に対する洪水資料

(5) 計画地域に対する流砂量，掃流砂量などの滞砂量の資料

(6) 計画ダム地点に対する地質及び土質調査

イラワジ川の右岸側には，各々の河川に沿って，左岸側とほとんど同様な地形，地質，土壌条件を有する広大な灌がい可能地区が存在する。

右岸側には南北方向の縦貫道路は未完成であるが，道路計画は既に確定され，各所で縦貫道路の建設が行われている（１９７８年３月で計画地域内の全長の$\frac{2}{3}$が完了している。）縦貫道路とイラワジ川横断施設の改良が完成すると右岸側においても森林開発に加えて左岸側と同様，農業開発に対する高いポテンシャルを有するものと思われる。上述の観点から右岸側においても基本的資料を取得するため自記水位計，雨量計及び蒸発計などの観測施設を設置することを勧告する。

面 接 者 リ ス ト

NAME	STATUS
U Ye Goung	Minister Ministry of Agriculture & Forests
Dr. Bo Lay	Deputy Minister Ministry of Agriculture & Forests
U Kyaw Htein	Deputy Minister Ministry of Agriuclture & Forests
U Khin Maung Latt	Director Genral, Planning and Statistics Department, MAF
U Hla Moe	Director, Planning and Statistics Department, MAF
U Khin Maung	Managing Director, Agriculture Corporation (AC), MAF
U Khin Win	General Manager, Extension, AC, MAF
U Aung Khin	General Manager, Agriculture Reserch Institute, AC
Dr. Myint Thein	General Manager, Reserch, AC, MAF
U Maung Maung Khin	Deputy General Manager, Statistics and Co-ordination, AC, MAF
U Chit Saing	Deputy General Manager, Extension AC, MAF

NAME	STATUS
U Sein Hlaing	Director General, Settlement and Land Records Department, MAF
U Htwe Nyunt	Director, Settlement and Land Records Deparmtnt, MAF
U Zaw Pe	Deputy Director, Settlement and Land Records Department, MAF
U Thein Han	Assistant Director, Settlement and Land Records Deparmtnet, MAF
U Aung Ba	Director General of Irrigation Department (ID), MAF
U Hla Khin Maung	Director, (ID), MAF
U Yi	Deputy Director, (ID), MAF (Planning and Design)
U Paw Oo	Assistant Director, (ID), MAF (Working Officer)
U Than Aung	Assistant Director, (ID), MAF (Administration)
U Tin Maung	Assistant Director, (ID), MAF (Hydrology)
U Thein Tun	Assistant Director, (ID), MAF (Planning and Design)
U San Lwin	Assistant Director, (ID), MAF (Geology)

NAME	STATUS
U San Hla Thaw	Meteorological and Hudrological Officer, Meteological and Hydrology Department, (MHD)
Dr. Tin Maung	Director, University Computer Center (UCC)
U Soe Paing	System Manger, (UCC)
U Ko Ko Lay	Operation Manager, (UCC)
U Myo Min	Application Manager, (UCC)
U Mg Galey	Director General, Forest Department, MAF
U Tha Tun San	Director, Forest Department, MAF
U Myint Aung	Deputy Director, Forst Department, MAF
U Saw Han	Deputy Director, Forest Department, MAF
U Mya Aung	Sub-Division Manager, Tharrawaddy Divisional Forest Office, Forest Department
U Tin Maung Kyi	Deputy Director, Prome Divisional Forest Office, Forest Department, MAF
Major Kyaw Shein	General Manger, Timber Corporation, MAF

収集データリスト

LIST OF COLLECTED DATA

(1) Daily Rainfall

	Gauging Station	Observation period
1.	HMAWBI	1954 - 1977
2.	TAIKKYI	1947 - 1977
3.	THARRAWADDY	1947 - 1977
4.	MINHLA	1959 - 1977
5.	OKPO	1977 - 1977
6.	GYOBINGAUK	1959 - 1977
7.	ZIGON	1959 - 1977
8.	PROME	1947 - 1977
9.	PAUKKAUNG	1966 - 1977
10.	SHWEDAUNG	1966 - 1977
11.	HENZADA	1947 - 1977

(2) Daily Water table of Irrawaddy River

	Gauging Station	Observation Period
1.	PROME	1960 - 1977
2.	HENZADA	1960 - 1977
3.	SEIKTHA	1975
4.	KYANGIN	1975
5.	MYANAUNG	1975
6.	KANAUNG	1975

(3) Daily Run-Off Discharge

	Gauging Station	Observation Period
1.	KYAUKPYINTHA	1970 - 1976
2.	KAUNGLAUNGTINE	1971 - 1976
3.	KWETMA	1972 - 1976
4.	CHAUNGZAUK	1971 - 1976
5.	BAUBIN	1970 - 1976
6.	MAGUIBIN	1972 - 1976
7.	TEME	1970 - 1976
8.	YONBINDET	1971 - 1973
9.	THAPANGAING	1972 - 1973
10.	MYODAUNG	1973 - 1976
11.	MAGWE	1973 - 1976
12.	YATTHIT	1973 - 1976
13.	KYIDAING	1971 - 1973
14.	KWINLAYGI	1971 - 1973

(4) Rating Curve

Prome

(5) Cross Section of Irrawaddy River

PROME	23/3/1966
	7/8/1970
	17/11/1970
	13/2/1975
HENZADA	

(6) Monthly Temperature

Rainfall

Actual Sunshine Time

Wind Velocity

Wind Direction

Humidity

Evaporation

Station	Location	
	(LN)	(LE)
PROME	18° 48'	95° 13'
HENZADA	17° 29'	95° 27'
THARRAWADDY	17° 38'	95° 48'
PEGU	17° 20'	96° 30'
BASSEIN	16° 46'	94° 46'
MAUBIN	16° 44'	95° 39'
PYINMANA	19° 43'	96° 13'
TOUNGOO	18° 55'	96° 28'
MINGALADON	16° 54'	96° 11'
RANGOON	16° 46'	96° 10'
MINBU	20° 10'	94° 53'

(7) Engineering Geological Report on Thegaw Dam

(8) Engineering Geological Report on Wagyi Dam

(9) Engineering Geological Report on South Nawin Dam

(10) Engineering Geological Map on South Nawin Dam
(Scale 1 inch 800 feet, contour interval: 10 feet)

(11) Geological Cross-Section of Alignment No.2
(South Nawin Dam Project)

(12) Geological Cross-Section of Alignment No.2
(South Nawin Dam Project)

(13) Geological Log of Drill Holes, South Nawin Dam

(14) Soil Test Data (Sough Nawin Dam)

(15) Seismic Zonation of Burma

(16) Soil Laboratory Testing Equipment

(17) Report to the Pyithu Hluttaw on
The Financial, Economic and Social Conditions of
The Socialist Republic of the Union of Burma
For 1977-78
1977 Ministry of Planning and Finace

(18) Notes on Agriculture in Surma
Dated the 10th January 1978
Ministry of Agriculture and Forests

(19) Land Revenue Rates in the Union of Burma

(20) A Brief Description of the Fixation of Land
Revenue Rates in Burma

(21) Current Rates of Land Revenue

(22) Higher Production Paddy Project in Taikkyi Township,
Rangoon Divsion and Project Plan 1977-78

(23) Actual performance of High Production Paddy Project in Taikkyi Township and Progress of Paddy Production in Taikkyi Township from 1974-75 to 1977-78

(24) Crop Production in Taikkyi Township 1976-77 (Actual Performance) and 1977-78 (plan) and Double Cropping Acrage

(25) Timber Production for the last 7 years nation wide and Project Area respectively

(26) Transportation and Shipment

(27) Road Network for Timber Industry in the Project Area

(28) Teak and Hardwoods Extraction

(29) List of Saw Mill in Ibaid Project Area

(30) List of Timber Ship in Ibaid Project Area

(31) Area of Forest Divisions

(32) Area of the Reserved and Unclassed Forests

(33) Growth and Increment of Teak and others of the respective Divsion

(34) Annual Allowable Cut

(35) Stocking

Data Source: 1 to 2, Meteorological Department

3 Irrigation Department

4 to 6, Meteorological Department

7 to 16, Irrigation Department

Data Source: 17 to 18, Agriculture Corporation

19 to 24, Land Records Department

25 to 30, State Timber Corporation

31 to 35, Forest Division

資　　料　　編

Appendix

ITEM OF THE DATA COLLECTED FROM TOWNSHIPS

No. 1	Population classified by ages and number of families
No. 2	Composition of estimated active labour forces engaged in various sectors
No. 3	Land Utilization
No. 4	Net sown area specified by irrigated and rainfed area
No. 5	Position of peasant families and land area occupied by them
No. 6	Irrigated area by means of irrigation
No. 7	Irrigated area by crops
No. 8	Production of crops
No. 9	Cropping pattern (including growth duration of each crop)
No. 10	High yielding variety paddy specified by Foreign H.Y.V., local improved varieties and Local ordinary varieties
No. 11	Distribution of quality seeds of paddy, groundnut and jute specified by varieties, by Government Agencies and Co-operatives

No. 12 Mechanization

1) Number of tractors and power tiller for agriculture use owned by Government co-operatives and group of farmers

2) Draught cattle and agricultural implements

No. 13 Utilization of fertilizer and chemicals by crops

No. 14 Procurement of paddy, pulses and jute by the State Enterprises

No. 15 Quota of paddy per acre

No. 16 Total amount of Advance Payment of Trade Corporation for paddy

No. 17 Agricultural Loans by Corporations (paddy, groundnut, sesamum. jute)

No. 18 Village Manager

No. 19 Expenditure on Rural Development Works such as land reclamation, road and bridges, health and education

Appendix

North Nawin Irrigation Project

1. Location : The Project is located in three township of Pegu Division, namely Prome, Paukkhaung, and Theogon.

2. Objective : A water impounding dam is to be constructed across North Nawin Chaung near Sezongon Village in Prome Township. The Project will serve 96769 acres of land on which it is projected to cultivate 182269 acres of crops under irrigation.

3. Project Description : The utilization of water resources of the North Nawin Chaung for irrigation purposes was first conceived by Government in 1953. In 1957 Energoproject was entertained by the Government to prepare a preliminary report for this project and again in 1963 the same firm was entrusted with the preparation of feasibility report and final designs of the Project. Feasibility report and final designs were submitted by the firm in 1967. Preliminary works were stated in 1967-68.

   In 1970 Energoproject was again employed by the Government for giving construction guidance to the Irrigation Department in the Implementation of the Project.

The Project provides for the construction of an earth dam to impound the stream flow and utilize it for year-round irrigation and also an irrigation and Drainage network will be constructed under the project.

Main features of the reservoir and irrigation system are:

(1)	Catchment Area		228.6 sq. miles
(2)	Length of Dam		5300 ft.
(3)	Height of Dam		115 ft.
(4)	Maximum depth at full reservoir		103.5 ft.
(5)	Top width of Dam		20 ft.
(6)	Storage Capacity		291000 acre ft.
(7)	Waterspread Area		8800 acres
(8)	Length of Conduit		414 ft.
(9)	Diameter of Conduit ...		8 ft.
(10)	Full Supply Discharge ..		810 $ft^3/sec.$
(11)	Spillway Width		210 ft.
(12)	Main Canal	3 Nos.	45 miles
(13)	Distributaries	123 Nos.	278 miles
(14)	Lined Canal		120 miles
(15)	Syphons	103 Nos.	
(16)	Falls	140 Nos.	

