宮津高公専門家報告書

指導分野 ： 圃場整備

派遣期間 ： 昭和５３年１１月 ２ 日
～５６年１０月３０日

任務地 ： メクロン・パイロット・プロジェクト

Meaklong P/P №2地区におけるExtensive な圃場整備の実施について

1. Mae Klong №2 地区ほ場整備事業の背景

当地区における圃場整備事業は、水稲単位面積収量の増大及び、水稲２期作面積の拡大により米作増産を図り、機械化営農を前提として行なわれる。圃場整備事業の推進及び、営農技術ならびに営農組織等の改善に資する目的で、No. 1 地区の Intensive method No. 2 地区の Extensive method による２地区が設定された。

(Fig 1)

計画地区	No.1地区	No. 2 地区	
		計画	実施
開発方式	Intensive	Extensive B	Extensive A
開発コスト	3,250 ฿/rai	—	2,100 ฿/rai
開発の目的	土地、水の高度利用	一定限度に土地、水利用を高め広範囲に事業を拡大	
区画	標準区画へ画一化	現況筆界維持	同左
交換分合	集団化	道路、水路沿いのみで実施	なし
道、水路計画	各筆(標準区画)毎に完全管理	田越し管理	同左
土地均平	均平化	部分的に一部	同左
農業の機械化	機械化体系	限定	同左
水管理	高度に改善	改善	同左
構造物密度 道路	72 m/ha	55 m/ha	27 m/ha
用水路	50 〃	104 〃	40 〃
排水路	44 〃	72 〃	24 〃
面積	393.7 ha	564.2 ha	同左

No. 2 地区では、地区内を縦貫する３L Canal (ライニング Q＝0.541 m^3/s) より取水し、配水するためにD＆D事業により施工された300～400m間隔に水用水溝が配置され田越しでかんがいされている。

しかしながら、３L水路の水位が低く、圃場への水位が充分でない上に用水溝の密度不足とゲートが壊されて、水管理が充分でないため適期に稲作が行なわれていない。

一方、地区内排水は、地区の北を東から西方へ流れる幹線排水路へ排水されているが、落差が大きく、浸蝕の被害が進んでいる。

この様な地区に対してExtensive な圃場整備が両国間の協議によって計画された。

この時点でのExtensive とは Fig 1 に示す B class に近いもので、当面する末端用水

施設の不備を改善することと農道の整備を主体とするもので、近い将来、必要な時期に補助用、排水溝のみを統廃合してIntensiveな圃場整備に容易に移行出来るものとされていた。

しかしながら、1978年末より施行開始したNo.1地区のIntensiveな圃場整備の進捗状況に合わせて、1979年末よりNo.2の計画方針を、タイ側（CLCO、RID Design Div., Project Office等）と協議を始めたが、インフレの進行、オイルショック、換地処分等の問題が生じ、1980年初めには、低コストで広範囲に普及出来るものとしたいとのタイ側の統一見解が出され、「Extensive　な方法で低コストなもの」として基本計画の設計に着手した。

参考までにタイ側の意見を表示するとFig 2の様に開発レベルが低くても、増産効果の大きさが変らないとの事である。

（Fig 2）

	cost (A)	増収量(Gross) (B)	増収量(Net) (C)	B／A	C／A
Intensive	21,000 ฿/ha	2.0 t/年 → 8 t/年 17,600 ฿	13,200	0.84	0.63
Extensive	13,100 ฿/ha	2.0 t/年 → 6 t/年 13,200 ฿	8,800	1.00	0.67

2. Extensive methodによるほ場整備（かんばい）について

(1) 設計方針

① 農地の、農道、用排水路敷地による潰地率を7％以内とすること。

（圃場整備法37条および39条に記されている評価額の変動率に抵触するため、各農家の農地について計算する。）

② 受益農地に対して70％以上の農家が直接取水可能な用水路配置とする。残農地に対しては田越とする。

工事費を抑え、用水路1路線の延長を極力抑えるとともに用水到達時間を少なくする。

③ 用水支配面積は、用水管理上50 ha 前後とする。

営農及び水管理グループを同一とし30戸前後とするため。

④ 用水路には維持管理上、道路を沿わせる。

⑤ 用水路と排水路の間隔は200 m程度とし、排水効果を確保する。

の5項目を設計の柱として、計画平面図を作成し、農家の同意を得て、用排水の水計算、縦横断、取水工、落差工、小構造物図の作成を行なった。さらに各構造物毎には、下記の点に留意しつつ細部設計を進めた。

1）農道巾員等について

現況の農地所有規模は2 rai（0.32 ha）～37 rai（5.9 ha）と差が大きいが、平均で

1.4 ha、1錐の平均的な面積は0.16 haとなっており、小型機械化営農の導入にはさほど支障なく移行出来るものと思われ、現在でも小型の乗用型耕耘機が散見できるが、ここ数年のうち普及すると考えられる事に対応して

○農道の幅員は3.0 mとする。

○雨期の交通を確保するため、20 cmのラテライト舗装とする。

○道路の盛土高は、農作業と用水路の維持管理を兼ね田面より最低30 cm、最高50 cmを原則として確保する。

○道路側法は1：1.0とする。

○盛土に使用する土は、数年前に堀削された幹線排水路の残を堀削～ダンプ運搬～散水～ブル転圧とする。

又Di tch の残土流用を優先する。

2）用水路について

全線土水路とし、自然取水可能なものとするため。

○1路線の延長は、1000m以内を原則とする。

○法勾配は1割とする（小断面であるため）

○道路に沿って配置するため、盛土は同時施工とする。

○堀削断面はバケットの寸法から最小施工断面を60ℓ／secとし、90ℓ／sec、120ℓ／sec の3タイプとする。

○Rotation Block 毎にcheck を設け、制御する。

○土砂の堆積を考慮する（年1回の維持管理を前提とし約5 cm）

○単位用水量は1.25ℓ／sec

3）排水路について

10年確率より141㎜／dayを排除するものとし、5.7 ℓ/sec／ha を単位排水量として、自然排水させる。

○排水は地表水のみとし、地下水排除は効果が少なく考えない。

○法勾配は、堀削深60 cm以下は1割、60 cm以上は1.5割とする。（近傍の既施工水路の法面安定状況より）

○排水路と盛土法尻の間に50 cmのBeam を設ける。

○排水路末端の落差の大きい所に落差工を設ける。

○浸蝕防止のため流速は40 cm／s 以下に抑える。

4）Intake について

Left main canal の堤防断面巾が、15～25 mと大きく、この堤防を堀削して新設するため、浸潤線の低下に留意する。

○小口径のパイプ埋設とし、サンドベッドの代替材料としてラテライトの散水締固めと

する。

- 埋戻しは、満水位までは人力による埋戻しとしコンパクター締固めとする。
- 通過交通量が有るため仮設道路をブルにより簡易な構造として作る。
- ゲートは、R.I.D標準タイプのものとする。
- 水管理の適正を期するため施錠出来るものとする。

5) その他構造物

- Inlet (ditch取水)は全てgateを付ける。
- Inletの敷高は、Erosion防止のため田面より20 cm以下に抑える。
- 必要水量から、φ20 cmに統一する。
- 横断暗渠は、工期、コストの面から全て、流量に応じたConcrete pipeの既成品とする。
- Sugar Caneの農地に対しては、将来、畝間かんがいを予想してInlet設置のみとする。(現在は自家用の2～4インチのポンプかんがい)
- 流速が40 cm/sを超える部分で、特に影響の大きい部分に対してのみ、石張工等の保護を行なう。
- Inletは各ownerの農地(1筆ではない)毎に1ヶ所とし、15 rai以上の面積については用水管理上2ヶ所とする。
- Farm Inlet (農地進入路)は有効巾4.0 mとし、パイプ延長5.0 mとする。

6) 工期算出について

Mae Klong地区の気象、排水条件等の自然条件と、営農による施工不可能な時期を調査し、下表のような施工可能な工程で実施した。

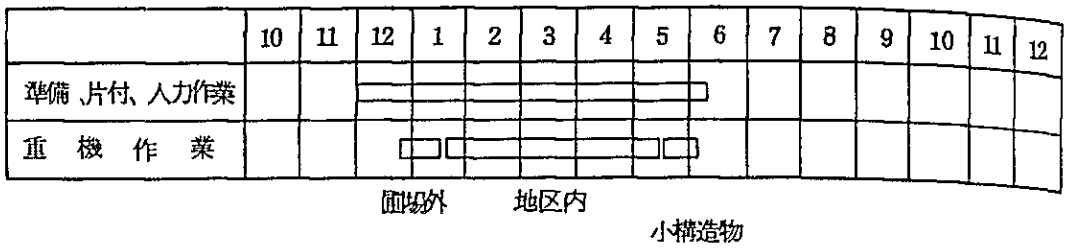
工事実施不可日数

	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
水稲栽培			収穫												
Sugar Cane															
降雨	5	5	3	1~2	1~2	3	6	10	15	10	16	17	19	10	7

工事実施可能日

	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
重機稼動															
圃場地耐力															
圃場外作業															

工事工程に採用した期間



- ○雨期に於ける稲作と、降雨強度から６月中旬～１１月下旬までは人力、重機作業とも不可能とする。
- ○１２月～２月までは部分的な地耐力不足と、サトウキビの収穫により作業不能地域とする。
- ○１２月～１月に地区外の工事施工可能な構造物の施工と、現場作成の小構造物の組立に充てる。
- ○５～６月は Inlet、Farm Inlet 等の設置に充てる。
- ○実質１８０日を稼動日とし１２月より６月までを稼動可能日とする。
- ○平均稼動日数を２４／３０とする。

(2) 調査、設計、積算業務について

No. 2 地区の圃場整備の基本計画が、タイ側の財政事情等により大巾に変更になった事に伴い、用排水、道路等の基本設計を最初からやり直すこととなり、基本計画図の作成、用排水計算、地元同意の取り付け、設計、積算についてFig －3、Fig－４に示すスケジュールで進んで来ている。

１）圃場整備工事の事務的な大きな手順について

ＲＩＤにおける圃場整備の事務処理の流れについて図に示す。Ｆｉｇ－５のようになる。また、この事業に関係する部局はFig６に示す通りである。

Organization chart でも解る様に、設計、製図（ＲＩＤ）、用地処理（ Land Department ）、測量、積算（ Project Office ）法手続（ COLC, ＲＩＤ Design Div, Land Consolidation Provincial Commitee）地元対策 (Kamphaeng Saen Office)、工事監督（ Project Office ）と縦割の組織となっており、各 Section を経由する処理時間が大きい。

２）日本人専門家の役割について

Fig ３～５の備考欄に示している如く、タイ側で不得意とする業務に携わって来ており、特に、作物の現況調査、必要水量、排水計画等基本計画に必要な部門が弱く感じられる。（ on farm に関して）さらに、施工管理についても監督員クラスでは、充分な知識があるとは云えず、専門家の業務は、調査、設計、施工管理と全面的に係わらざるを得ない事

となっている。（詳細については、別添「業務実施経過」に記述）

3）積算業務について

○直営工事については、ＲＩＤ各Regional Office 毎に、毎年８月頃に 複合単価が示され、この単価を基に、各プロジェクトの技術者により積算され実行予算が要求される。単価構成の一例と実行単価を示せばFig 10、Fig 11 の通りである。

各プロジェクトに於ける積算の技術者は、ＲＩＤ Design Division において設計され、承認された図面をもとに単価構成に見合う数量を計算し、全体金額（工事費）を算出し、単位面積当り（○○㌔／rai、○○㌔／ヶ所 等）の単価に換算し、工事担当の各Section へ予算配分を行なっている。

○請負工事については、ＲＩＤの実行単価に諸経費相当分を乗じて得られる（No.２地区の場合は、複合単価に２１.８％を乗じた単価）単価×数量を合計したものを予定価格として入札、Negotiation を行なった。

（入札設計量様式、応札設計書別添参照）

Schedule of the pilot project No. 2 (243.8ha) (70.4 ha)

Fig—3

1980

No.	Items	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	
1.	Explanation to the farmer of General plan													Japan Thai
2.	Surveing													Thai
3.	Caluculation of Irrigation requirement													Japan
4.	- do - Drainage discharge													Japan
5.	- do - Cross-section area of flow													Japan
6.	- do - Canal and Road lot													Thai
7.	Longetudinal Slope of Canal allotment													Thai Japan
8.	Design													Thai Japan
9.	Drawing													Thai
10.	Squaring and Specifications													apan
11.	Bidding Negotiation													
12.	Construction													

Plan ——
Actual ——

Schedule of Works (No 2) 1981—1982

Pig— 4

No.	Items	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	In Charge
1.	General Lay out	———	———													D.D JICA
2.	Checking alignment In The Field		—													D.D JICA
3.	Prepare the Map			—												D.D
4	Calculation For Irrigation Lost of Land Drain			—												D.D JICA
5.	Explanation To The Farmers			———	———	——										D.D.Project L.C.P.C COLC.JICA
6	Tertiary ALignment Survey				———	-----										Project
7.	Prepare The Final Map For Consolidation Committee				----	-----										D.D
8	Design tertiary				——	———	---									D.D
9	Design Drainage System				——	———	----									JICA
10.	Submit Final Design to Provinsial Committee					-----	----									D.D COLC.
11.	Show the map to Public					----	----	———								COLC.
12.	Cost Estimate					———	-----									Project JICA
	CONSTRUCTION									———	———	———	———	———	———	Project

圃場整備工事の流れ（Mae-Klong No. 2）

Fig －5

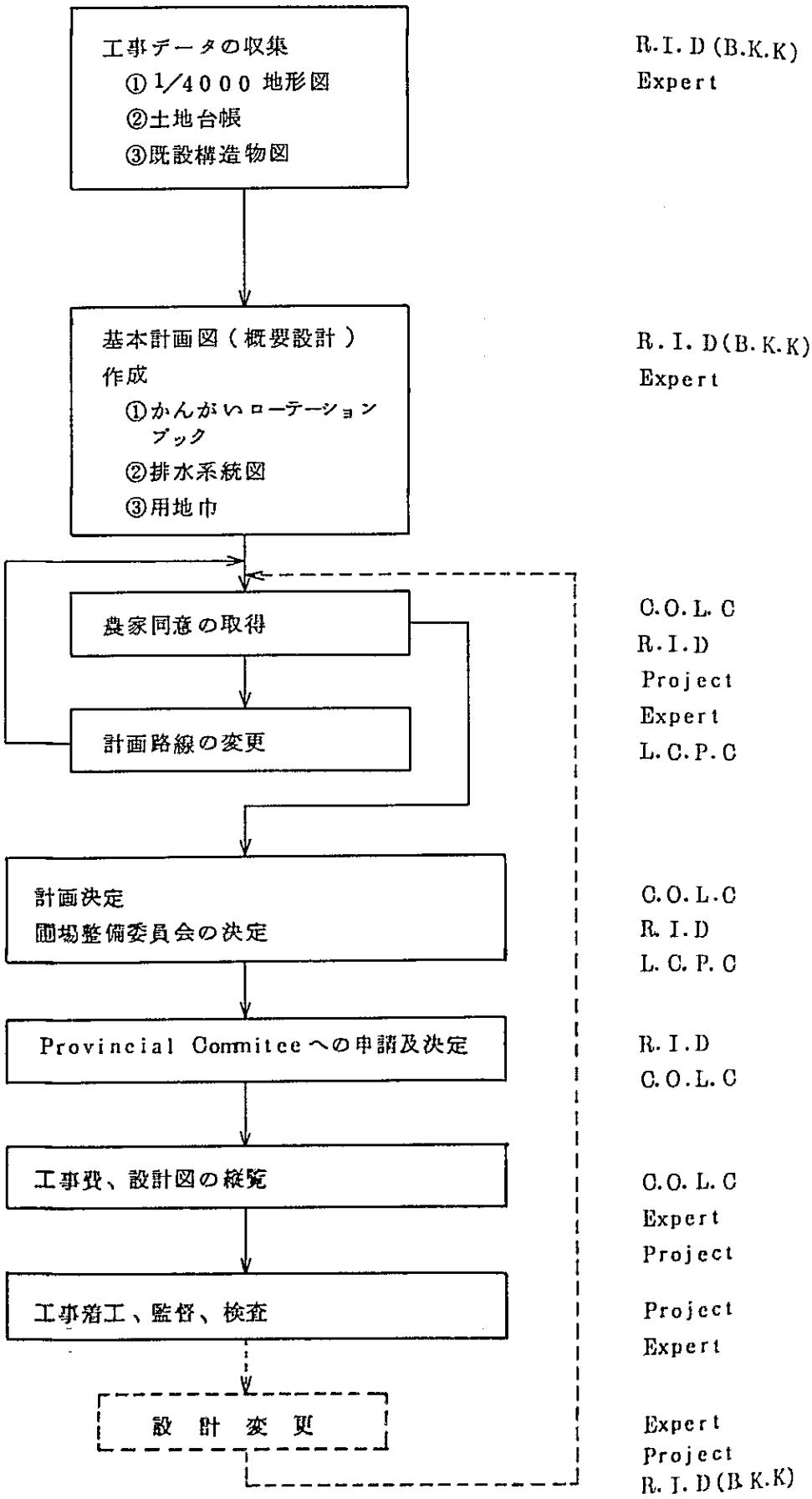
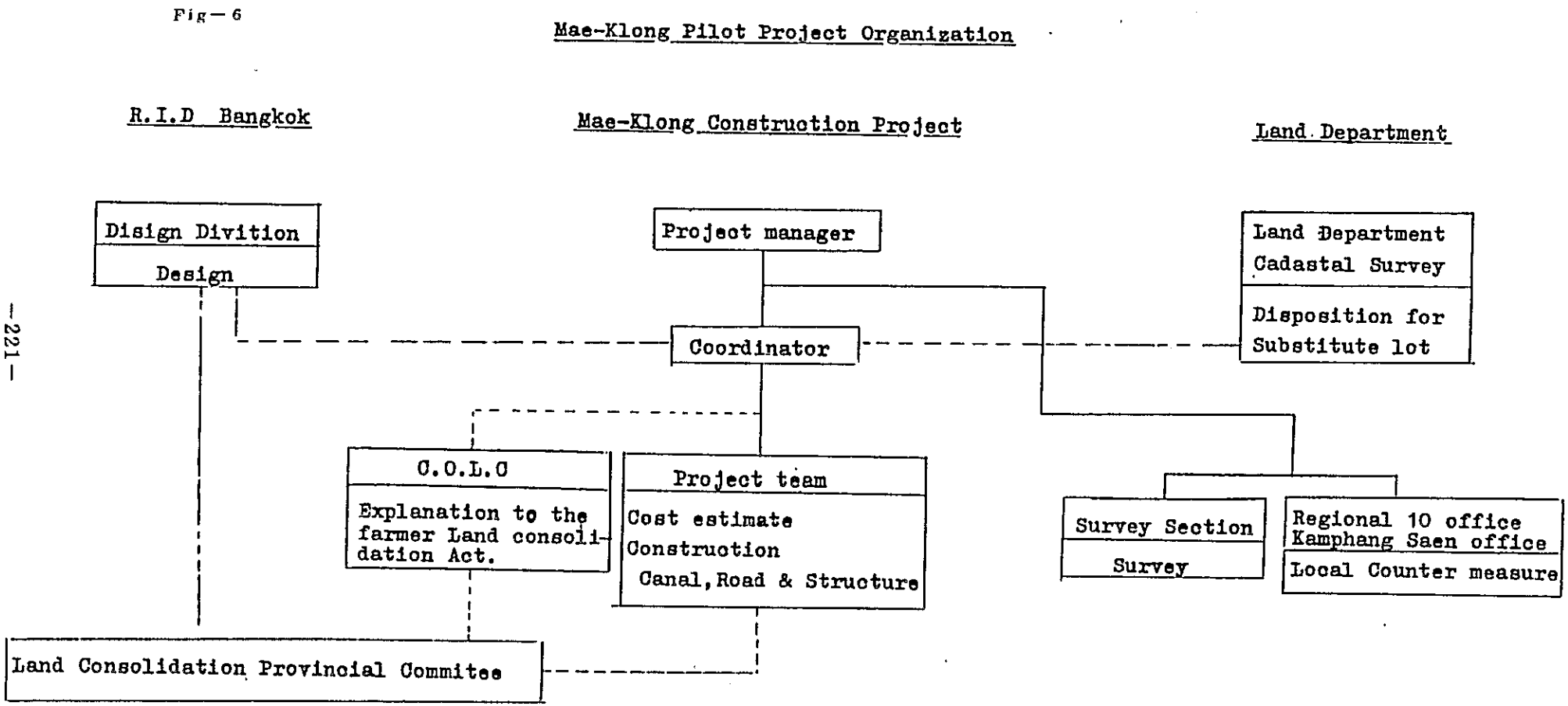