(17)	Canal Head Regulators	220 Nos.
(18)	Bridges	279 Nos.
(19)	Outlets	2224 Nos.

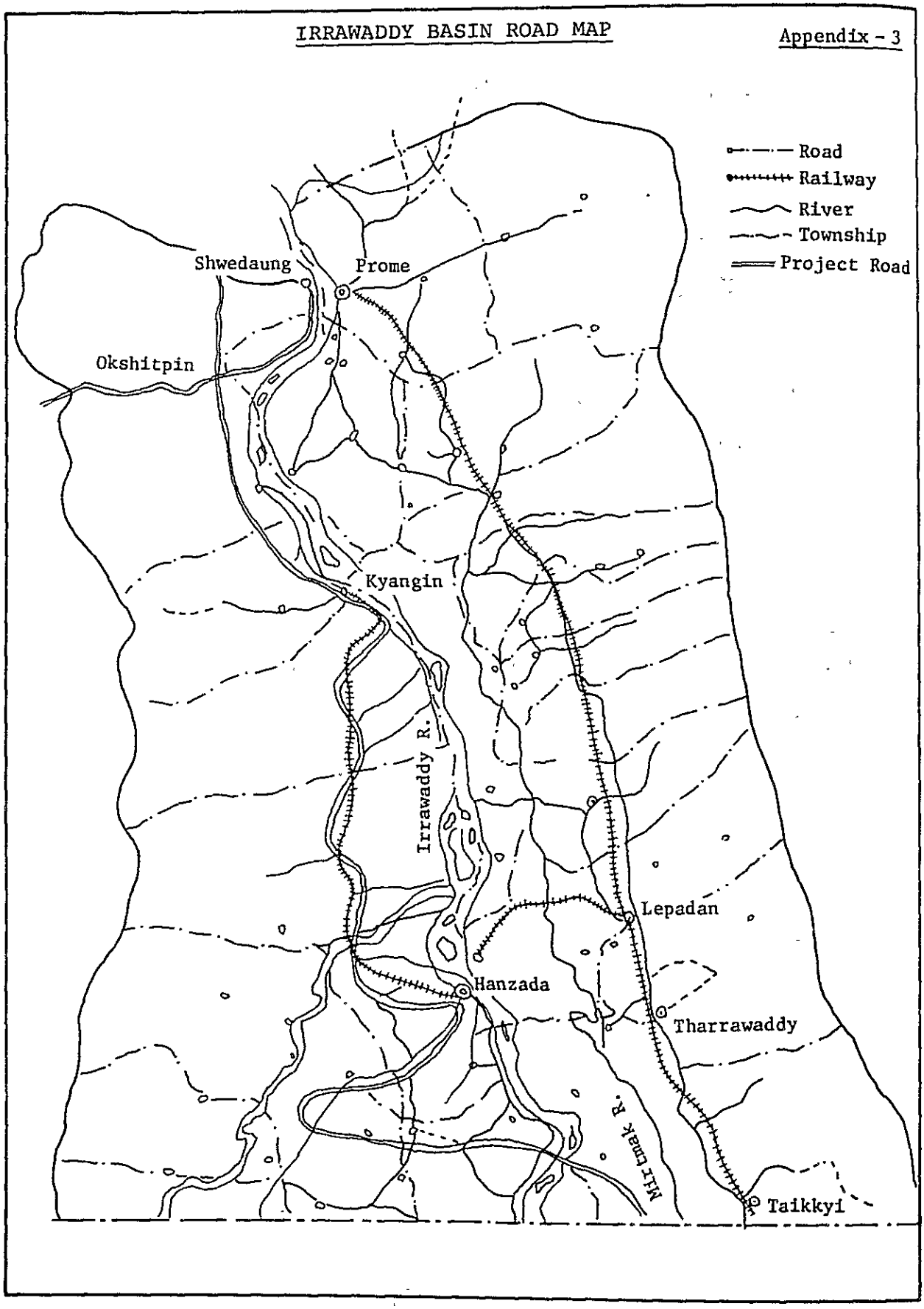
4. Cost Estimate : The total estimated cost of the North Nawin Irrigation Project is about K 250 Millions.

5. Project Construction Period : Implementation of the Project and Preliminary Works were started in 1967-68 and the Project is phased for completion 1981-82.

Source : Planning and Design Division, Irrigation Department, MAF.

IRRAWADDY BASIN ROAD MAP

Appendix - 3



Appendix - 4

WATER MEASURED IN THE FIELD SURVEY

(1978)

	Date	Time	Dissolved Oxygen	PH	Water Temperature	Remarks
Irrawaddy	Mar. 20th	12:30	8.5 PPM	8.3	27.3°C	
River	Mar. 22nd	12:20	8.5	8.5	27.4	
Daka	Mar. 20th	16:00	6.9	7.6	31.0	
River	Mar. 21st	07:30	5.3	7.5	27.9	
Inyegyi	Mar. 21st	09:00	7.8	8.5	28.5	Kanzu Village
Lake	"	10:15	5.4	8.1	27.5	Sai-Lay Station
	"	12:00	4.2	7.9	29.3	Inyegyi Station
	"	14:00	8.2	8.5	32.7	Kanzu Village
Duya Lake	Mar. 22nd	09:20	7.3	8.4	27.5	
Ragwinpyin River	Mar. 24th	11:10	5.4	7.4	30.9	
Kanzu Village fish pond	Mar. 21st	14:30	6.0	7.1	33.6	
Private fish pond	Mar. 24th	08:00	5.5	8.1	28.3	
near Rangoon	Mar. 24th	08:30	6.6	8.4	27.4	

THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

REPORT

ON

THE MASTER PLAN SURVEY OF THE FIRST STAGE

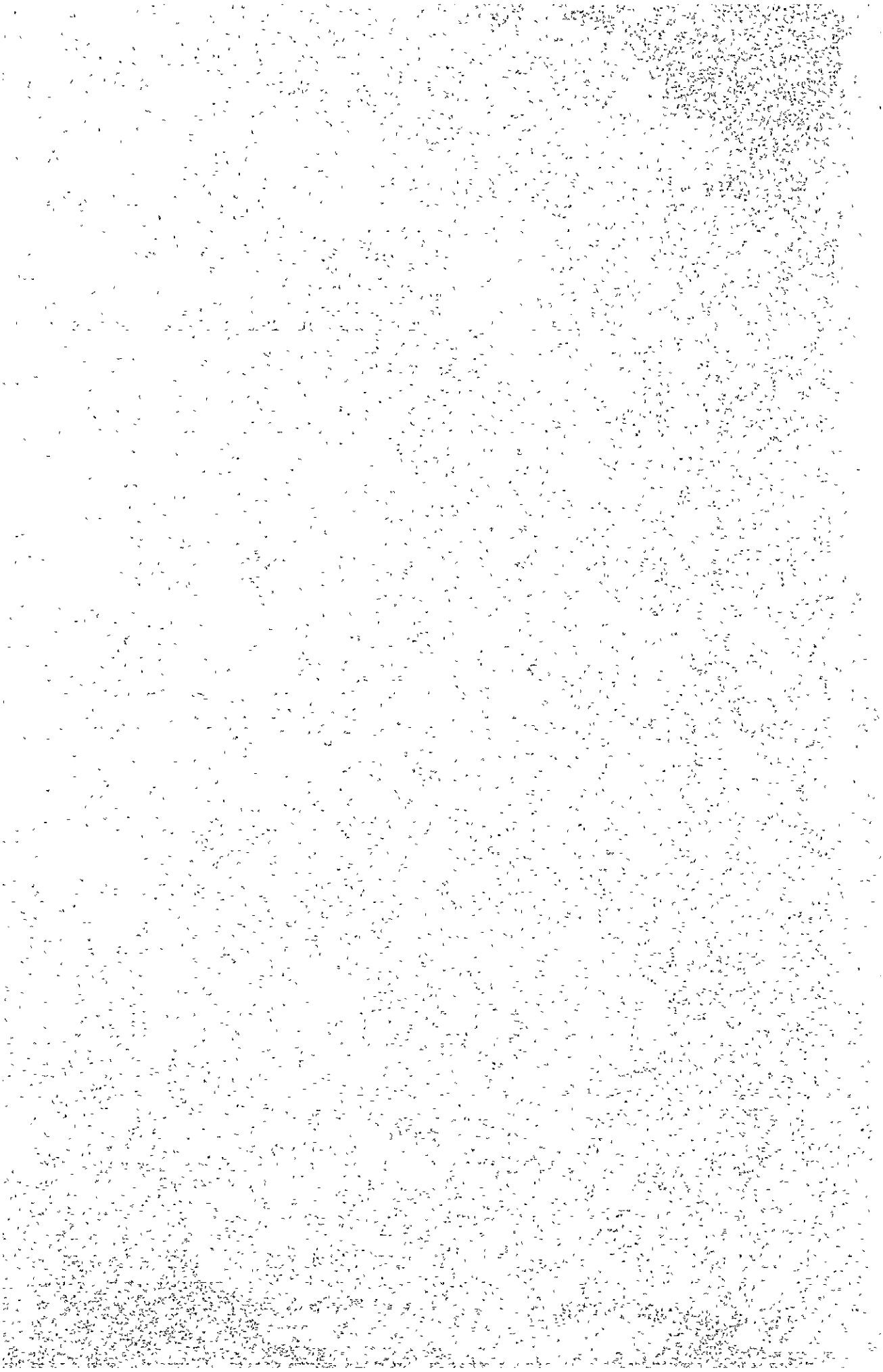
FOR

THE IRRAWADDY BASIN

AGRICULTURE INTEGRATED DEVELOPMENT PROJECT

MARCH 1978.

JAPAN INTERNATIONAL COOPERATION AGENCY



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

Dear Sir,

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

I have a great pleasure to submit herewith twenty (20) copies of the Report on the Master Plan Survey of the First Stage for Irrawaddy Basin Agriculture Integrated Development Project in accordance with the Scope of Works for the First Stage Survey Team.

In the report, findings in the survey and Team's view on approach to the Master Plan Survey are briefly stated together with recommendations.

From the experience in other countries under similar circumstances to your country, we have come to realize more and more the importance of Master Plan, which will enable us toplace appropriate priority to various stages and aspects of development project.

I am also happy to inform you that according to your emphasis on quick-yielding projects, reconnaissance survey was carried out by the Team at five dam sites. Based on the results on survey and also the relevant data and information available, technical discussion regarding the priority of these irrigation projects were made between the Burmese Authorities concerned and the Team. For a final decision

the comprehensive discussion between His Excellency U YE GOUNG, Minister of Agriculture and Forests and His Excellency TAKEO ARITA, Ambassador of Japan, was also made. Consequently, South Nawin area is decided as a feasibility study.

I would like to express my sincere thanks for the kind cooperation and assistance extended to us by Government Agencies concerned during our stay in Burma.

Yours faithfully,

TOSHIKI SAITO

Mission Leader
The Master Plan Survey of the
First Stage for the Irrawaddy
Basin Agriculture Integrated
Development Project

KEY MAP

30°

BURMA

PROME

Project Area

Bay of Bengal

RANGOON

10°

95°

GENERAL MAP

Mawin C.

PROME

Wetpot C.