Fig – 6

Mae-Klong Pilot Project Organization



3. パイロットインフラ整備事業の導入について

(1) メクロンパイロットプロジェクト地区には、Fig 3 に示すスケジュールで工事を実施して来たが、1980年よりインフレの進行とオイルショックにより財政事情の逼迫により予算的に不足し、圃場整備工事の遅れが予想され、このため、日本政府に対しパイロットインフラ費の要求を行ない、当初のスケジュールを確保すべく努力した。

(Fig 3) Construction Schedule

項　　目	事業量	1978 1979 1980 1981 1982
No.1 Intensive 1. 圃場整備	386.4 ha	46ha 168.4ha 147.7ha Ⓟ 37ha Ⓟ 117.4ha Ⓟ 232 ha
2. Trial Farm	9.8 ha	6.33ha 98ha Ⓜ
3. 建築、給配水	2.25ha 13棟	2.25ha 13棟 Ⓕ Ⓕ Ⓟ
No.2 Extensive 1. 圃場整備	557.3ha	212.9 ha 291.1ha Ⓟ 243.8h 243.5ha Ⓕ 70.4ha

Ⓜ = Model Infra
Ⓟ = Pilot Infra
Ⓕ = Froced Account

この事業促進のため、RIDは復活要求と、他プロジェクトからの流用を含めて、最大限の努力をして、新規プロジェクト50%削減の政情にも係わらずNo.1地区の1981年完成の予算化が図られ、一方、日本側に於てもパイロットインフラ費の要求手続きと、1981～1982年にNo.2地区の完了を目ざして基本設計作業、請負と直営工事の予算配分、実施能力を検討し、直営分70.4ha、請負分243.8ha の総面積314.2haの圃場整備工事の実施を行なった。

(2) 請負契約に対する準備

1) 契約書、仕様書の作成

設計、積算業務と並行して、契約書、仕様書の作成を行なったが、特に留意した点を要

約すれば、

a) 契約方式を一括契約とするか、単価契約とするか、両方のmeritを検討し、数量増減のつかみやすい単価契約方式とした。

b) 工事期間中および工事完成後一年間の保証期間中に生じる受注者側の責任により起る被害に対する弁済を保証する契約額の５％の銀行保証書の提出義務

c) 契　保証人（Witness ）

相手国の財産を工事するものであり、法手続、事務手続を行なう機関（ＲＩＤ)の長に証人となってもらう事により支払、工事施工の実施可能性を保証する。

d) 支払方法

工事着手前の前払金、出来高の９０％までを支払う中間出来高払いと最終支払で処理する。

市中銀行の金利の高いことと、毎年１～２月と１０月に物価上昇が２０％近くも上り請負者のリスクを少なくするため、資材の一括購入と物価上昇による変更契約をしない事を前提に２５％の前払を行なう。ただし、一般競争入札は避けて、ＲＩＤより優良な請負業者の推せんを受けて指名競争とすることを前提とした。

その支払いについては、検査委員会（別添List ）を設けて委員会の検査後支払うものとした。

e) 契約相手方の選定

ＲＩＤより推せんを受け、施工機械の保有台数等施工能力の調査を行ない、主要材料表、金抜設計書により見積り合せを行ない、Negotiationによって契約相手方を決定する。

f) 検査委員会（ Inspection Commitee ）の設置

契約当時者であるＪＩＣＡ バンコック事務所長の指名のもとに、ＪＩＣＡ職員1名、派遣専門家２名、タイ側の関係するプロジェクトマネージャー２名、カウンターパート２名により構成されるInspection Commitee（４名）、Sub Inspection Commitee（３名）で、工事契約、監督、施工管理、竣工検査を行なった。

このようなパイロットインフラ工事の場合、工事費負担を全額日本政府機関で支出、契約し、相手方国有財産、私有財産を外国の法律の制約を受けて工事を行なう場合の便法として設置し、工事施工上発生する諸問題を処理する機関として利用し、カウンターパートと共同処理することが技術移転の場としても、良い方法だと考えられる。

g) 工事仕様書の作成

当該工事の場合、Extensiveな圃場整備であり高度な施工管理を必要とする構造物、材料も特にないが、主要材料となる下記について、ＲＩＤの仕様書を参考とし、定めている。詳細については、別添仕様書を参照されたい。

○盛土工事に於いて、雑物混入を防ぎ、敷固めの適正を期するためのLand Clearing とStripping

○農道舗装の主要材料であるラテライトの品質の指定と撒き出し転圧。

○Intake等主要構造物に使用するコンクリート材の保管方法

○コンクリートの強度、スランプ、鉄筋の加工等

○コンクリートパイプの品質と、埋戻しの施工法

○R. I. D 仕様のゲートの使用義務

No.	Construction Items	1981			1982		
		Actual valume	Budget	cost	Actual alume	Budget	ccst
	Contract (243.8 ha)	1,523.7 rai 243.80 ha	4,148,408 ฿	2;722.฿/rai 17,015฿/ha			
1	Intake	3	163,376.8	54,459฿			
2	Waote Way	3	203,000	67,666฿/p			
3	Drainage Canal	6.144	917,190	149 ฿/m			
4	Drainage Culvert	14 p	776,104	55,436฿/p			
5	Road & Irrigation canal	Rd=2549 m canal= 9,741 m	1,836,542	122฿/m 94฿/m			
	Inlet	190 p	75,797	399฿/p			
6	Culvert	66 p	176,399	2,673฿/p			
	Forced Account(70.4 ha)	(440rai) 70.4 ha	864,272	1,964฿/rai 12,276฿/ha			
1	Survey for Building		17,442.5				
2	Clearing	(19.14 rai) 3.06 ha	5,742	300 ฿/rai 1,876 ฿/ha			
3	Earth fill	(13,500 m³) 3,059 m³	337,500	25 ฿/m³ 110 ฿/m	Road 116.4 ฿/m		
4	Stripping	(4,405 m³) 3,200 m³	30,720	9.6 ฿/m³ 7 ฿/m			
5	Irrigation ditch(Exca)	(3,059 m³) 2,000 m³	18,600	9.3 ฿/m³ 6.1 ฿/m	Irrigation canal 77.6 ฿/m		
6	Drainage ditch (")	(1,346 m³) 7,000 m³	65,100	9.3 ฿/m³ 48.4฿/m	Drainage canal 75.7 ฿/m		
7	Road surface(laterite)	(1,066 m³) 740 m³	57,868	78.2 ฿/m³ 54.3 ฿/m³			
8	Farm Inlet	65	22,400	344 ฿/p			
9	Ditch Turn out	3	18,000	6,000฿/p			
10	Drainage culvert	2	26,000	13,000฿/p			
11	Road way crossing with Check	5	26,500	5,300฿/p			
12	Tail Ragulator	5	28,000	5,600฿/p			
13	Road way crossing	7	23,800	3,400฿/p			
14	Turn out	2	45,000	22,500			
15	Waste way	4	141,600	35,400฿/p			

2 - 1. Records of Constraction works (Contracted Area)

243.8 ha

No.	Items	Quantity works Amount	Vol.	1980 Nov.	Dec.	1981 Jan.	Feb.	Mar.	Apr.	May	June	July	Remarks
	Construction works 2,722 ฿/rai 17,015 ฿/ha	(4,194,059) 4,148,408	rai (1,523.7) 243.8 ha			1 Bull x2 2 Dozer shovel 1.2 m³ x1 3 Back hoe 0.3m³,0.4m³			4 Dump truck 4tx2 5 Watering car 4t x1 6 Tamper x1			7 Motor 0.17m³ x1	
1	Intake 3 p	163,376.8	Excavation 604 m³ Back fill 573 m³					5 day Bull x1 24 day Back hoe x1 3 day Dump truck x2 6 day tamper x1			2 day Dozer shovel x1 1 day Grader x1 10 day Mixer x 1 4 day Pump x1		
2	Waste Way 3 p	203,000	E 167 m³ C 25 m³ H 26 m³ P 10m x 3					4 day Bull x1 2 day Dozer shovel x1 6 day Back hoe x1 7 day Dump truck x1 3 day Tamper x1 4 day Mixer x1			8 day Pump x1		
3	Drainage L=6,144 m	917,190									13 day Bul x1 3 day Dozer shovel x1 89 day Back hoe x1 61 day Dump truck x1 12 day Temper x1		
4	Drainage Culvert 14 p	776,104				4 day Back hoe x1 3 day Dozer truck x1 2 day Temper x1			2 day Pump x1			6 day Bull x1 3 day Back hoe x1 6 day Dump truck x1 2 day Tamper x1 3 day Mixer x1	11 day Pump x1
5	Road & Irrigation canal Rd.=7,549 m canal=9,741 m	1,836,542		126 day Bull 81 day Dozer shovel 49 day Back hoe 135 day Dump truck								41 day Watering Car 2 day Tamper 41 day Pump 3 day Grader 10 day Road Roller	
6	Inlet, culvert 256 p	252,196.1							29 day Mixer x1				

2 - 2. Records of Condtruction Works (Forced Account Area)

70.4 ha

No.	Items	Quantity works		1980		1981							Remarks
		Amount	Vol.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Jul.	
	Construction works (1,964 ฿/rai) 12,276 ฿/ha	฿ 864,272	70.4 ha (440 rai)	1.Bull 15t x 2 2.Tractor shavel 0.8m³ x 1 3.Back hoe 0.4 m³ x 1				4.Dump truck 6t x 3 5.Wates car 5.5 m³ x 1 6.Motor scraper 6.4 m³ x1			7.Motor grader 2.01m³ x 1		
1	Survey for Building	17,442.5	70.4ha			7p x 11 day	5p x 24 day						
2	Clearing	5,742	(19.14 rai) 3.06 ha				14 day x 15t Bull x 1						
3	Earth fill	337,500	13,500 m³					38 day Motor scraper . 1 . 5 day	Bull x 2 x 18 day	Watering car x 1 x 11 day			
4	Stripping	30.720	3,200 m³				15 day x 15t Bull x 1 Motor grader x 1						
5	Irrigation ditch	18,600	2,000 m³			41 day	Dump truck x 2 Bull x 2 x 8 day	Back hoe 13 day x1		15 day Back hoe x 1			
6	Drainage	65,100	7,000 m³				Dozer shovl x 1 x 15 7 day	Dump x 1 6 day	Back hoe x1	3 day x Back hoe			
7	Road Surface (laterite)	57,868	740 m³				7 day Back hoe x1	6 day Motor grader x1 Dump truck x2		3 day	Moter grader x1 Dump truck x3		
8	Farm Inlet	22,400	65 L.S					Dozer shovel x 4			Dozer shovel x2		
9	Ditch Turn out	18,000	3 "										
10	Drainage Culvert	26,000	2 "										
11	Road way crossing with check	26,500	5 "										
12	Tail Regulator	28,000	5 "										

No.	Items	Quantity works		1980		1981							Remarks
		Amount	Vol.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	
13	Road way crossing	23,800	7 L.S				□□□	□□					
14	Turn out	45,000	2 "			□							
15	Waste way	141,600	4 "			□	□	□					

1. Labour 3 party (21 person)
2. Operation days of machinery
   (1). Bulldozer (15^t x 2) 81 days - unit
   (2). Tractor shovel (0.8 m^3 x 1) 21 days-unit
   (3). Black hoe (0.4 m^3 x 1) 31 days-unit
   (4). Dump truck (6^t x 3) 110 days-unit
   (5). Watering car (5.5 m^3 x 1) 11 days
   (6). Motor Scraper (6.4 m^3 9 days
   (7). Motor grader (4.01 m) 24 days

5. Land Consolidation Work Schedule of Pilot Project No. 2 (Contracted Area)

Plan
Actual implement-ation

Items	Amount (฿)	Quantity works	1980 Nov.	1980 Dec.	1981 Jan.	1981 Feb.	1981 Mar.	1981 Apr.	1981 May	1981 June	1981 Jul.
Construction works (1,523.75 rai) 243.80 ha	(4,194,059.8) 4,148,408.9	Land levering (45.1rai) 7.2 ha Soil cement test 30 m									
(1) Intake 3. L.S	(163,376.8) 163,376.8	Excavation 604 m^3 Back fill 573 m^3 Concrete 16.9 m^3 Gate x 3									
(2) Waste way 3 L.S		Excavation 167 m^3 Concrete 25.03 m^3 Masory 26.2 m^3 Concrete pipe 10 m x 3									
(3) Drainage l = 6,144 m	(1,031,690.5) 917,190	Excavation 8,123 m^3 Embankment 6,942 m^3									
(4) Drainage culvert 14 L.S	(699,000.0) 776,104	ø400 ø1000 x 6.0 10.0 m									
(5) Road & Irrigation canal Rd.=7,549 m canal=9,741 m	(1,837,492.5) 1,836,542	Banking 28,584 m^3									
(6) Inlet,culvert ø200 ø500 x 1.0 6.0 m 156.-L.S	(229,500.0) 252,196.1										

Fig – 10

UNIT COST TO
LAND CONSOLIDATION WORKS
MAE KLONG PROJECT

Cost of Forced Account 1981 R.I.D

No.	I T E M' S	Unit	Price	Remark
1	Surveying	rai	84.52	
2	Land Clearing	〃	300~500	
3	Land Levering	〃	895.37	
4	Stripping	m^3	9.60	
5	Fill Excavation	〃	25.0	by machinery
6	Laterite	〃	62.0	only material
7	Irrigation Canal (Excavation)	rai	37.06	
8	Drainage and Drainage Ditch (Excavation)	〃	15837	
9	Concrete (A) Reinforcement	m^3	2,445.0	
10	– do – (B) Plain	〃	1,045.0	
11	– do – (C) Lean	〃	585.0	
12	Morter	〃	9100	
13	Masonry	〃	130.0	
14	Wooden form	〃	5,500.0	only material
15	Concrete pipe ϕ1000 mm	1 m	1,200.0	include labour fee
16	800 mm	〃	950.0	〃
17	600 mm	〃	630.0	〃
18	500 mm	〃	500.0	〃
19	400 mm	〃	380.0	〃
20	300 mm	〃	270.0	〃
21	200 mm	〃	100.0	〃
22	Broken stone (riprup)	m^3	3550	〃
23	Steel Bar	ton	9,110.0	only material
24	Labour	day	4695	
25	Fuel	rai		
26	Oil	〃		
27	Excavation (Labour)	m^3	24.0	
28	Back fill (–do–)	〃	480	
29	Fill Excavation (Road and Irrigation Ditch)	〃	480	by labour

Fig－11

R. I. D に於ける１９８０年施工単価構成の一例

No.	材　　料	単価	単位	鉄筋コンクリート		空石張り	
				数　量	金　額	数量	金　額
1	Small stone	98	m^3	1.10	107.00		
2	Big stone	91	〃			125	113.75
3	Sand	35	〃	0.6	20.00	0.3	10.50
4	Gravel	90	〃			0.5	45.0
5	Cement	4697	back	65	305.30		
6	Steel Bar	7.08	K.G	1250	885.0		
7	Steel tied cost		m^3		90.9		
8	Wooden form		〃		184.72		
9	Form Broken cost		〃		180.18		
10	Labour		〃	4.71	198.19	3.0	126.13
11	Concrete Coring		〃		30.00		
12	Mechanical Parts		〃		20.30		
13	Oil and fuel		〃		30.00		
14	Repair		〃		9.00		
15	Others		〃		10.50		6.30
	合　　計				207.289		301.68
	金　　額				207.0.0		300.0
	使用単価				1840.0		290.0

List of Comparison

No	Name of Machinery	Forced Account(70.4 ha)	Contract (243.8 ha)
		Job day	Job day
1	Bulldozer 15 t x 2	81	126
2	Dozer shovel 0.8 m^3	21	81
3	Back hoe 0.4 m^3 0.3 m^3	38	49
4	Dump Truck 6 t	16 (other's) 94	135
5	Motor grader B = 4.01 m	24	3
6	Road Roller 2.5 t	-	11
7	Watering Car 5,500 l	11	41
8	Mixer	28	56
9	Tamper	-	25
10	Motor scraper 6.4 m^3	9	-

4. 水管理計画について

(1) 現況の施設容量、用水利用について

ライニングされた3L Canal の施設容量0.541 m^3/s の通水断面に対する支配面積は640ha（うち水田511ha、サトウキビ、その他129ha）と、単位当り用水量（0.84ℓ／sec）は、雨期作栽培の用水補給程度しか考慮されておらず、又、落差土によって位置エネルギーを大きく低下させて、gravity によるかんがい不可能な農地がある。（Sugar cane の約90ha） －別添、現況水源別農地図－

このため、乾期に於ける当地区の営農は、天水によるSugar Cane と Borrow pit沿い及び溜池利用の一部農地のみ乾期水稲栽培が行なわれているのみで、不安定な営農となっている。

一方、用水利用にあっても、Ditch & Dike による施工の用水溝も施工位置と維持管理が悪く、充分機能してなく、大部分が田越しかんがいであるため、シロカキ～田植に2ケ月程度の期間を要している。

(2) 新設の用水施設利用による水管理計画について

既設のライニング水路3L Canal の施設容量が不足しているため、Left main Canal に4ケ所の直接取水を求め、乾期作の不足分を確保し、水稲2期作を可能なものとする。

全て土水路であるため、用水到達時間、水位低下、到達容量より水路延長400m 前後で One Rotation Block とする。（Fig－8参照）。農家の水管理に対する考え方が普及するまでは、部分的に排水路の堰上げによるかんがいも考慮する。

(3) 施工後の用水路における末端までの用水到達時間、Inlet（φ200 m/m）より取水開水後の田面における100㎜までかんがい水深到達時間を調査し下表とFig－8の如く、流水に対する水路の曲り、草性による抵抗、施工誤差による水路勾配の部分的な違いによって設計数値と異なっている。

Fig－8

	T009			T009－2	T009－1
到達時間	19分	19分	50分	18分	28分
区間距離 追加距離	（380） 380	（178） 558	（442） 1,000	（200） 200	（500） 500
水路勾配	1/4000	1/4000	1/1500	1/4000	1/4000
平均流速	0.33m/s	0.24m/s	0.15m/s	0.23m/s	0.30m/s
流速に関する影響	良好	ベントロス 植性	ベントロス 勾配1/4000 施工ミス		

また、１農家の所有する農地（台張上の面積１１,７８４㎡、５筆に小割して１筆平均2,000㎡前後）に対して、水口を全筆開けた状態で、湛水深１００m になるまでの時間を調べた結果Fig －９の如くなり、田越しかんがいの時間判定の困難さが伺える。

田越しの数、到達距離が多くなるに従って、水路近くの農地は深水にならざるを得ないこと。さらに時間的に長くなりRotation の切替え時が深夜になる等不規則となる。

この水管理に於けるRotation の切替時間は１日１回を原則とすることが望ましい。具体的には，毎朝午前７～８時に農作業開始前の見廻りでInlet の gate を操作し、特別に水管理だけの作業のために農場へ足を運ぶ手間を掛けないことである。

5. Maintenance計画について

維持管理に要する作業項目として当面考えられるものとしては、

① 水路に堆積する土砂の除去

② 蟹穴、水牛、降雨による浸蝕等に起因する水路決壊の補修

③ Inlet、Check の gate の補修

④ 水路の除草

⑤ Intake のゲートスピンドルのグリスアップ及びさび止め

⑥ 農道路面の農業機械による傷に対するラテライトの部分補修

⑦ 水番に対する共役費用

以上の７項目があるが、費用算出、費用負担区分を示すと下表の如く提案される。

（３１４.２ha）

No.	項　　目	全体数量	管理費用	算　出　基　礎
	用水路	12,800m	25,792B	土砂 12,800÷50m/day/人×62B/人=15,872B 除草 12,800÷80m/day/人×62B/人= 9,920B
	〃　決壊補修	12,800m	518	盛土量(0.50+1.3)/2×0.4×1.5m＝0.54 m³ ２０ヶ所×0.54×48B/m³＝５１８B
	Inlet check gate補修	293	2,270	２９３P/１０×９５B/p＝２２７０B
	Intake maintenance	4	1,600	４P×４００B＝1,６００B
	農道路面、Laterite	8,615m	3,100	200m×2.5m×0.10m×62B/m³＝3,100B
	水番に対する共役費用	5	27,900	５×９０日×６２B/day＝２７,９００B ２３０戸
	合　　計		61,180	1戸当り費用＝61,180B/230＝266B/年/戸