Paungde

Kanthe

Kyangin

Bawbin C.

Gyobingauk

Myoung C.

IRRAWADDY RIVER

Minhla C.

Mokka C.

Kadin-bidin C.

Lepadan

Henzada

Tharrawaddy

Okkan C.

Okkan

Myitmaka

Taikki

Bawle R.

Hlaing

Panhlaing

Panhlaing C.

RANGOON

Maubin

Bassein

BAY OF BENGAL

18°

17°

93°

94°

95°

1 : 1,000,000

0 10 20 30 40 50 km

MEMBER OF THE MISSION

Mr. Toshiki SAITO Leader	Assistant Chief, Land Improvement & Consolidation Division Construction Department. Kyushu Regional Agricultural Administration Office. Ministry of Agriculture and Forestry.
Mr. Masao TAKAHASHI Hydrology	Section Chief, Land Improvement & Consolidation Division Agricultural Structure Improvement Bureau, Mnistry of Agriculture and Forestry.
Dr. Hidehiko SHIRAISHI Hydro Analysis	Chief Researcher, Irrigation Department. National Research Institute of Agricultural Engineering. Ministry of Agriculture and Forestry.
Mr. Kiichi ITOH Drainage	Researcher, Irrigation Department National Research Institute of Agricultural Engineering. Ministry of Agriculture and Forestry.

Mr. Kazuo YAMADA Forestry	Controller Audit Division Forestry Agency Ministry of Agriculture and Forestry.
Mr. Heijiro YOSHIHARA Agro-Economy	Advisor (Economist) Sanyu Consultants Inc. (S.C.I.)
Mr. Hironori TAKAHASHI Hydrology	Hydrologist S.C.I.
Mr. Tetsuro HORI Geology	Director S.C.I.
Mr. Chuzo SAIKA Agronomy & Soil	Advisor (Acquaculture Specialist) S.C.I.
Mr. Masahiro IIDA Mapping Survey	Section Chief Third Technical Department S.C.I.
Mr. Yukio ASAKURA Inland Fishery	Advisor (Agriculture Specialist) S.C.I.
Mr. Tsugio HORII Coordination	Official of Planning and Survey Department for Agriculture & Forestrt. Japan International Cooperation Agency.

MEMBER OF COUNTERPART

U Ba Toke	Assistant General Manager Agriculture Corporation.
U Tha Tun Oo	Assistant General Manager Agriculture Corporation.
U Tin Win Latt	Deputy Assistant General Manager Agriculture Corporation.
U Ba Aye	Executive Engineer Survey Section Irrigation Department.

ITINERARY OF THE MISSION

(1978)

Date	Description
6 February	Left for BAngkok
7 February	Arrived in Burma Made courtesy call to Japanese Embassy of Burma
9 - 13 February	Collected data from Department and Corporations concerned
14 February	Made Reconnaissance Survey by aircraft
15 - 17 February	Made First field Survey by all members
18 February	Held meeting with all memebers
19 February	Holiday
20 February	Collected data
21 - 25 February	Made second trip
26 February	Holiday
27 February	Made meeting with all members

Date	Description
1 March	Made meeting with Hydraulic analysis team
2 - 4 March	Made Third field survey on the Irrawaddy River.
5 March	Holiday
6 March	Held meeting with Mission and Irrigation Department.
7 March	Made Reconnaissance survey by aircraft.
8 - 10 March	Made Fourth field survey to right bank of the Irrawaddy River.
11 March	Dr. Shiraishi and Mr. Ito left for Japan.
12 March	Mr. Asakura arrived in Burma.
13 - 15 March	Made Fifth field trip at Pyinmana, meeting with Mission members and Agricultural Corporation.
16 March	Made courtesy call to the Government of Burma.
17 March	Visited the Hmawbi Experimental Farm.

Date	Description
18 March	Held Film show at Japanese Embassy.
19 March	Holiday.
20 - 22 March	Made Sixth field trip (Henzada).
23 March	National Holiday.
24 - 25 March	Prepared reports.
26 March	Holiday.
27 March	National Holiday.
28 - 29 March	Submitted survey reports and held meeting with the Mission and the Government of Burma.
30 March	Left for Bangkok.
31 March	Arrived in Japan.

C O N T E N T S

ABBREVIATIONS AND CONVERSION TABLE

AC	=	Agriculture Corporation, MAF
APS	=	Advance Purchase System
BKT	=	Basket(s)
DG	=	Director General
DY	=	Deputy
FC	=	Foreign Currency
GM	=	General Manager
GNP	=	Gross National Product
HP	=	Horsepower
HYV	=	High Yielding Variety (Paddy)
IBRD	=	International Bank for Reconstuction and Development
ID	=	Irrigation Department, MAF
IDA	=	International Development Association
LICA	=	Japan International Cooperation Agency
LC	=	Local Currency
LIV	=	Local Improved Variety
MAF	=	Ministry of Agriculture and Forests
MD	=	Managing Director
MPF	=	Ministry of Planning and Finance
PSD	=	Planning and Statistics Department, MAP
SD	=	Survey Department, MAF
TEM	=	Township Extension Manager

1 foot (ft)	=	30.48 centimeters (cm)
1 mile	=	1.609 kilometers (km)
1 acre (ac)	=	0.405 hectare (ha)
1 square mile (sq. mile)	=	2,590 square kilometers (sq. km)
1 cubic foot (cu. ft)	≈	28.32 liters (l)
1 cubic yard (cu. ya)	≈	0.765 cubic meters (cu.m)
1 acre-foot (ac-ft) (AF)	≈	1,233.48 cu.m
1 cubic foot per second (cu.sec)	=	0.025 cubic meter per second (cu.m/sec)
1 long ton (lg ton)	=	1,016 kilograms (kg)
1 lac (lakh)	=	100,000
1 crore	=	10,000,000
1 viss	=	1.633 kg
1 pyi	=	2,127 kg
1 pound (lb)	=	0.4536 kg
1 basket paddy	=	20.9 kg
1 basket rice	=	34.0 kg
1 bag rice	=	75.6 kg
1 U.S.$	=	Kys 7.3

I. INTRODUCTION

The unprecedented population explosion all over the world has created the attendant necessity for production of more food.

Consequently, Agriculture is drawing the attention of all the nations. All of them are endeavouring to find ways and means of improving the existing techniques and inventing new methods in their attempt to enhance agriculture production. As far as the Socialist Republic of the Union of Burma is concerened, there are not only vast extent of unclultivated land in the dry season but also enough water resources. If these resources are properly harnessed for the development of agriluture, Burma would have a very prosperous future.

(1) Dispatch of the Master Plan Survey Team of the First Stage

In response to the request made by Burmese Government for the technical cooperation for the Master Plan Survey for Irrawaddy Basin Agricultural Integrated Development Projects, Japanese Government dispatched a Survey Team of the first stage to exchange views and experiences with the Burmese authorities concerend and to carry out necessary field survey.

(2) Scope of Works

a) Field investigation

b) Supplemental data collection

c) Hydrological survey

d) Crop and soil survey

e) Forestry investigation

f) Inland fishery investigation

g) Agro-economic survey

h) Other various surveys related to the Project

II. PROJECT AREA

(1) An area which is identified by the flight and field reconnaissance survey is located in the upper delta betwen 17° 15' NL and surrounded by two mountain ranges, namely the Arakan and the Pegu as shown in the General Map attached. The area is estimated at around 2.5 million hectares in total acreage.

(2) The boundary of the Project Area is decided after consideration of factors mentioned below:

(i) East and West

Watersheds of the Arakan mountain range and the Pegu mountain range.

(ii) North

Boundary line near Prome dividing the Irrawaddy Basin into a wet zone and a dry zone.

(iii) South

Approximate 17° 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.

The Project Area 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.

III. TEAM'S VIEW OF APPROACH TO THE MASTER PLAN

The necessity, purpose and principle of The Master Plan are described in the interim report of preliminary survey Team. Therefore, what is described in said report will not be repeated in this report, but only some points that require elaboration, in view of the results obtained by Team's survey, ans study will be dealt with.

(1) Among the natural resources in the Project Area, water resources which can be utilized effectively for agriculture are limited. From this point of view, the selection of irrigable area of each sub-project in the Master Plan should be investigated in detail, If irrigation of some areas located in the lower region of a river can be found feasible economically and technically by use of pond, pump, etc., the Project Area which is irrigated by reservoir should be selected in the upper region.

(2) The Project Area in the Master Plan can be classified as follows: -

i) Area which can be improved by irrigation facilities during both rainy season and dry season.

ii) Area which can be converted to agricultureal land by providing drainage system.

iii) Area which can be converted to agricultural land by the construction of polders with drainage facilities.

iv) Area which can be converted to the agricultural land by the flood control facilities of Myitmaka River, Irrawaddy River, etc., with the construction of drainage system.

(3) For the drawing up the Master Plan, the hydrological analysis of Myitmaka River and Irrawaddy River should receive sufficient attention. A considerable amount of survey equipment will be required.

(4) Together with the irrigation projects other projects mainly with regard to Research and Extension as well as the rural development works, should be duly considered and included in the Master Plan.

The study and investigation of those projects will be conducted with the kind cooperation of the Department and Corporation concerned such as Planning and Statistics Department and Agricultural Corporation from the view point of integrating into the Master Plan.

In the area of the Feasibility Study of the irrigation projects, it is important to integrate the various aspects fo the agricultural development, that is, the introduction of high yield varieties, the strengthening of the ofganization and function of the Research including those of the Central Farms and Seed Farms and Extension as well as the improvement of social infrastructure.

IV. FINDINGS IN THE PROJECT AREA

IV-1 Climate and Hydrology

(1) Climate

Metorological observation is carried out by the meteorological observatories: Prome, Henzada and Tharrawaddy observatories in the Project Area. The locations of the three observatories as well as observatories in the circumference are shown in the appendix. Daily observation is carried out for temperature, rainfall, atmospheric pressure, humidity, evaporation, actual sunshine time, wind speed and wind direction.

The climate conditions of the Project Area are tropical and strongly affected by the south west monsoon. There are three seasons: the rainy, the cold and the hot seasons. A well-defined rainly season starts in the middle of May and ends in the middle of October. It is a rare case to have rainfall in other seasons. The average rainfall at Henzada reaches to 2,287 milli-meters while that at Prome, 1,279 milli-meters respectively.

The cold season comes after the rainy season from November to January. The temperature fall s down to the lowest in a year, and the humidity is also the lowest.

The hot season preceding the rainy season lasts from February to April which is the hottest in a year. The maximum temperatures at Prome and Henzada are 40 degree centigrade respecitvely.

(2) Hydrology

Daily rainfall data are available at the following gaueine stations.

	STATION	PERIOD
1)	Hmawbi	1954 - 1977
2)	Taikkyi	1947 - 1977
3)	Tharrawaddy	1947 - 1977
4)	Minhla	1959 - 1977
5)	Okpo	1972 - 1977
6)	Gyobingauk	1959 - 1977
7)	Zigon	1959 - 1977
8)	Prome	1947 - 1977
9)	Paukkau	1966 - 1977
10)	Shwedaung	1948 - 1977
11)	Henzada	1947 - 1977

Daily discharges for the proposed fourteen dam sites have been observed at the followine water gauge stations.