このうちNo.１～２およびNo.６は共同作業で賄い得る作業内容であり、No.３～５の項目の材料購入費が必要であろう。

ただし、乾期について部分的にポンプ揚水の必要性があるかも知れない。

6. 業務実施経過

(1) 工事調査、計画について

業務処理項目（専門家の役割含む）	タイ側の実施体制、手続	直面した問題
1. 事業計画策定にあたって、MOAC 部局が多岐に渡っているため、協議に対する準備、調整に時間を要するため。 結果的には資料作成等に全面的に携わる事となった。	a）法手続きに関してはC.O.L.CとL.C.P.C b）設計に関してはR.I.D（BKK）Design Div. c）工事施工、事業費に関してはproject office d）工事完成後の施設管理についてはKampaeng Saen office e）Main Canal の操作は、O&M office ※L.C.P.C＝Land Consolidation Provincal Commitee	1.(A) 時間的な余裕がなく、工事同意率の未確認のまま着工したため、反対農家が発生し、説得のため約2ケ月を要した。また、1路線については、部分的な路線変更を行なった。 (B) この縦割の業務による時間ロスを省くため、project office で一元化ral meeting で申し入れたが、具体化されていない。
2. 用水計画に対する基本的な考え方は、雨期の用水補給が前提であり、基幹施設断面も、乾期容量でないため充分と比言えない。	現在、ＲＩＤとして用水補給の考え方に対して見直しを始めている。	2. 減水深9.7 mm／day 位少なく、11.7mm／day 前後必要と思慮される。 (A) 乾期における蒸発量8～9 mm／day を観測 (B) 既存施設容量は0.75 ℓ/s／ha であり、乾期の156 ℓ/s／ha は不可能である。
3 増産を図る重要な要素である水路密度、配置について、Extensive な方法では単純作業ではあるが、労力を要する。	「個人所有毎に潰地率7％を超えた場合は、国は買上げする事が出来る」の条項あり。 境界より均等巾で配置するのではなく、潰地の少ない農地側に中心線を移す。 （ＲＩＤ設計Div & Land Department）	3(A) 路線が直線で通せなく、ベントロスが多くなる。 (B) 用水路密度、排水路密度、道路密度が少なくならざるを得ない。
4 計画に使用する図面、測量成果が充分でなく、施工段階での修正が必要である。	再測を要請しても、Survey team としても多忙を極め所要日数が多く、急場の修正が出来ない。	4(A) B.Mのミスによる設計と現地との不都合 (B) 再測の期間工事中止

業務処理項目（専門家の役割含む）	タイ側の実施体制、手続	直面した問題
5. 既存の基幹施設より分水利用を計画するにあたり非常に窮屈な設計内容となる。		5.(A) 現在まで施工された用水路は、雨期の稲作の用水補給を目的として設計され（必要水量から有効雨量を差し引いた０７５ℓ/s/ｈａ）ており、乾期水稲作には 1.56 ℓ/s/ha が必要である。 (B) この施設は、分水工、落差工等での水位損失（２～３ｋｍで0.5～0.6ｍ）が大きく、損失を減らして管理水位を高める工夫が必要である。 (C) このため、末端の Ditch では 1/4000 ～ 1/5000 と、土水路であるにも係わらず、水路勾配が充分に取りにくい。
6 構造物の配置計画について	用、排水路等の路線配置について R.I.D Design Div と協議しつつ決定	6. 路線決定までに、各農家の潰地率を計算し、Land Department の了解を取り地元説明し、最終同意を取るため、反対農家が有るとこの繰し作業が多くなるため、相当の時間を必要とする。 又、用排水、構造計算についての計算に熟練した技術者が少なく、大部分が図工に等しい。

(2) 設 計 積 算

Mae Klong P/P

業務処理項目（専門家の役割含む）	タイ側の実施体制、手続	直 面 し た 問 題
1. R.I.D design Division が担当して、設計、水利、水理計算を行なっているが、スタッフ3名で数project を抱えているため、業務処理の遅れがある。また、設計図と現地とが合わない。 このため、専門家が積極的に水利、理、設計に対して応援しているが、測量ミスによる現場との不一致は施工時に修正変更せざるを得ない。	a）測量は現場のSurvey Section b）設計はR.I.D（B.K.K）Design Section c）施工管理はR.I.D（現場カウンターパート） d）用地同意はC.O.L.C 出先とR.I.D、Land department	1.(1) 工期が乾期の6ケ月間と短いため、測量手配、水利計算、潰地率の再確認、設計積算、仕様書作成、契約業務、農家説明と時間を費し、図面作成が遅れ、着工してから現場での変更を余儀なくされた。 この事は、測量精度の低さにも言えるが、基本的なB.Mが古いためと、水面高とBMのcheckを怠った事による。 (2) 着工し、施工杭打の段階で、水位標高と既設水路の底版とのELより全体を修正（R.I.D Survey team に指示）

(3) 現説、入札、Negotiation（請負関係）

業務処理項目（専門家の役割含む）	タイ側の実施体制、手続	直 面 し た 問 題
1. 測量、農家説明、図面作成に時間を労費し工期を充分に取る必要から、安全性のある請負業者をR.I.Dに選定依頼し、現説、入札に臨んだが、推選を受けた3者は、見積依頼には応じたもののNegotiationの段階で、工事規模、金額的なMerit に乏しいとして、2社は辞退した。	1.a）R.I.D Project manager より3社の請負業者の推せんを受けた。 b）R.I.Dの公式スタイルによる契約書、仕様書、特別仕様書、図面作成に協力 c）R.I.Dの統一単価の提出 d）Negotiation に対する協力 e）契約書にWitnessとしてSunthon 局長署名	1.(1) R.I.Dより推せんを受けた3社に対し、契約書（案）、設計図、主要材料表、金抜き設計書を送付し、見積依頼を行なった。この見積金額の差が予定価格に対して5～50名と大きく、工期、工事規模と請負業者の規模により適正な基準が必要と感じた。

(3)

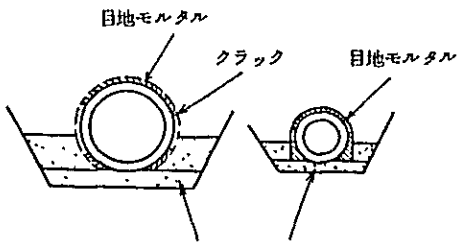
業務処理項目（専門家の役割含む）	タイ側の実施体制、手続	直面した問題
	（）契約図面の契約番号非公式登録	(2) 一般仕様に関しては請負者も了知しているが、中小規模の請負者が圃場整備工事を実施する事は初めてに等しく、特別仕様書は現地語で欲しいと要求された。 (3) 単価によっては積算単価（R.I.D基準による）と2～4倍も異るものがある。 (4) 単価の構成、仕様書の内容について熟知しておらず、複合単価による見積り要素が強い。

(4) 検　査

業務処理項目（専門家の役割含む）	タイ側の実施体制、手続	直面した問題
1. 検査員の任命 Inspection Commitee A）Chairman；Team Leader B）JICA officer C）project manager D）Kampaen office Manager Sub Inspection commitee A）JICA Expert B）officer of RID C）〃　〃	Project manager よりタイ側カウンターパートに委嘱	

(5) 施工管理について

業務処理項目（専門家の役割含む）	タイ側の実施体制、手続	直面した問題
1. 契約締結後、請負者より工程表を提出させ、請負者準備可能な重機台数とその能力から検討した結果無理ないものであったので、承認しこれをもって承認工程計画書とし、工程管理を行なった。	1. a）カウンターパートチームと打合せを行ないNo.2地区全体の責任者としてMr. Sawat、請負地区のカウンターパートとしてMr paiboon、直営施工のカウンターパートとしてMr. pratheepの3名が配置された。 b）請負工事は現場近くの Tharua に現場事務所兼仮宿舎を附帯事務費で借上げ、直営については現場地区内に Banboo house を設置し常時現場監督を行なった。	1.(1) 乾期の常識を超えた連続降雨があり盛土工事の中止日が起った（6日）。 (2) 工事に対する反対農家が生じ、工程管理に遅れが生じた。 (3) 業者と反対農家の直接取引きによる土取場の変更（農家の交換条件による Fish pond の堀削） (4) 当初予定土取場（Main 排水路堀削残土）の使用計画変更
2 工程の遅れに対する協議	2 a）カウンターパートを通じて申し入れを行なっても実質的な動きがない。 b）請負業者より工期延長について申し入れがあり、Inspection Commitee memberの決裁により契約変更と工期延長の手続きを実施	2(1) 契約がＪＩＣＡ対施工業者となっているため Sub Inspection Commitee member となっていても、発言力がないため専門家が常に監督員的な仕事をせざるを得ない。 (2) 搬入機械も古い物が多く、故障が多い。 このため、用地問題、降雨、故障と休止期日が予定より増えたため、雨期作開始まで完工させるべく、昼夜2交替制を申し入れ不可抗力の反対農家の路線を除きほゞ回復。
3. 品質、出来高管理について (1) 盛土管理 a）まき出し厚を20cm前後にし、ブル転帯により破砕する。	a）カウンターパートも業者も盛土に関しては余り b）神経を使わない。	a）含水比が適当であると、堀削塊が多く、まき出しブル転圧の際に、空隙が多く残る。

業務処理項目（専門家の役割含む）	タイ側の実施体制、手続	直面した問題
b）撒水を先行させ、撒水後1～2時間で転圧を行なう。 この処理のため、現場から目を離せない。		b）乾燥した土では撒水転圧を行なっても表層2cmまでで飽和し下層まで浸透しなく撒水効果がない。 c）工期が延び、施工コストが高くなる。 d）法面転圧が良く出来ない。
(2) ラテライトの品質チェック	搬入トラック1台当りの容量チェック	a）Type D.Eのものは品質は良いが、降雨によって流出してしまう。 b）Type Bの粒径の大きいものに使用変更 強度に対して説明が不明確であり、工場より現場搬入の時点で、寸法、クラック等の検査を行ない、不合格となる。クラック、鉄筋はみ出しのものを取り換えさせた。
(3) コンクリートパイプの品質チェック	形状寸法、材料の検査のみで、強度に対しては殆んど実施しない。 運搬時点の取扱いのみ規程している。	
(4) パイプ工事について	 500m/m～1000m/m	a）サンドベッド施工について、材料を変更し、ラテライトにより施工し、撒水後タンパーにより転圧を行ない、パイプ布設を行なったが、砂で施工した1ケ所のみ吸出しを受け崩壊している。 b）流速が大きいか、水圧を受けるパイプ構造物では、砂基礎よりラテライトによる基礎の方が、安全である。 特に目地モルタルの施工に注意を要する。

農務処理項目（専門家の役割含む）	タイ側の実施体制、手続	直面した問題
(5) 農道の幅員について		農家より申し入れが有り、幅員3.0 mは狭い。収穫物搬出に4～6 tonトラックを使用するため、最低4.0 m欲しいとの事であるが、潰地に対する反対と矛盾する。将来の機械化がどの程度のスピードで進展するのか、予想をつける必要がある。

7. 業務実績（'80／10～'81／10）

Mae Klong No.2

	Mae Klong Pilot Project
1980年10月	Pilot Infra の契約業務 ○契約書、仕様書の作成 ○請負業者の選定 ○予定価格の作成 ○現説、見積依頼書の送付（10月16日） ○現場事務所の開設準備
1980年11月	Pilot Infra の契約業務 ○見積提出3社に対する技術審査とNegotiation の実施（3～7） ○契約書締結（12日）（₿4,194,059.80） ○ Inspection Commitee の指名 ○起工測量の立合い。 ○前払の実施（26日 ₿1,048,514）
1980年12月	Pilot Infra ○請負工事の着手と施工管理 ○現場事務所開設 ○測量（B.M）の誤りにより Intake の数高修正
1981年 1月	直営工事（70.4ha）の着工（進度率125％） Pilot Infra ○工程打合せと施工管理の実施 その他、水路ライニング材料、施工法の検討 部分的な田面修正の必要性から農家同意の取付け実施
1981年 2月	Pilot Infra ○用地問題発生と降雨による工程遅れに対する打合せ ○反対農家に対する説明と対策案の検討 ○ Sub Inspection commitee の開催 － 工程遅れ、用地問題 直営工事（進度率58％）

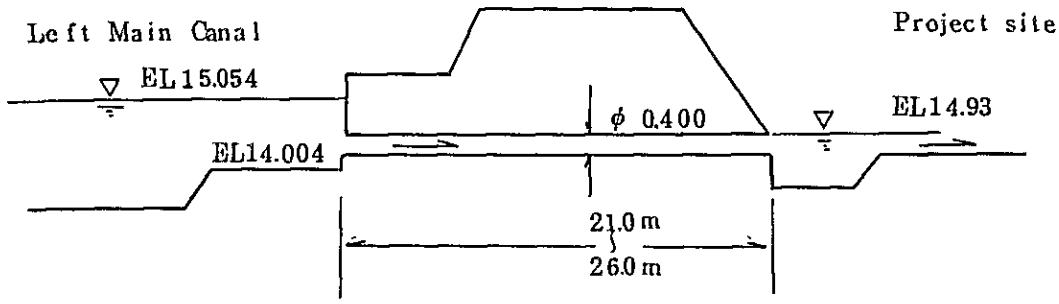
Mae Klong Pilot Project

1981年 3月	Pilot Infra（進度率62％） ○反対農家説得困難なため、設計変更に着手 ○出来高検査の実施と、第1回出来高払い。（16日 ₿1,005,397.00） ○繰越手続 ○反対農家の同意取付け残1戸のみとなる。 その他 次年度施工地域の構造物配置の検討着手 直営の工事進度率（78％）
1981年 4月	Pilot Infra（進度率74％） ○反対農家、降雨のため請負業者より工期延長申請あり協議 ○試験舗装材料（ラテライト）の試験依頼 ○反対農家の同意取付け 直営工事その他 ○村道拡張工事に伴う直営工事排水路位置の協議 ○次年度施工地域の設計施工について協議
1981年 5月	Pilot Infra ○用地問題解決による地方圃場整備委員会開催 ○第2回出来高検査と出来高払の実施（5月12日）（₿1,046,862.80） ○設計変更の数量計算 直営工事その他（100％） ○直営工事の完成 ○次年度施工地域の路線道走
1981年 6月	Pilot Infra ○工期延長、数量変更に伴う契約変更実施（6月10日）（₿4,352943.90） ○逆田修正 ○会計検査受検 ○現場事務所閉鎖 直営工事その他 ○用水路の通水試験の実施 ○ラテライトによる試験舗装の実施

	Mae Klong Pilot project
1981年 7月	Pilot Infra ○竣工検査の実施と支払 その他 ○次年度工事地域の図面作成と農家説明
1981年 8月 〜 10月	○次年度工事の図面作成、水理計算 ○水管理計画案（暫定）の作成 ○報告書作成

8. Intakeのゲート開度及び流入量計算

(1) Left main Canal は取水地点の下流約3㎞地点に水位 Controle のための Check gate があり、雨期にはEL15,054M に定水制御を行なっているが、Mae Klong 本流の流況が安定しておらず計画水位の確保は年間を通じて不安定である。



$\alpha = A/r^2$　　$\beta = R/r$　　Head＝0.85　　Head＝0.124

H/r	α	A (m²)	β	H(m)	Q(m³/s)	Q(m³/s)
2.0	3.141	0.196	0.500	0.400	0.367	0.140
1.9	3.082	0.192	0.572	0.380	0.399	0.152
1.8	2.978	0.186	0.595	0.360	0.393	0.150
1.7	2.846	0.178	0.606	0.340	0.378	0.144
1.6	2,694	0.168	0.608	0.320	0.357	0.136
1.5	2.527	0.158	0.603	0.300	0.332	0.126
1.4	2.348	0.147	0.592	0.280	0.304	0.116
1.3	2.161	0.135	0.576	0.260	0.275	0.105
1.2	1.968	0.123	0.555	0.240	0.244	0.093
1.1	1.770	0.111	0.530	0.220	0.214	0.081
1.0	1.570	0.098	0.500	0.200	0.183	0.070
0.9	1.371	0.086	0.466	0.180	0.154	0.058
0.8	1.173	0.073	0.428	0.160	0.125	0.048
0.7	0.979	0.061	0.386	0.140	0.099	
0.6	0.792	0.050	0.341	0.120	0.075	
0.5	0.614	0.038	0.293	0.100	0.053	
0.4	0.447	0.028	0.241	0.080	0.035	
0.3	0.295	0.018	0.185	0.060	0.020	

よってIntakeのパイプは低水位でも取水可能とするためφ400m/mを設置し、ゲート操作によって用水制御を行なう。

Mae Klong 流域の用水制御に関しては、少なくともバチラロンコンダイバージョンダム上流のシリナカリンドダムが満水し、発電開始するまでは流況が安定するとは考えられず今後数ケ年の年月を必要とするため、パイプ径を大きめのものとした。