STATION	RIVER	CATCHMENT (SQ.KM)	PERIOD
1) Kyaukpyintha	Okkan	313.4	1970 - 1976
2) Kaunglaungtine	Tgegon	88.1	1971 - 1976
3) Kwetma	Kadinbilin	240.9	1972 - 1976
4) Chaungzauk	Gamon	80.3	1971 - 1976
5) Baubin	Baubin	261.6	1970 - 1976
6) Magyibin	Taungnyo	549.1	1972 - 1976
7) Teme	Wegyi	538.7	1970 - 1976
8) Yonbindet	Thegon	51.8	1971 - 1973
9) Thapangaing	Shwele		1972 - 1973
10) Myodaung	Dingyi	323.8	1973 - 1976
11) Magwe	Alenawin	274.5	1973 - 1976
12) Yatthit	South Nawin	639.7	1973 - 1976
13) Kyidaing	Kyun Chaung	72.5	1971 - 1973
14) Kwinlaygyi	Kyun Yaung	64.8	1971 - 1973

Water levels of the Irrawaddy River are observed by the Meteorological Department at Prome and Henzada in the Project Area. A rating curve has been established only for Prome station. It seems very difficult to establish a rating curve at Henzada, because the river course moves quite often during a flood season.

The Irrigation Department has four water gauge stations between Prome and Henzada. They are Seiktha, Kyangin, Myanaung, Kanaung stations.

No observation data of rainfall is available in Pegu Yoma area in the left bank of the Irrawaddy River, where the fifteen dams are proposed. No accurate discharge analysis can be performed without any observation data. Observation data of more than one year give much contribution to the accuracy of the discharge analysis by taking a co-relation between the rainfalls in the flat area and those in the mountain area.

In the right bank of the Irrawaddy River, there are a few rain gauge stations along the River. It will be required to install new rain gauge stations both in the flat area and mountain area.

A co-relation analysis based on the observation data will reveal a local characteristic of the rainfall and auto-relation analysis will be performed in order to distinguish a pattern of the rainfall.

Such methods as multiple regression model and tank model simulation can be used for estimating the discharges from the rainfalls, and analysis will be performed by using computer.

IV-2 Geology and Soil

(1) Geology

The Project Area mainly consists of two topographical units which are closely co-related with their geology; that is to say, plain and hilly areas. The first belongs to the Irrawaddy valley or rather to the northern part of the Irrawaddy Delta and the second belongs to the mountain range of Arakan and Pegu Yomas.

According to the Geological Map of Burma published by the Bureau of Mines, Rangoon, in one inch to four miles scale, the geology of the Project Area consists of Tertiary formations with sedimentary faces as base rocks. Quarternary formation with both Pleistocene and Holocene alluvials are unconformaly overlying onthe base rocks across on both sides of the Irrawaddy River with strenching vast plain.

The basic stratigraphic succession of formations in the Project Area is shown in the following table.

Basic Stratigraphic Succession

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

The Project Area can basically be divided into certain lithostratigraphic units and remarkable geological features of each unit are as follows:

The Longshay Series spread on the transitional region between the Arakan Yoma and alluvial plain running from north to south with a narrow strip and belong to Eocene Age. The base of Eocene is composed of mainly conglomerates with some grits and sandstone, however, these conglomerates are overlain by a thick series of shales called Longshay shale.

The Pegu Series spreads around the Arakan and Pegu Yomas, adjoining the hilly and undulation area, and shoots up in the limited area at the south of Prome with a narrow strip, and belongs to Miocene Age. The Pegu Series is composed fo shales and sandstones with greenish or gray colours, and exposed at many places. Those rocks are rather soft and weatherable and have varing distribution in places. The potential damsites are located on the alternation of shale and sandstone of the Pegu Series formation.

The Irrawaddy Series spreads near the foot of the Arakan and Pegu Yomas on the transitional region between the hilly area and alluvial plain adjoining to the Pegu Series region and the limited area along the Irrawaddy River at the South of Prome, belonging to Pliocene. The Irrawaddy Series is made up of almost sandstone and contains silicified fossil wood and mixture of ferruginous, calcareous and siliceous concretions and a quantity of pebbles can be observed.

The alluvium region occupies the central part of the Project Area along the Irrawaddy River forming the vast plain which is composed of the alluvial deposits derived from the Arakan and Pegu Yomas, and the Irrawaddy River itself. This region can be subdivided into two divisions from the view points of its relief and composing deposits. The hilly alluvial plain is a transition from the hills of the Arakan and Pegu Yomas to the central alluvial plain and it occupies almost of the alluvium region. The deposits are mainly composed of the coarse layers interbedded with silty and loamy layers. However the upper portion becomes

more clayey. Numerous young coarser local alluvial deposits are found along small stream in the area. This division is closely co-related with the agricultural products and almost irrigable areas are located in this division. Central alluvial plain -- this division is spreaded along the Irrawaddy River, forming a narrow belt of south-north direction. The division is composed of fine sorted heavy textured alluvium which is rather homogeneous. It is traversed by numerous stream flowing from the hills.

The othe minor lithostratigraphic units such as serpentine and limestone are distributed in limited places at the northern part of the Project Area.

According to the aforesaid Geological Map of Burma, there are three major paralleled faults in the north-east part of the Project Area near Prome, mainly extending beyond the Project boundary with north-west direction, and it seems to have no direct effect for the potential damsites. However, numerous minor derivative faults from the major faults exist aroud northern part of the Pegu Yoma in the Project Area where some of the potential dams are located.

(2) Hydrogeology

Ground water behavior is closely co-related to the characteristics of the geological formations. The shales and sandstones belonging to Tertiary unit are generally impervious, and more or less pervious respectively, and Quarternary unit is mainly composed of the coarse layers interbedded with silty and loamy layers; but the upper portion becomes more clayey.

The ground water table in the Project Area is not so low. In the rainy season rises to the ground surface and in the dry season it falls about six meters below ground surface. Thus, the domestic water supply in the Project Area is mostly from shallow wells, which are sometimes dried up during the dry season. No systematic and large scale irrigation from the ground water has been excuted in the Project Area.

Due to the above mentioned conditions in the Project Area, it can be considered that the possibility of the development of large scale irrigation projects from the ground water resources is evidently lower than that from the surface waters.

(3) Soils

The differentiation of the soils is closely connected with their gemorphological regions as follows:

(i) Yellow Brown Forest Soils are feveloped in the good drained condition under the influence of forest vegetation. These soils cover the Pegu Yoma and foothills of the Arakan Yoma. Thev are highly productive as the forest land, and should be kept under the forest for the water conservation.

(ii) Primitive Crushed Stone Soils are found in combination with the Yellow Brown Forest Soils, and exist especially on the steep slopes and hill tops. They should also be kept under the forest.

(iii) Lateritic Soils develop on the gentle slopes of the foothills of the southern part of the Pegu Yoma, and are combined with Yellow Brown Forest Soils. Upper horizon of the profile is light loamy and in the lower horizon there exist heavy soils. Mostly covered with bamboo brackets and dense shrubs, they are regarded as good Ya-lands which are suitable for orchard or rubber plantation. Lateritic Soils are also easily eroded because of their friable surface soils.

(iv) Cinnamon Soils occupy the under-hill alluvial - diluvial plain of the northern part of the Pegu Yoma. The soil texture varies with the various parent materials, however, light loamy texture predominates. These soils are now mostly under the forest with low productivity, but are regarded as Ya-land of good fertility, especially under irrigation.

(v) Meadow Soils occupy a vast area which stretches from the north to the south in the eastern part of the central plain of the Project Area. They are rather good drained, ranging from medium loam to heavy clay in texture. They are now utilized as paddy field of moderate fertility and also suitable for second cropping after paddy.

(vi) Meadow Gley Soils a;sp pcci°u a vast stretched area by the west of the Meadow Soils belt. They are developed under rather humid conditions than

the Meadow Soils. Their textures range from heavy loamy to clayey soils containing much silt. They are now fully utilized as paddy field of best fertility. Second crops after paddy are also possible but it is required to adopt the suitable sowing time and take some counter-measure for preserving the soil moisture.

(vii) Meadow Alluvial Soils are the recent and sub-recent alluviums which cover the Meandering Belt of the Irrawaddy River and Mitmaka River. These soils vary in their textures, degree of gleyness and swampiness in accordance with their locations on the microrelief geomorphology, but light loamy soils are predominant. These areas are not generally cultivated except higher places at present due to the inundation, but the fertility is rather higher than the other soils. These soils will, therefore, be suitable for upland crops as Kaing land of good fertility after taking counter-measures for the floods.

(viii) Meadow Swampy Soils are located in the depressed area in the Meandering Belt predominated with the Meadow Alluvial Soils, and the degree of the gleyness of the soil is far advanced than the Meadow Alluvial Soils. Texture of the soils is generally heavy clayey, and permeability is very low. As the content of untrients and humans is rather high, it will become a good paddy field after amelioration.

(ix) Swampy Gley Soils are developed under the similar conditions to Meadow Swampy Soils but content of nutrients and humus is less than that of the Meadow Swampy Soils.

(x) Alluvial Soils are located on the Irrawaddy River banks and the islands. They are developed in the conditions of yearly inundation and deposition of a new alluvium, and fertility is still low.

Above explanation about the Soils is based upon the reports on the "Soil and Land Use Survey" of Prome, Tharawaddy, Insein and Henzada District, which are printed by the Land Use Bureau in 1959.

IV-3 General Feature of Agriculture

(1) Guideline for Crop Production

The Government has been taking a policy to encourage farmers to grow cotton, jute, sugar, pulses, and groundnut and sunflower (oil crops) besides paddy so as to increase export of farm products as well as to increase in their self-sufficiency ratio.

The measure for production icrease has been carried out both by extensive development of new farm lands and by better utilization of existing farm lands; it is deemed reasonable to promote the policy by improvement of farming techniques including breeding, and extension of multiple cropping.

At present, however, most of the farmers are being engaged in the single cropping of the wet season paddy and the extension of multiple cropping has made very slow progress, although the authorities concerned have been making every possible effort.

	Net sown ares (1)	Total sown area (2)	Ratio (2)/(1)
	(1,000)	(1,000)	
Union 1970-71	7,896 Ha	9,040 Ha	1.145
1975-76	8,129 Ha	9,411 Ha	1.161
Increasing rate/year	58 %	87 %	

(2) Kinds of Arable Lands and Their Cropping System

(a) Paddy field: The most of arable lands are under paddy cropping and absence of irrigation facilities has not allowed to grow the second crops, excepting for only a small area cropped with pulses, chillies and so on after paddy cropping.

In some lands that the water is supplied from ponds or rivers, the farmers grow the pre-monsoon jute and late planting paddy after harvesting the jute.

In other places that the sowing of pre-monsoon jute is unavailable due to lack of irrigation water, the monsoon jute is sown after a little rainfall comes.

The North Nawin Project, after its completion in 1980-81, will provide irrigation water available for some 39,200 hectares in the Project Area, of which about 33,800 hectares are planned to carry our the double cropping.

(b) Kaing Land: The land of this kind extends mainly along the Irrawaddy River and cultivationis easily practised there because of the sandy soil prevailing in the recent alluvial soil. In the wet season, there is a flood coming over the land, and in the sesamum is grown before the flood. After the water sinks completely, the lands are cultivated with groundnut, pulses, chillie, and Burmese tobacco as winter crops.