ROTATION BLOCK No.2

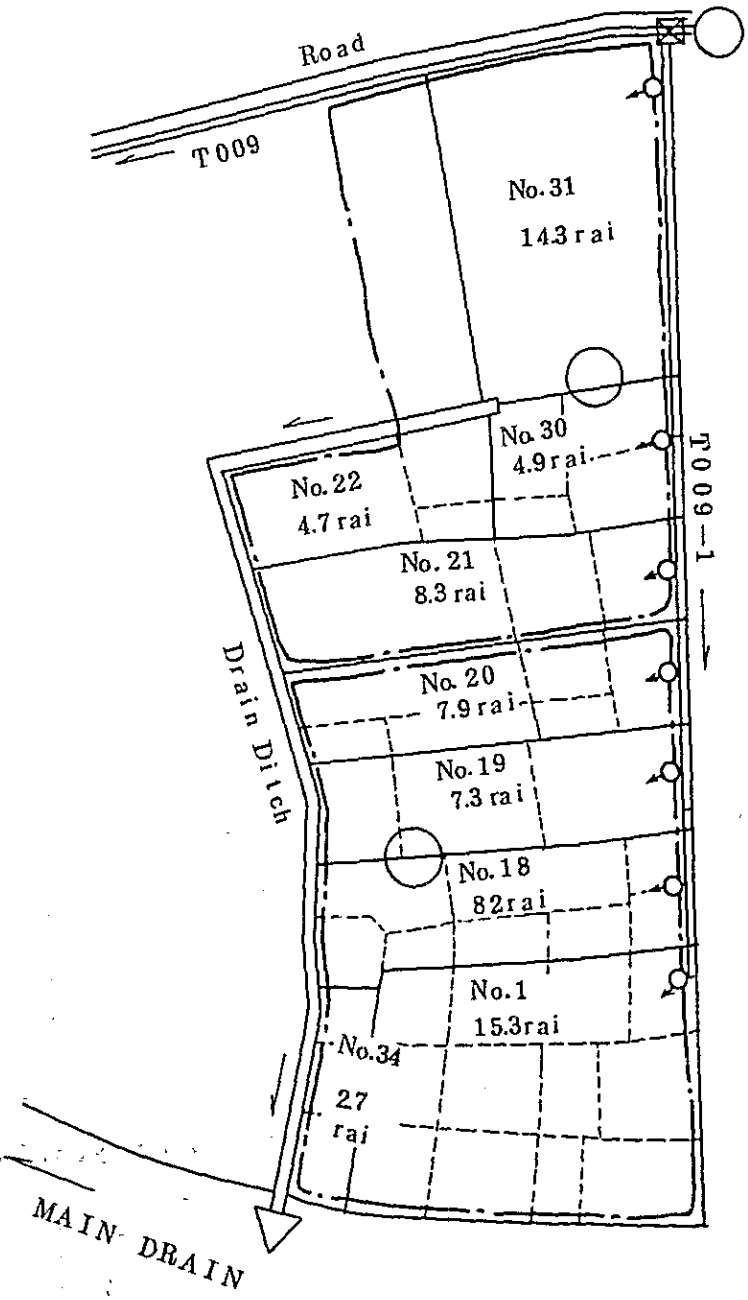
Fig－8

ACREAGE : 73.6 RAI

No. of Farmers : 9

Example of Wet Season

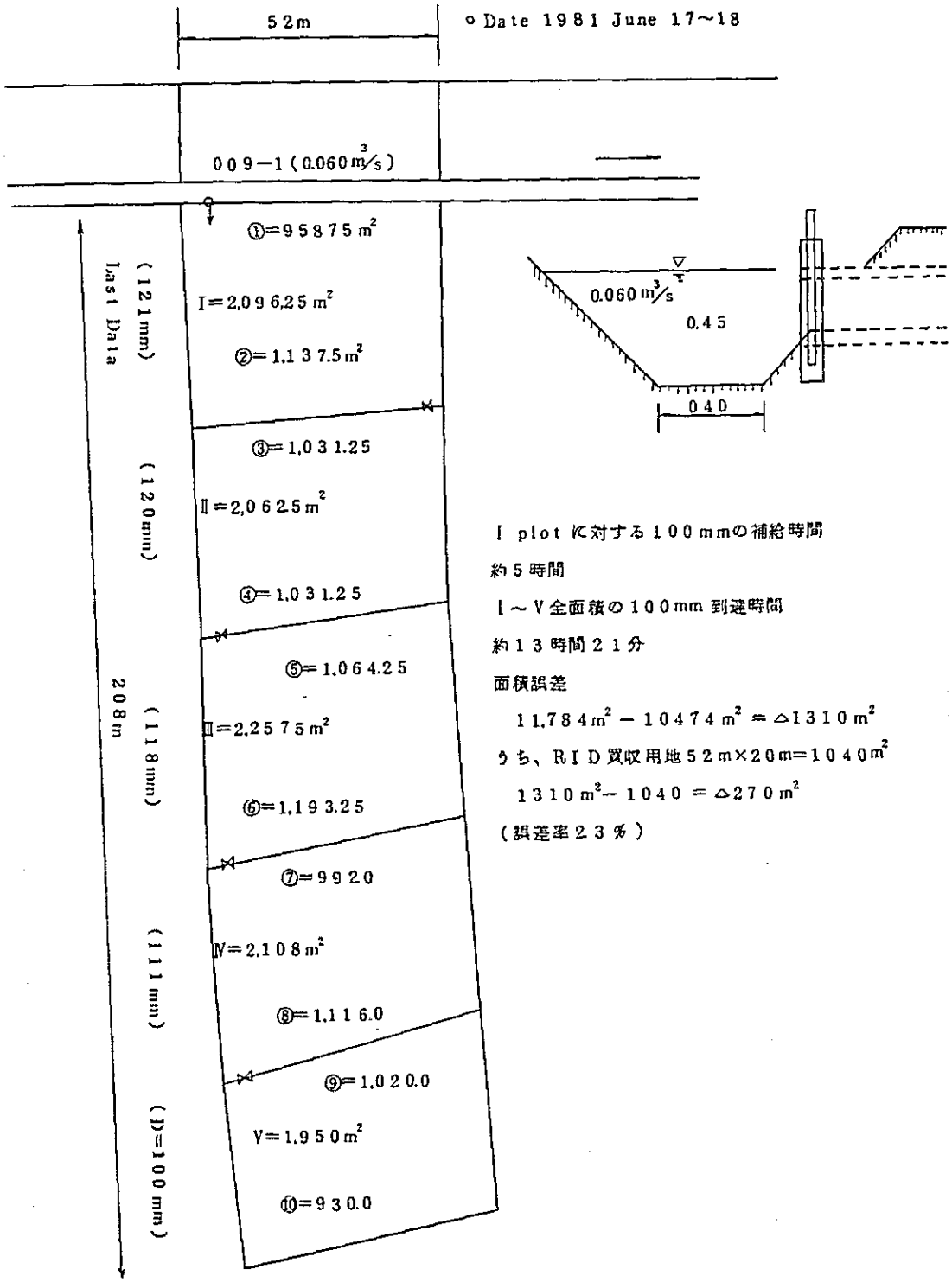
100% of paddy culture



Fig－9

Watering Survey

- Intake No.1
- Plot No. 19 （7－1－46）
- Ditch Name T009－1
- Canal capacity 0.060 m^3/s
- Date 1981 June 17～18



Ⅰ plot に対する１００mmの補給時間

約５時間

Ⅰ～Ⅴ全面積の１００mm 到達時間

約１３時間２１分

面積誤差

$11,784 m^2 - 10474 m^2 \fallingdotseq \triangle 1310 m^2$

うち、ＲＩＤ買収用地５２m×２０m＝$1040 m^2$

$1310 m^2 - 1040 = \triangle 270 m^2$

（誤差率２３％）

$\Sigma_1^V = 10474.25 m^2 = 1.0474 ha = 655 rai$

IRRIGATION SCHEDULE

Service Unit | Intake No1 | Rotation Block | No. 1 | Dry Season

		1	2	3	4	5	6	7		Total
(1)	Rotation Unit									
(2)	Irrigation Area (rai) paddy	382	415	409	420	426	424	400		
	other crops	—	—	3.2	—	—	—	—		
(3)	Daily Water Requirement (mm/day) paddy	10.8	10.8	10.8	10.8	10.8	10.8	10.8		
	other crops	—	—	4.6	—	—	—	—		
(4)	Converted to paddy Area (rai)	382	415	410	420	426	424	400		2908
(5)	Irrigation Interval (days)	7	7	7	7	7	7	7		
(6)	Irrigation Hours for every unit (hrs)	22	24	235	245	24.5	24.5	23		168

7 days × 24 hrs × $\frac{(4)}{2908}$

Intake No. 1 — IRRIGATION CALENDAR — Common Irrigator

Irrigation Area : Paddy 287.6 rai + Other Crops 3.2 rai = 290.8 rai — Wet Season

No. of Rotation Unit	7	Rotation Unit	1		2		3		4		5		6		7	
Area of Rotation Unit (rai)			P 382 O —		P 41.5 O —		P 409 O 3.2		420 —		P 426 O —		424 —		P 400 O —	
Plot No.																
Duration of Irrigation (hrs)			22	44	24	48	23.5	47	24.5	49	24.5	49	24.5	49	23	46
Time of Irrigation		From	8:00AM	8:00AM	8:00AM	4:00AM	8:00AM	4:00AM	7:30AM	3:00AM	8:00AM	4:00AM	8:30AM	5:00AM	9:00AM	6:00AM
		To	6:00AM	4:00AM	8:00AM	4:00AM	7:30AM	3:00AM	8:00AM	4:00AM	8:30AM	5:00AM	9:00AM	6:00AM	8:00AM	8:00AM
Water Requirement (ℓ/sec)			$287.6^{rai} \times 0.20^{ℓ/mi} + 3.2^{rai} \times 0.085^{ℓ/mi} = 57.79^{ℓ/sec}$													
1	Jun	Nursery	15		16		17		18		19		20		21	
2		Land		22/23		24/25		26/27		28/29		30/1		2/3		4/5
3	Jul	Prepar		6/7		8/9		10/11		12/13		14/15		16/17		18/19
4		Transplant	20		21		22		23		24		25		26	
5			27		28		29		30		31		1		2	
6			3		4		5		6		7		8		9	
7	Aug		10		11		12		13		14		15		16	
8			17		18		19		20		21		22		23	
9			24		25		26		27		28		29		30	
10	Sep		31		1		2		3		4		5		6	
11			7		8		9		10		11		12		13	
12																
13																
⋮																
22																

Irrigation Area : Paddy 262.5 Rai + Other Crops 44.1 Rai = 306.6 Rai Dry Season

No. of Rotation Unit	7	Rotation Unit	1		2		3		4		5		6		7	
Area of Rotation Unit (Rai)			P 31.5 O 14.5		P – O 29.6		P 48.4 O –		P 46.2 O –		P 47.5 O –		P 48.1 O –		P 40.8 O –	
Plot No.																
Duration of Irrigation (hrs)			22.5	45	7.5	15	29	58	27.5	55	28.5	57	28.5	57	24.5	49.0
Irrigation Order	Time of Irrigation	From	8:00AM	8:00AM	6:30AM	5:00AM	14:00PM	8:00PM	19:00PM	6:00AM	22:30PM	13:00PM	3:00AM	22:00PM	7:30AM	7:00AM
		To	6:30AM	5:00AM	14:00PM	8:00PM	19:00PM	6:00AM	22:30PM	13:00PM	3:00AM	22:00PM	7:30AM	7:00AM	8:00AM	8:00AM
	Water Requirement (l/sec)		262.5 Rai x 0.20 l/Rai + 44.1 Rai x 0.085 l/Rai = 56.25 l/sec													
1	Feb/mar	Nursery	15		16		16/17		18		19		20		21	
2		Land pre		22/23		24		24/26		27/28		1/2		3/4		5/6
3	Mar	Transplant	7		8		8/9		10		11		12		13	
4			14		15		15/16		17		18		19		20	
5			21		22		22/23		24		25		26		27	
6			28		29		29/30		31		1		2		3	
7	Apr		4		5		5/6		7		8		9		10	
8			11		12		12/13		14		15		16		17	
9			18		19		19/20		21		22		23		24	
10			25		26		26/27		28		29		30		1	
11	May		2		3		3/4		5		6		7		8	
12			9		10		10/11		12		13		14		15	
13																
14																
15																
16																
17																
18																
19																
20																