The Kaing land does not occupy so large part in the Project Area. Nutrient substances annually flooding into the land have allowed to carry out non-fertilizer farming to produce a considerable yield.

(c) Ya-land: The Ya-land develops in the slopes of piedmont area and upland fields at the plateau, generally being cultivated with only monsoon crops owing to its property of good drainage. Mainly single cropping or mixed cropping by sesamum, pulses and cotton (local variety) are grown, and in some part, pulses are grown after harvesting early sesamum.

In the first year after land development, yield is rather high, however, since continuous cropping reduces the fertility of lands, sometimes the shifting field method has been employed. There are some perenial crops like fruit-trees found in this kind of land.

The Ya-land develops mainly on the left bank of the Irrawaddy River but occupies only a small part in the Project Area.

(3) Some findings on Major crops in the Project Area

(i) Paddy

The annual rainfall of the northern part of the Project Area is not necessarily sufficient to rainfed paddy production. As the rainy season is over in October when the late matured variety is still in ripening stage, and the surface of paddy fields goes dry, so that the paddy may result in incomplete mature at

harvesting. Therefore, further investigation is required in this respect. The early matured variety growing will make it sure to be fully matured and HYV growing will make it more sure to produce much better yield.

The ratio of broken rice after milling ishigh and the causes of this are considered as,

1) Improper way of paddy drying,
2) Over matured harvesting, and
3) Poor facilities of rice mill.

It is desirable to take adequate counter-measures for the above facts.

Varietis which have less shattering habit are apt to be harvested in over-mature, because those are not easy to be threshed by the traditional method when harvested just at the matured time.

The Government encourages the farmers to grow HYV or LIV (Local Imporved Varieties) and apply the improved techniques including fertilizing and pest-control so that the higher unit yield per acre can be obtained. In Taikkyi, as mentioned below, thereare five High Yield Centres established which give farmers the intensive guidance of improved techniques and have succeeded in paddy production increase to a considerable extent.

The share of cropping acreages of HYV and LIV in 74 villages covered by these High Yield Centres in 30 per cent and 38 per cent respectively, in 1977-1978. In the neighbouring Tharrawaddy Townships, however, the HYV and LIV will be introduced in 1978-79. The positive guidance and assistance by the Government will make it possible to carry out the successful extension in the line.

For references, the LIV seems more easy in extension works than the HYV from the view point of taste and preference of consumers.

(ii) Groundnut

There are four types included in the groundnut cropping pattern, that is, cropping for pre-monsoon, monsoon, late-monsoon and winter, and the winter groundnut cropping prevails in the Project Area.

Most of winter groundnut is grown after paddy harvesting, and some are cropped in the Kaing lands. The growth of winter groundnut, however, can be more favourable than at present if irrigation is applied.

It is urgently needed to introduce the desease resistant varieties in considering the fact that there are many occurrences of leaf spot on the plants.

(4) Some technical problems on the intensive crop production

(i) Multiple cropping

The reason why the multiple cropping is reluctantly extended is that the absence of water utilization

facilities make it difficult for farmers to grow the winter crops after paddy, and their harvest to be uncertain. The Government has employed tractors for land preparation of the paddy field for second crop sowing immediately after paddy harvesting. However, the tractors owned by Government or Co-operatives have been mostly time-worned by long operation and yet the spare parts for repair are short in quantity. On the other hand, the bullocks have not increased in number so quickly.

(ii) Paddy double cropping with irrigation facilities

Varieties and cropping time of winter cropping paddy should be carefully decided lest the larvesting season should last into the rainly season.

The present winter cropping paddy has an estimated growth duration of 125 - 135 days.

The cropping pattern should be established reasonably in taking into account the rainfalls after harevesting, high temperatures in April and floodings.

(iii) Intensive cropping

As multiple cropping and high yielding culture are carried out, much application of fertilizer, introduction of disease resistant varieties and adequate pest control are essentially required. Naturally, the improvement of thechniques, their extension and guidance should be strengthened intensive cropping.

The further studies and analyses are required for establishing proper measures to meet the local conditions and requirements in the country, although there would be various ways and means considered for solving the above problems.

(5) Land Tenure

All cultivated land in Burma is owned by Government. No farmer is allowed to sell or buy the farm lands. This institution leaves very limited rooms for any farmer to enlarge his farm land to get the most remunerative size of holdings.

On the other hand, this land tenure institution ensures every farmer the necessary certainty of tenure which is fundamentally important factor for the development of agriculture. In the interview with several farmers, any anxiety could not be found among them with regards to their land tenure. But at the same time, no stron will could not be seen among farmers to invest in the improvements of the land, for instance, minor irrigation and so forth.

Some of the Township area visited, is included in the irrigable ara of the proposed irrigation projects by Government. When secondary or tertiary canals are constructed together with the land consolidation in these area, there may be some substitution of farm land necessitated. In this case the present land tenure institution may be conductive to this land substituiton programme because all land is owned by Government.

(6) Size of Holding

When compared with the average size of holding of about 2.2 hectares in the whole of Burma, that of those Townships visited is a little smaller.

The figure of the size of holding in whole Burma shows that about thirteen per cent of the farms is larger than about four hectares and they cover about 42 per cent of the cultivated land. Big farms more than about 40 hectares are negligible in number of farms and their coverage.

These figures show that land distribution among farmers is rather even, and the number of landless worker seems very small.

These conditions are rather favourable for introducting the intensified technology after the development of water resources.

(7) Paddy Procurement and Advance System

Compulsory paddy procurement and the Advance System are the mainstary of the agricultural administrative framework.

With regard to the transportation, milling and storage, there are so much to be done for the improvements of these facilities. These improvements will be studied in more detail in future study of the Master Plan.

Quota and procurement price are very important but difficult policy framework. In the Township where the high yield varieties have been introduced by the Government

institution (High Yield Centre), the quota has been increased about 50 per cent in one year. This increase in quota seems to be very sharp and may have some unfavourable effect on the extension of the high yield varieties.

(8) Paddy High Production Programme
(Whole Township development Programme)

The very intensive project of increasing the production of paddy not only through the introduction of the high yield varieties but also by disseminating the improved agricultural techniques by five camps have been promoted in Taikkyi Township.

The increased application of fertilizers and insecticides, and the increased number of village managers are the principle features of this programme.

It started from the very limited acreage in 1975 and in 1977 it covered the whole Township area of about 53 thousand hectares. In the year of 1977-78, this whole Township development programme of Taikkyi has raised the net profit of about 12.5 million Kyats with the input increment of about four million Kyats, or which three million Kyats was invested by farmers. This programme is very encouraging instance which tells the very important role to be played by the extension activities.

The demonstration of the improved agricultural techniques to farmers through the increment of personnel of extension and of input material has proved its effectiveness of increasing the production of paddy.

The Government of Burma has the plan to set up this paddy high yield production programme in 21 township in whole Burma, including three in Okpo, Henzada and Kyonpyaw in this Project Area.

This type of development of extensions together with the development of reserch would be suitable for the international projects of technical and financial co-operation.

(9) Data Collection

The statistical data with regard to agriculture are available only in the national level and divisional level. Those of the Project Area must, therefore, be collected anew, because there are Townships comprising of one Township of Rangoon Division, fourteen of Pegu Division (West) and nine of Irrawaddy Division in the Project Area. The statistical data of these 24 Townships are now being collected through the Agriculture Corporation. Data collection by the team has been proceeded to a certain extent and the agricultural statistical data shall be completely collected by the folloing survey team to conduct a supplemental survey and analysis.

IV-4 Irrigation

(1) Existing irrigation systems

According to the Irrigation Department and field survey, there exist no irrigated fields in the Project Area, except some minor village irrigation works which are currently rainfed. If the irrigation water is supplied to these fields, the second cropping in the dry season will be available with paddy, seasmum, groundnut, etc. to increase farm production.

(2) Proposed irrigation project

The Irrigation Department has one on-going project and fifteen proposed projects in irrigation programme on the light bank of the Irrawaddy River. The former is located at the east of Prome, involving those townships of Prome, Paukkaung, and Thegon, and scheduled to be completed in 1981-82 by the Irrigation Department. The project components are an earth dam with length of about 1.6 kilometers and gross storage capacity of about 360 million cubic meters, and irrigation and drainage networks serving irrigable areas of about 39 thousand hectares. Completion of the project will allow the irrigable areas to be converted into the double cropping areas. (Refer to Appendix)

The latter, fifteen projects prepared by the Irrigation Department, aims at irrigation some portion of land potentiality of about 400 thousand hectares that have more potentialities to produce much farm products.

After completion of these projects, the related areas will be able to supply Rangoon, the capital of the country, and other many municipalities with agricultural products.

The other irrigation systems than those mentioned above will be planned to employ the pumping irrigation method. The locations of the pumping stations along the Irrawaddy River, however, require further surveys and studies in taking into account the considerable river course shifting due to floodings in the rainy season.

IV-5 Flood and drainage

River dikes have been constructed long before in some area along the Irrawaddy River. A flood water from the Irrawaddy River sometimes flows over the dikes and it causes the destuction of the dikes. When the dikes were destructed, the new dikes have been reconstructed in the behind of the destructed ones. The dikes are used as roads and are connected with villates which are established on thenatural levees.

The Myitmaka River is an old reiver course of the Irrawaddy iver, running down the lowest parts of the area. An inundation along the Myitmaka River has been caused not only by the flood discharge from the catchment area itself but also by the overflow discharge from the Irrawaddy River. The inundation water cannot be drained in a short time. Swamps can be found in the lowland area along the Myitmaka River even in the dry season.

In order to grasp the existing condition of inundations and also to provide for the analysis of the future flood control methods, the longitudinal and cross sectional profile of the Myitmaka River and the topographical map of the inundation area will be required. Observation of the water stage of the Myitmaka River will be required at the several important points from a hydraulic and hydrological aspects and field survey must be carried out during a flood season.

A mathematical model can be considered most suitable to simulate the total system of the hydrological and hydraulic pehnomena which consist of such sub-systems as rainfall, run-off, flood inundation and drainage. In this simulation, the flood control effects of the proposed fifteen reservoirs and such hydraulic structures as dikes, gates, pumping plants and retarding basins, if necessary, can be fully taken into account, and most effective flood control measures can be sought out by using an electric computer.

IV-6 Road Conditions

In the left bank of the Project Area, the asphalt-paved two-lane national road linking Rangoon with Mandalay runs from north to south through almost the center of the Area. However, other connecting roads, township roads and farm roads, have been poorly provided in physical conditions as well as density of networks.

Under the situation, transportation of agricultural inputs and outputs takes so long time andmuch labour. Particularly in the rainy season, muddy roads largely prevent inhabitants from not only doing smooth transportation but also positive social activities and production activities.

In the right bank area, the Ministry of Construction has started some construction works at Insein for national road linking Insein with the northern areas via Thongwa, Henzada and Okshipin, and other national road construction project has been completed to link Shwebontho with Sandwa traversing over the Arakan mountain range. Poor farm road system can be found in the ara.

It will be necessary to formulate a rural development project by establishing functionally connected networks of township roads and farm roads.

For inhabitants in the both banks of the Irrawaddy River, boats are the only means of transportation to haul the daily necessities and farm products because of no bridge available over the river.

Therefore, the improvement of living enviroment of the inhabitants requires to provide a bridge over the river. A construction site of the bridge should be determined after careful study on how the bridge can contribute to welfare of majority of the people by environmental improvement and farm product distribution, in taking account the characteristic features of the river and technical and economical feasibility as well.

IV-7 Mapping

All maps to cover whole area of the country are prepared and controlled by the Survey Department. At present, there are three kinds of maps in different scales(*1) and the maps for the proposed Project Area are vailable in those three kinds.

All of those maps, however, were prepared in 1940's and the scale is indicated on the yard system, that is in inch and mile. The Survey Department has been making rectification of locations of road, rivers, etc. on the basis of aerophotos taken in 1972.

The Master Plan Study requires the maps on a scale of about 1/250,000. The Survey Department will be able to develop the required scale maps for the Project Area within 1978 by rectifying the existing ones. Such rectification and mapping works will be carried out by the Survey Department in accordance with priority the Government takes.

Notes: (*1)	Inch Map	Scale:	1: 63,360
	Half inch map		1:126,700
	Quarter inch map		1:253,400

V. FORESTRY

The forest of the Project Area covers the area along the western Pegu and eastern Arakan mountains ranges and occupies 70 per cent of the whole Project Area. Most of the forests are mixed decious forests made up mainly of teak and hard wood trees. The teak largely grows on the hilly region of the Pegu mountain ranges and the other hard-wood trees mostly grow on the Arakan Mountain ranges.

The reserved forest which has been properly and strictly managed comprises of 38 per cent of the whole forest area. When compared with the average 25 per cent of the whole Burma, this is the region where forests are well cared and managed.

Moreover when viewd from the percentage to the forest data of this region to that of the whole country, in the Project Area the percentage of production of teak wood is fairly high and it is also a very important part of the forest industry as it has the capacity and possibilities of development of hard wood trees apart from teak.

(1) Findings

(i) The condition of the forests of Teak Selection working circle and Hard Wood Selection working circle is good and the area can be described as a close forest which means the land is almost all covered with forest trees without any bare land.

(ii) This is due to the fact that the selected felling of trees has been executed according to the principle for a long time and it can be considered as an indication of the appropriate forest management and the forest operation-technique of Burma.

(iii) The proposed dam site is located in that region of the forest which has been preserved in such a very good condition and the catchment area is the forest land which has an efficient function of water regulation.

(iv) Forest reguneration has been conducted mainly by natural regeneration along with Burma's selected forest-cutting system. But in those forests where forests stock is very low, planting of trees is carried out as a measure of artificial regeneration in order to replenish them. This technique brings good result and has been practised throughout a long history. The species of trees are mainly Teak and Pyinkado. It is presumed that the planting of such species will keep the forest in a very good condition.

(v) The forest pretty downstream of the proposed dam site is supposed to be public forest mainly for extraction of wood for private construction of local houses. Hence the forest stock of this part is rather low. Recently the planting of quick growing species such as Eucaliptus is speeded up. It is found that such kind of forest is efficient showing good result, for it can meet the local communities' demand for forest produce.

(vi) Therefore considering the above points, it can be noted that in future the water-regulating function of the forest in the river basin and in the catchment area upstream of the dam site as well will be evidently maintained and improved.

(2) Forest working plan

The system of forest working planning is roughly as follows:

(i) As the result of the long time investigation the working plan of the forest has been formulated and established with due consideration on the forest growth and ofrest type and stock, and in accordance with this plan the proper forest management is executed.

(ii) A ten year forest working plan is made in each administrative divisional area and this is a long time system which is renewed every ten year.

(iii) The contents of the working plan and their system and the application of the sampling technique for forest investigation and the forest management map etc. are exactly the same as the system of the working plan and forest investigation of Japan.

And the forest working plan has much to do also with the development in other fields such as agriculture, industry, etc., with the overall development of the whole Project Area.

(3) The constraints and problems

(i) limited mechanization and thelack of cable logging techniques

(ii) rough forest roads network

(iii) poor nursery equipment

(iv) old and inefficient milling plant

(v) mechanization of plantation establishement.

To overcome the above mentioned constraints and problems, the investigation and study with regard to the following item may be useful.

(i) To review the forest working plan of the Project Area.

(ii) To improve nursery.

To have the contral model nursery for the improvement of seedling production techniques including srinkler system, the introduction of more exoitic quick-growing species and the training of technicians.

(iii) To make the processing and distribution of timber more efficient.

To have the model milling plants for the improvements of the processing and manufacturing technique.

(iv) To make the forest road network more intensive.

(v) To increase the acreage of plantation establishment, it is necessary to provide machinezies and equipment for its mechanization.

VI. FISHERY

According to the field survey, there are the following three type of fish production practised in the inland areas:

(1) River fishing

Irrawaddy River: In the dry season, gill net fishing can be seen at Henzada port. In the rainy season (June - August) tow species of Indian carp fries are caught with bag nets in the River where phtoplanktons are abundant.

Daka River: Cast net fishing can be seen at Kyanpyaw Township. Water hyacinth is growing on the both river-sides.

(2) Leasable fishing

Inyegyi Lake: The lake is linked with the Daka River by narrow channel. An estimated area ia about 700 hectare. The People's Pearl & Fishery Corporation is managing fishery at three fishing points with gill nets, trap nets and cast nets from production to sales. Annual production is about 60 tons of fish, in which Indian major carps are main species. The lake, where phtoplanktons are abundant, seems to rpovide a good fishing ground.

Duya Lake: This is a horn-shaped lake. The Fishermen Production Co-operative produces about 25 tons of fish in year. Water vegetation is so thick that big fishes can hardly be caught with existing fishing methods by various nets, although many big fishes are found. The lake, where photplanktons are abundant, seems to provide a good fishing ground.

Ragwinpyin River: Trap net fishing is available only in a period from September to December.

(3) Fish Culture

Kanzu village fishpond: The fish pond is operated by Kanzu Village near Inyegyi. An estimated area is about 0.6 hectares. Indian major carps caught in Inyegyi Lake are released to this fish pond, and about 500 kilograms of fish were harvested. Rice bran is given as a supplemental feed.

Private fish pond near Rangoon: An estimated total pond area is about 1.2 hectares by eleven ponds. Indian major carps fries are released in the rainy season and two years later fish weighing about two kilograms is caught and sold to Rangoon wholesalers. Rice bran and peanuts cake are given as supplemental feeds. Water is fertilized with cattle feces. Annual production is about sixteen tons.

River fishing and leasable fishing are very important in this country. The fish from inland water has been indispensable protein source for the habitants. According to the Department of Fisheries, annual flood of Irrawaddy River is an essential factor for natural fish production. So it is considered necessary that the harmony must be kept between agricultural developments and fishery in the Master Plan Study of the Project.

The Department of Fisheries stressed the necessity to resolve the following three problems:

i) Improvement of fishing ground

ii) Control water hyachinth

iii) Increase of seed production, especially Indian major carps.

A careful study should be made on possibility of fish culture programme in the use of such agricultural facilities planned in the Master Plan as reservoirs, farm ponds and canals.

The findings on the existing fish culture facilities and water quality of the rivers revealed that there was no harmful factors of the water quality to the fish culture. The results of water quality measurement was illustrated in the Appendix.

VII. PRIORITY FOR THE PROPOSED DAMS

To give a priority for the commencement of Feasibility Study for the dam construction in the Project Area, the reconnaissance survey has been carried out for five proposed dam sites which were selected from fifteen potential dam sites by the Irrigation Department in considering their basic priority. (Locations of the potential damsites are shown in the attached figures in the end of this chapter.)

VII-1 Result of the Reconnaissance Survey

As far as the reconnoitered damsites are concerend, it can be said that the topographical and geological conditions and availability of embankment materials are fairly similar to the followings.

The proposed damsites are located in the hilly region where the flat plateau is well spread withundulation.

The river meanders through the hilly region to the west where a comparatively narrow valley is carved in the bed rock formation with the maximum height of both banks by about 40 meters above the river bed.

The foundation rock of the proposed dam sites is composed of the alternation of shale and sandstone of the Upper Miocene to Pliocene, however, the distributed proportion of the aforesaid rocks varies in places.

The lithologic character of the bed rock at the proposed dam sites is almost fine grained medium hard to soft, comparatively massive and with less fructures.

Since there are no large faults but a few major joints at the proposed damsites, the permeability of bed rocks is in rather lower order of $nx10^{-5}$ centimeter per second and this figure shows the bed rocks are generally impervious.

The prevailing strike and dip at the proposed damsites is in north-south direction and 20 degree to 30 degree toward downstream respectively.

As for the embankment materials, a suitable borrow areas consisting of residual clayey soil originating from the shales are found abundantly around the proposed damsites for the use of the impervious fill.

However, the pervious fill and concrete aggregate materials are not distributed near the damsites. The sandy materials consisting of closed fine grain originating from the sandstone is not suitable as the embankment material of fill dam for avoiding the liquefaction and quicksand.

As a result, a homogeneous type fill dam is most suitable for the proposed damsites in this case, and the height of dam may be limited to less than 35 meters according to the topographic condition and soil mechanics of the embankment materials.

The foundation rocks at the proposed damsites seem to have sufficient lithological character such as bearing capacity and shearing resistance to construct the fill dam with height of less than about 35 meters, and also it is probably free from the seepage problem without taking any specialcounter measures for the leakage in reservoir except otherwise specifically mentioned.

The summary for the reconnoitered damsites are described as follows: (Detailed descriptions of damsite geology for the proposed dams except Okkan and Kadin Bilin are seen in collected data which were drew up by Engineering Geologists of the Irrigation Department.)

No. 4 OKKAN Damsite (Okkan Chaung, Catchment area: 207.2 sq.km)

The proposed Okkan damsite is located on the Okkan Chaung, it is about 300 meters downstream from the confluence of the Okkan and Dat Chaung where the comparative narrow valley is carved in the shale formation.

The topographic survey and geological investigations are now on going in the site in February, 1978, and finally total ten bore holes (total drilling length about 135 meters) will be drilled around dam axis. The width of the river bed is about 20 meters at the site and the slope angle of the right bank is about 30 degrees, contrarily the left bank about 15 degrees. Both banks have the same height of about 35 meters from the river bed and thier upper parts become flat; however, on the right bank, there is a narrow saddle where a small dike should be constructed. The flat plateau is covered with varying thickness residual clayey soild originating from decomposition of the alternation of shale and sandstone formation. Alluvial deposits along the river bed around the proposed damsite are generally scarce.

The foundation rock of the Okkan damsite is mostly composed of shale with conformity belonging to the Pegu Series. The outcrop of shale is distributed around the river bed and almost of the right bank. However, on the left bank, the weathering depth seems to be rather thin. The prevailing dip in

this site is nearly 30 degrees toward donstrea.

The shale formation is comparatively sound, massive, with less fructures, and generally impervious. As far as the results of pressure permeability tests on the river bed, are concerned the permeability of shales are in rather lower order of $nx10^{-5}$ centimeter per second.

According to the above mentioned facts, the shale formation in this site seems to have sufficiently lithologic characters such as bearing capacity and shearing resistance to construct either the fill type or concrete gravity type dam with height of about 30 meters, and also it is probably free from the seepage problem without taking any special counter measures for the leakage in reservoir.

As for the embankment materials, a suitable borrow area for impervious material is found abundantly around the damsite, and also the rock material for the use of the riprup is distributed about two kilometers of the upstream of the damsite; however the filter and concrete aggregates are not distributed near the damsite.

A homogenous type of earth fill dam appears most suitable to this site taking into account the topographical condition and embankment materils available around the damsite.

No. 13 Thegaw Damsite (Thegaw Chaung, a tributary of Kadin Bilin Chaung, Catchment area: 90.7 sq.km)

The proposed Thegaw damsite is located in a hilly region adjacent to the alluvial plain, about 250 meters down stream from the confluence of small stream of the Shawdon and Hmya Chaung where the valley is well-developed along the river course.

The topographic survey, geological investigations and soil tests had been conducted from 1975 to 1977 and total ten bore holes (total drilling length about 270 meters) with permeability tests were drilled along the dam axis. The bottom width of valley is about fifteen meters at te site and the slope of both banks is very gentle of about fifteen dgrees angle. Height of the both banks is almost 20 to 22 meters above the river bedn and their summits become flat with rolling.

An area around the damsite is covered with residual sandy with varying thickness and comparative dense vegetation. Alluvial deposits in and around damsite are, in general, found scattered in small scale. The foundation rock of the Thegaw damsite is composed of the alternation of shale and sandstone belonging to the Pegu Series.

The outcrop fo aforesaid formation is distributed around the river bed; however, in the slope and summit of both banks, the weathered portion is rather thick in comparisen with the expected dam height of about 20 meters. The prevailing dip in this site is nearly 20 degrees toward downstream.

The fine grained medium hard to soft bluish sandstones predominate in this site, in which the silt and hard calcareous snadstone are found interbedded. There are few major joints and minor fructures in the site; however the permeability of bed rock is normally impervious except the weathered sandstone portions. Since the both abutments consist of weathered sandstone layers, the curtain grouting should be considered in order to obtain an impervious curtain within the dam foundation rock. According to the results of permeability test, the weathered bed rock layer is in rather higher order range from

6.1×10^{-4} to 8.0×10^{-5} centimeter per second and the fresh bed rock layer is in order below 3.3×10^{-5} centimeter per second.

As regard to the embankment materials, a suitable borrow area for impervious materials which is classified into CL group by Unified Soil Classification System is found in abundantly in a haulage distance about two kilometers from the damsite. However there are no materials for the use of the pervious fill and concrete aggregates in the vicinity of the damsite.

The most suitable dam type in this site is evidently homogeneous type fill dam, judging from the topography and available embankment materials near thedamsite.

No. 14 Kadin Bilin Damsite (Kadin Bilin Chaung, Catchment area: 155.4 sq.km)

As a result of reconnaissance survey, it seems to be difficult to find the damsite applicable to dam height more than around 35 meters between Natthami community and confluence of the Kadin Bilin and Ngapyawdon Chaung. However, the field survey could find a site with a height of about 30 meters available near the upstream of Natthami community. A rough topotraphical survey will be carried out in order to select the difinite and most adequate damsite in considerint the case to give high priority to this site. The folloiwng description is concerned with the finding of damsite which is located about 1.7 kilometers downstream from the confluence of the Kadin Bilin and Ngapyawdon Chaung. The possible damsite is located in the hilly plateau near alluvial plain hwere the comparative sharrow valley is carved in the alternation of shale and sandstone formation.

Neither topogaphic survey nor geological investigation has been carried out in this site.

The bottom width of valley is about 20 meters at the site and the slope of both banks is considerably steep at about 30 degrees angle. Both banks have the same height of about 30 meters from the river bed and their summits become flat.

The hilly plateau is covered with residual clayey soil and comparatively poor vegetation. Alluvial deposits along the river course near the site are generally scarce.

The foundation rock of the Kadin Bilin damsite is composed of the alternation of shale and sandstone belonging to the Pegu Series.

Outcrops of the aforesaid formation can be seen at the both banks and around river bed; however, in the top of slope and flat plateau of both banks, the weathering depth seems to be rather thick. The prevailing dip in this site is nearly 20 degrees toward downstream.

The fine grained comparative sound grayish sandstones predominate in the site and this formation is mostly massive, having less joints, and considerably impervious. However, the upper part of the valley consists of weathered sandstone and shale layers in the thick, and it may be required to take some counter measures for the leakage in reservoir.

As for the embankment materials, a suitable borrow area consisting of residual clayey soil originating from the shale formation is found around damsite for the use of the imprevious fill. However, the pervious fill and concrete aggregate materials are not distributed near the damsite. A homogeneous type

earth fill dam will be most suitable on this site taking into account the topographical limitation of the dam height and the quality and quantity of the available embankment materials around the damsite.

However the above mentioned type is only applicable to dam of less than about 30 meters in height, while for higher dam more than about 35 meters, a zone fill dam would be considered suitable for avoiding the effect of pore pressure and dimnishing the embankment volume.

No. 15 South Nawin Damsite (Middle Nawin Chaung, Catchment area: 642.3 sq.km)

The proposed South Nawin damsite is located on the Middle Nawin Chaung, about 100 meters downstream from the confluence of the Dingyi and Alenawin Chaung, where the comparative wide valley is carved in the alternation of shale and sandstone formation.

The topographic survey, geological investigation and soil tests had been carried out from 1974 to 1976, and total 34 bore holes (total drilling length about 1,020 meters) with permeability tests were drilled along the dam axis, and also total eight sample materials from the proposed borrow areas were tested in the laboratory of the Irrigation Department.

As a result of reconnaissance survey, the ready-aligned dam axis on the valley has been shifted to about 200 meters downstream to avoid the improvement of permeability for the gravel and sand layer which is spreaded in limited range at the left band of the valley and it seems to be difficult to obtain an impervious curtain in the layer.

The bottom width of valley is about 30 meters at the site and the slope of left bank is very steep at about 45 degrees, contrarily the right bank about 30 degrees,. Height of the both bank is, for the most part, 30 to 35 meters above the river bed and their top becomes flat with rolling.

The area around the damsite is covered with residual sandy and sility soil with varying thickness in rather thin and comparatively poor vegetation by timbers and scattered bushes. Alluvial deposits near the damsite are seen in the valley with shallow depth; however at the left bank near the valley, old river deposit of gravel mixed with coarse sand is underlaid about 25 meter thick at maximum, and fortunately the distribution of gravel layer is limited in a small scale.

The foundation rock of the South Nawin damsite is composed of the alternation of sandstone and shale belonging to the Pegu Series; however loose Irrawaddian Series sandstone is exposed about 1.2 kilometers west of the damsite. The outcrop of Pegu Series rocks is found unly upstream of the river bed in a limited extent and the other area is covered with residual clayey soil in the thickness of one to six meters around the damsite. The prevailing dip in this site is nearly 20 degrees toward downstream.

The fine to medium grained and almost weak sandstones predominate in this site, in which 1.5 to 4 meters thick of the shale bands are alternated. The compressive strength of sandstone is considerably low in the range of ten to 20 kilogram per square centimeter. Fractures in the sandstone decrease in depth of 1.5 to 3 meters, and below 3 meters it becomes less fractured. Since the left abutment lines down the weathered sandstone layers, the shallow curtain will be required inorder to obtain an impervious curtain within the dam foundation rock.

The results of permeability test reveal the permeability coefficient of the sandstone layers vaires from 4.8×10^{-4} to 3.9×10^{-5} centimeter per second in accordance with the weathering condition.

According to the geological profile along the dam axis, two minor fold axis of the anticline and suncline structure are assumed on the left bans where the acting water head is very low. However, these places seem to have some problems for the leakage in reservoir and adequate counter measure should be considered.

As regard to the embankment materials, a suitable borrow area for impervious materials is found abundantly near the damsite. Eight samples have been carried to the soil laboratory of the Irrigation Department, where the physical and dynamical tests were performed.

On the other hand, there are no materials for theuse of the pervious fill and concrete aggregates in the vicinity of the damsite.

Themost suitable dam type in this site is evidently homogeneous type fill dam, judging from the topographical and geological condition, and available embankment materials near the damsite.

No. 2 Wegyi Damsite (Magyi and Shabaung Chaung, tributaries of Shwele, Catchment area: 531.0 sq.km)

The proposed Wegyi damsite is located in a hilly region of the mature topography, about 300 meters upstream from the confluence of the Magui and Shabaung Chaung where the rivers

are well developed in U-shape valley along the meandering river courses. The dam axis passes through the two tributaries such as the Magui Chaung on the right side and the Shabaung Chaung on theleft side.

The topographic survey, geological investigations and soil test had been carried out from 1972 to 1974 and total fourteen bore holes (total drilling lengthabout 645 meters) with permeability test were drilled along the dam axis. Around the damsite, the topography generally represents valley with parallel homoclinal sandstone. This complicated topography has been caused mainly by the intensive epirogenic movements, different lithology and physical characteristic of bed rocks. At the Magui Chaung, the bottom width of valley is about 40 meters at the site and the right bank is considerably gentle, where the flood plain terrace were found with maxium thickness about nine meters.

On the other hand, the left bank slope is very steep having no extension of the terrace. In the Shabaung Chaung, the bottom width of valley is narrow by about ten meters at the site and the slope of both banks is comparatively gentle.

Since the area around the damsite is covered by alluvial and residual clayey or silty soil of varying thickness, the distribution of outcrops is limited on the river beds except a few places at the river banks. The top of hilly range is well covered with the residual clayey soil with thickness fainging from three to fourteen meters originating from the alternation of shale and sandstone. The holding portion between both Chaungs is a slightly high terrain covered with mainly silty sand with depth about seven meters.

The foundation rock of the Wegyi damsite is composed of the alternation of shale and sandstone belonging to the Pegu Series. The upper portion of the bed rock consists of silty sandstone with thin shale layers and the sandstone is slightly hard and compact. In gneral the bedding and joint planes are tightly closed at the upper portion; however, the weathering depth sometimes reaches about sixteen meters and the rocks become more soft. The lower portion of the bed rock is represented by argillaceous shale with a few sandstone bands, and the opening of joint fructures are mostly narrowly closed with clayey materials. Minor folds and local changes in dip angle are found at someplaces in the bed rock; however, there are no supporting evidences of the existence of major faults around the damsite, but many liner folds are found.

The prevailing dip in this spite is nearly 20-40 degrees toward downstream.

According to the results of permeability tests, the weathered bed rocks are in rather higher order ranging from 8.4×10^{-4} to 2.9×10^{-5} centimeter per second in accordance with weathering condition; however, the fresh bed rock is in the order below 1.9×10^{-5} centimeter per second. In general it is concluded that some of the fresh and slightly weathered rock in this site could be considered as practically impervious layer.

However, since the both abutments and the portion held between both Chaung provide the weathered sandstone layer, an adequate counter measure such as replacement or grouting method should be considered to keep the water tight.

As for the embankment materials, a sutiable borrow area for impervious fill which is classified into CL and ML groups by Unified Soil Classification System is abundantly around the damsite. However there are no materials for the use of the pervious fill and concrete aggregates in the vicinity of the damsite. The most suitable dam type in this site is homogeneous type fill dam, judging from the topography and available embankment materials near the damsite.

VII-2 Economic Evaluations

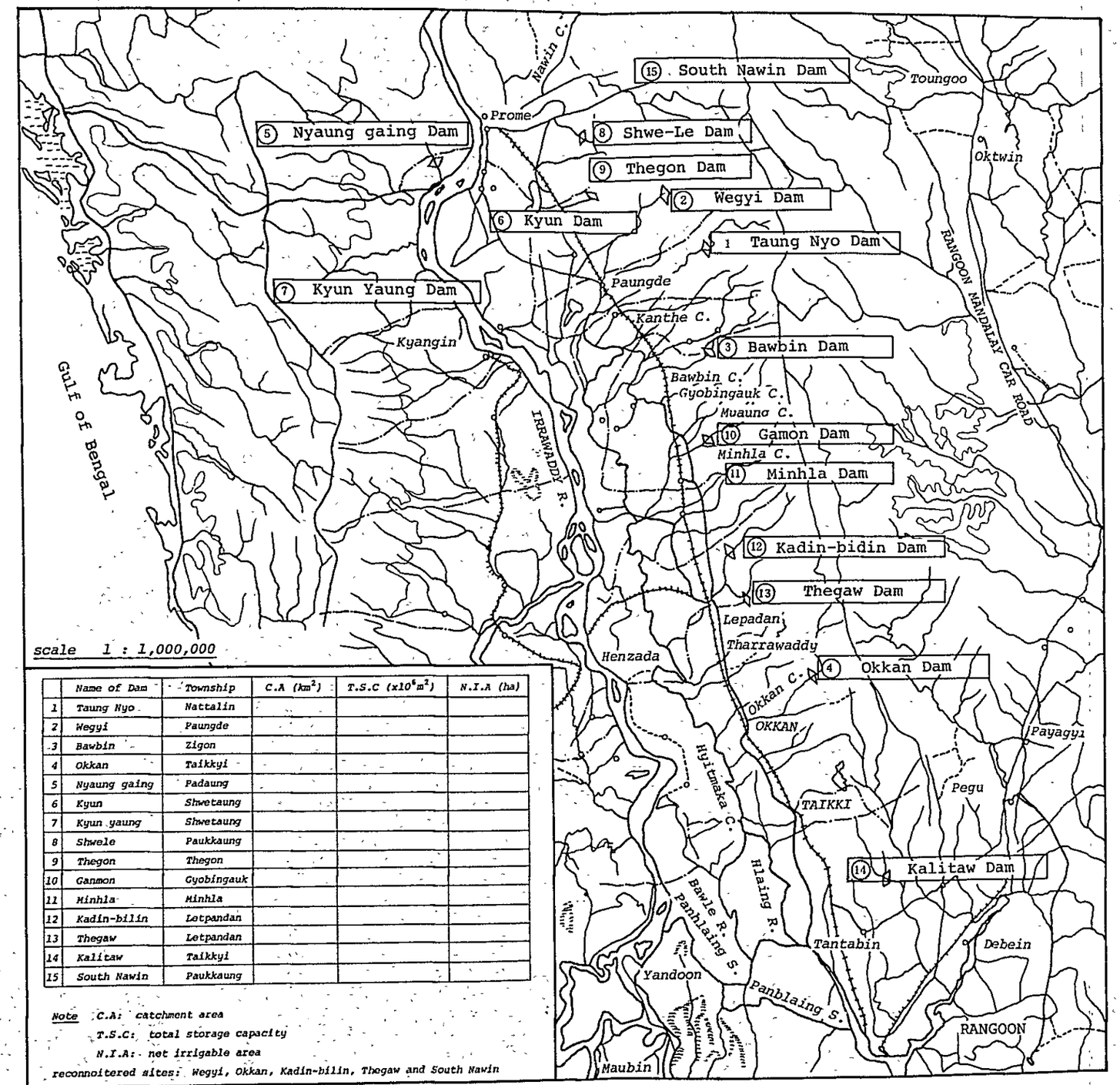
On the economic evaluation for giving priority to the commencement of Feasibility Study for the dam construction in the Project Area, a primary study has been carried out by the Irrigation Department from the view point of irrigation water supply. As far as the reconnoitered dams are concerened, there are no major problems in regard to constructing the dam in the proposed damsites from the view point of engineering geology.

Therefore, the priority evaluation is mainly carried out based on the results of primary study from the view points of storage capacity, irrigation area, project cost. B/C ratio and internal rate of return, in considering the irrigation water supply. And the relevant result is shown in the following table.

It is learned from the above-mentioned table that a higher priority will be given to No.4 Okkan dam, No.15 South Nawin dam and No.2 Wagui dam from the aspect of the irrigation water supply, and these results are reasonable in comparison with the commenced constructionof North Nawin dam, Sedawgyi dam and Nyaunggyat dam.

As mentioned above, it is recommended that the observation equipment such as automatic water level recorders, automatic rain gauges, evaporation pan and etc. should be provided for further studies and analysis.

LOCATION OF POTENTIAL DAM SITE



scale 1 : 1,000,000

	Name of Dam	Township	C.A (km^2)	T.S.C ($x10^6 m^2$)	N.I.A (ha)
1	Taung Nyo	Nattalin			
2	Wegyi	Paungde			
3	Bawbin	Zigon			
4	Okkan	Taikkyi			
5	Nyaung gaing	Padaung			
6	Kyun	Shwetaung			
7	Kyun yaung	Shwetaung			
8	Shwele	Paukkaung			
9	Thegon	Thegon			
10	Ganmon	Gyobingauk			
11	Minhla	Minhla			
12	Kadin-bilin	Letpandan			
13	Thegaw	Letpandan			
14	Kalitaw	Taikkyi			
15	South Nawin	Paukkaung			

Note C.A: catchment area
T.S.C: total storage capacity
N.I.A: net irrigable area
reconnoitered sites: Wegyi, Okkan, Kadin-bilin, Thegaw and South Nawin

EVALUATION TABLE OF PRIORITY FOR PROPOSED DAMS

Dam Name	Location		Catchment Area (Km^2)	Total storage capacity Million Cum	Net Irrigable Area (ha)	Dam Dimension			Project cost (XIDUS$)	Net agricultural Benefit (XIDUS$/Year)	Economical Evaluation			Technical Judgement	Remarks
	Division	Township				Height (m)	Length (m)	Volume			B.C. Ratio	IRR (%)	Unit costs (US$/ha)		
1. Taung Nyo 2)	Pegu	Nattalin	551.7		20,250	30.5	914		10.71					C	Reconnoitered Higher Priority
2. Wgyi 2)	Pegu	Paungde	531.0		24,300	30.5	1,067		12.86						
3. Bawbin 2)	Pegu	Zigon	261.6		24,300	18.3	1,524		12.86						
4. Okkan 1)	Pegu	Taikkyi	207.2	204.42	17,820	25.9	701	387.1	12.89	6.89	9.50	24.5	723.1	A	Reconnoitered Higher Priority
5. Nyaunggaing 2)	Pegu	Padaung	90.7		1,013	18.3	762		0.54						
6. Kyan 2)	Pegu	Shwedaung	72.5		4,050	13.7	2,434		2.14						
7. Kyung Yaung 2)	Pegu	Shwedaung	64.8		2,025	12.2	1,219		1.07						
8. Chwe-Le 2)	Pegu	Paukkaung	75.1		1,013	13.7	1,067		0.54						
9. Thegon 2)	Pegu	Thegon	51.8		2,025	12.2	914		1.07						
10. Gamon 2)	Pegu	Gyobingauk	95.8		8,100	18.3	1,219		4.29						
11. Minhla 2)	Pegu	Minhla	27.7		8,100	15.2	914		4.29						
12. Kadin Bilin 1)	Pegu	Lepadan	155.4	175.78	17,010	38.4	265	392.9	12.47	6.58	9.40	24.3	733.2	C	Reconnoitered
13. Thegon 2)	Pegu	Lepadan	90.7	82.09	7,290	21.7	1,646	343.3	6.37	2.82	7.99	19.0	901.4	B	Reconnoitered
14. Kalitaw 2)	Pegu	Taikkyi	51.8		2,025	10.7	1,981		1.07						
15. South Nawin 3)	Pegu	Paukkaung	642.3		32,400	31.2	3,050		34.29				1058.2	B	Reconnoitered
North Nawin 4)	Pegu	Prome	592.1	358.95	39,178	35.1	6,616		35.71				911.6		Under construction
Sedawgyi 5)	Mandalay	Madaya													Commenced construction
Nyaunggyat 6)	Mandalay	Kyaukse													Under construction

EVALUATION TABLE OF PRIORITY FOR PROPOSED DAM

Data Sources:

1) Medium Size Reservoir Project, 197 Irrigation Dept.

2) Western Pegu Yoma Irrigation Project, 197 Irrigation Dept.

3) North Nawin IrrigationProject, 197 Irrigation Dept.

4) South Nawin Irrigation Project, 197 Irrigation Dept.

5) Sedawgyi Multi purpose Dam and Irrigation Project, 197, Irrigation Dept.

6) Nyaunggyat Irrigation Project, 197 Irrigation Dept.

Notes:

1) Project cost and Net Agricultural Benefit is estibated on 1977;s Price.

2) The economic life of the project is calculated by 30 years.

3) Foreign exchange rate is taken by one U.S. Dollar equal to seven Kyats.

4) A, B and C in the items of Technical Judgement show the rank of the hardness for foundation treatment according to the engineering geology. A, B and C mean there exist a few minor problems, some minor problems and several minor problems respectively.

5) At the underlined damsites, survey and investigations are completed or on going. (Okkan dam)

VIII. RECOMMENDATIONS

In the Project Area, those sub-projects that have no overlapping with others in their programme, but technical feasibility and urgent need of development for the national economy, and positive support by benefitted farmers for realization, should be taken up for the earlier implementation according to the feasibility study. The South Nawin Project, one of such sub-projects, can be implementated independently from any other irrigation and drainage projects, and the said project area, where the inhabitants have earnest wishes to realize the project, will be a major base of the grain supply in the country.

In considerationof the request from the Government of Burma and the results of economical and technical evaluation for the proposed dams, the South Nawin Project including dam construction is recommended to commence the Feasibility Study with the highest priority.

In order improve the technical and economincal accuracy of the Master Plan, the collecting basic data in the Project Area should be executed as follows:

(1) Mapping from the aerial photo for the Project Areas.

(2) Soil map and land use map of the Project Area.

(3) Hydrological data for the runoff from the hilly and mountainous areas.

(4) Flood data for the inundated area including the effect of the Irrawaddy River.

(5) Sediment data for the Project Area such as bed load and suspended load.

(6) Geological investigations and embankment materials tests for the Project damsites.

As regard to the right bank of the Irrawaddy River, the vast irrigable areas are spreaded along the river course with almost similar conditions to the left bank topography, geology and pedology. There is no principal road running south to north in the right bank of the Project Area; however, the road planning had already been fixed and the constructions of principal roads are on going in many places. After completion of the road with improvement of the facilities to cross over the Irrawaddy River, the right bank area seems to have high potentiality for the agricultural development besides the forestry as well as the left bank area.

As mentioned above, it is recommended that the observation equipment should be installed in the right bank area to obtain the basic data.

PERSONNEL CONTACTED DURING THE SURVEY

NAME	STATUS
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Dr. Bo Lay	Deputy Minister Ministry of Agriculture & Forests
U Kyaw Htein	Deputy Minister Ministry of Agriuclture & Forests
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U Hla Khin Maung	Director, (ID), MAF
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NAME	STATUS
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U Than Htike Pe	Deputy General Manger, PPFC, MAF
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