IRRIGATION SCHEDULE

Service Unit — **Intake No.2** — **Rotation Block No.2** — **Dry Season**

		1	2	3	4	5	6	7	Total
(1) Rotation Unit									
(2) Irrigation Area (Rai)	paddy	31.5	-	48.4	46.2	47.5	48.1	40.8	
	Other Crops	14.5	29.6	-	-	-	-	-	
(3) Daily Water Requirement (mm/day)	paddy	10.8	-	10.8	10.8	10.8	10.8	10.8	
	Other Crops	4.6	4.6	-	-	-	-	-	
(4) Converted to paddy Area (Rai)		37.7	12.6	48.4	46.2	47.5	48.1	40.8	281.3
area $x\frac{4.6}{10.8}$ + paddy area									
(5) Irrigation Interval (days)		7	7	7	7	7	7	7	
(6) Irrigation Hours for every Unit (hrs)		22.5	7.5	29.0	27.5	28.5	28.5	24.5	168
7 days x 24 hrs x $\frac{(4)}{281.3}$									

Intake No..2

Irrigation Area : Paddy 2625 rai + Other Crops 44.1 rai = 3066 rai																Dry Season	
No. of Rotation Unit	7	Rotation Unit	1		2		3		4		5		6		7		
Area of Rotation Unit (rai)			P 315		P —		P 484		P 46.2		P 475		P 48.1		P 408		
			O 14.5		O 29.6		O —		O —		O —		O —		O —		
Plot No.																	
Duration of Irrigation (hrs)			225	45	7.5	15	29	58	27.5	55	285	57	28.5	57	245	49.0	
Irrigation Order	Time of Irrigation	From	8:00AM	8:00AM	6:30AM	5:00AM	14:00PM	8:00PM	19:00PM	6:00AM	22:30PM	13:00AM	3:00AM	22:00PM	7:30AM	7:00AM	
		To	6:30AM	5:00AM	14:00PM	8:00PM	19:00PM	6:00AM	22:30PM	13:00PM	3:00AM	22:00PM	7:30AM	7:00AM	8:00AM	8:00AM	
	Water Requirement (ℓ/sec)		2625 rai × 0.20 ℓ/rai + 441 rai × 0.085 ℓ/rai = 562.5 ℓ/sec														
1	Feb/Mar	Nursery	15		16		16/17		18		19		20		21		
2		Land		22/23		24		24/26		27/28		'1/2		3/4		5/6	
3	Mar	Prepare	7		8		8/9		10		11		12		13		
4		Transplant	14		15		15/16		17		18		19		20		
5			21		22		22/23		24		25		26		27		
6			28		29		29/30		31		1		2		3		
7	Apr		4		5		5/6		7		8		9		10		
8			11		12		12/13		14		15		16		17		
9			18		19		19/20		21		22		23		24		
10			25		26		26/27		28		29		30		1		
11	May		2		3		3/4		5		6		7		8		
12			9		10		10/11		12		13		14		15		
13																	
14																	
15																	
16																	
17																	
18																	
19																	
20																	

IRRIGATION SCHEDULE

Service Unit　　Intake No.2　　Rotation Block　　No. 2　　Wet Season

		1	2	3	4	5	6	7		Total
(1)	Rotation Unit									
(2)	Irrigation Area (rai) paddy	31.5	—	484	46.2	47.5	481	408		
	other Crops	145	29.6	—	—	—	—	—		
(3)	Daily Water Requirement (mm/day) paddy	10.8	—	10.8	10.8	10.8	10.8	10.8		
	other crops	4.6	4.6	—	—	—	—	—		
(4)	Converted to paddy Area (rai)	37.7	12.6	484	462	47.5	481	408		2813
	area $\times \frac{4.6}{10.8}$ + paddy area									
(5)	Irrigation Interval (days)	7	7	7	7	7	7	7		
(6)	Irrigation Hours for every Unit (hrs)	22.5	7.5	29.0	27.5	28.5	28.5	24.5		168
	7 days × 24 hrs × $\frac{(4)}{281.3}$									

Intake No. 3

Irrigation Area : Paddy 297.9 rai + Other Crops 46.5 rai = 344.4 rai																											
Wet Season																											
No. of Rotation Unit	7	Rotation Unit		1		2		3		4		5		6		7											
Area of Rotation Unit (rai)				P 317 O 123		P 399 O 29		P 287 O 31.3		P 522 O —		P 404 O —		P 57.6 O —		P 47.4 O —											
Plot No.																											
Duration of Irrigation (hrs)				19.5	39.0	22.0	44.0	22.0	44.0	27.5	55	21.5	43.0	30.5	61.0	25.0	50.0										
Irrigation Order	Time of Irrigation			8:00AM	8:00AM	3:30AM	11:00PM	11:30AM	7:00PM	11:30PM	3:00PM	3:00AM	10:00PM	0:30AM	5:00PM	7:00AM	6:00AM										
				3:30AM	11:00PM	1:30AM	7:00PM	11:30PM	3:00PM	3:00AM	10:00PM	0:30AM	5:00PM	7:00AM	6:00AM	8:00AM	8:00AM										
	Water Requirement (ℓ/sec)			$297.9^{rai} \times 0.20^{ℓ/rai} + 46.5^{rai} \times 0.085^{ℓ/rai} = 63.5^{ℓ/sec}$																									
1	June	Nursery		15		16		17		17/18		19		20		21											
2		Land			22/23		24/25		25/27		27/29		29/1		1/3		3/5										
3	July	Prepar			6/7		8/9		9/11		11/13		13/15		15/17		17/19										
4		Trans		20		21		22		23		24		25		26											
5				27		28		29		30		31		1		2											
6				3		4		5		6		7		8		9											
7	Aug			10		11		12		13		14		15		16											
8				17		18		19		20		21		22		23											
9				24		25		26		27		28		29		30											
10				31		1		2		3		4		5		6											
11				7		8		9		10		11		12		13											
12	Sep																										
13																											
14																											
15																											

IRRIGATION SCHEDULE

Service unit — Intake No.3 — Rotation Block — No.3 — Wet Season

		1	2	3	4	5	6	7	Total
(1)	Rotation Unit								
(2)	Irrigation Area(rai) paddy	31.7	39.9	28.7	52.2	40.4	57.6	47.4	297.9
	other crops	12.3	2.9	31.3	—	—	—	—	46.5
(3)	Daily Water Requirement (mm/day) paddy	10.8	10.8	10.8	10.8	10.8	10.8	10.8	
	other crops	4.6	4.6	4.6	—	—	—	—	
(4)	Converted to paddy Area (rai)	36.9	41.1	42.0	52.2	40.4	57.6	47.4	317.6
	area $\times \frac{4.6}{10.8}$ + paddy area								
(5)	Irrigation Interval (days)	7	7	7	7	7	7	7	
(6)	Irrigation Hours for every Unit (hrs)	19.5	22.0	22.0	27.5	21.5	30.5	25.0	168
	7 days × 24 hrs × $\frac{(4)}{317.6}$								

Intake No. 4

Irrigation Area : Paddy 466.5 rai + Other crops 101.5 rai = 5680 rai																Wet Season	
No. of Rotation Unit	7	Rotation Unit	1		2		3		4		5		6		7		
Area of Rotation Unit (rai)			P 92.1 O —		P 88.2 O —		P — O 83.2		P 88.7 O 2.0		P 75.3 O 16.3		P 67.3 O —		P 54.9 O —		
Plot No																	
Duration of Irrigation (hrs)			30.5	61.0	29.5	59.0	12.0	24.0	30.0	60.0	25.5	51.0	22.5	45.0	18.0	36.0	
Irrigation Order	Time of Irrigation	From	8:00AM	8:00AM	14:30PM	9:00PM	20.00PM	8:00AM	8:00AM	8:00AM	14:00PM	8:00PM	15:30PM	11:00PM	14:00PM	8:00PM	
		To	14:30PM	9:00PM	20:00PM	8:00AM	8:00AM	8:00AM	14:00AM	8:00PM	15:30PM	11:00PM	14:00PM	8:00AM	8:00AM	8:00AM	
	Water Requirement (ℓ/sec)		$466.5^{rai} \times 0.2^{\ell/rai} + 1015^{rai} \times 0085^{\ell/rai} = 1019^{\ell/sec}$														
1	June	Nursery	15		16		17		18		19		20		21		
2		Land prepare		22/24		24/26		26/27		28/30		30/2		2/4		4/5	
3	July			5/7		7/9		9/10		11/13		13/15		15/17		17/18	
4		Transplant	19		20		21		22		23		24		25		
5			26		27		28		29		30		31		1		
6	Aug		2		3		4		5		6		7		8		
7			9		10		11		12		13		14		15		
8			16		17		18		19		20		21		22		
9	Sep		23		24		25		26		27		28		29		
10			30		31		1		2		3		4		5		
11			6		7		8		9		10		11		12		
12			13		14		15		16		17		18		19		
13			20		21		22		23		24		25		26		
14			27		28		29		30		1		2		3		
15			4		5		6		7		8		9		10		

IRRIGATION SCHEDULE

Service Unit　　Intake No. 4　　Rotation Block　　No. 4　　Wet Season

		1	2	3	4	5	6	7	Total
(1)	Rotation Unit								
(2)	Irrigation Area (rai) paddy	92.1	88.2	—	88.7	75.3	67.3	54.9	466.5
	other crops	—	—	83.2	2.0	16.3	—	—	101.5
(3)	Daily Water requirement (mm/day) paddy	10.8	10.8	—	10.8	10.8	10.8	10.8	
	other crops	—	—	4.6	4.6	4.6	—	—	
(4)	Converted to paddy Area (rai)	92.1	88.2	35.4	89.5	77.2	67.3	54.9	504.6
	area $\times \frac{46}{108}$ + paddy area								
(5)	Irrigation Interval (days)	7	7	7	7	7	7	7	
(6)	Irrigation Hours for every Unit (hrs)	30.5	29.5	12.0	30.0	25.5	22.5	18.0	
	7 days × 24 hrs × $\frac{(4)}{504.6}$								

Intake No. 5

Irrigation Area : Paddy 247.0 rai + Other Crops 249 rai = 271.9 rai														Wet Season					
No. of Rotation Unit	7	Rotation Unit		1		2		3		4		5		6		7			
Area of Rotation Unit (rai)				P 39.4 O —		P 20.3 O 22.9		P 42.6 O —		P 42.6 O —		P 43.9 O 2.0		P 38.0 O —		P 25.0 O —			
Plot No.																			
Duration of Irrigation (hrs)				25.5	51.0	19.5	39.0	28.0	56.0	29.0	58.0	24.5	49.0	25.0	50.0	16.5	33.0		
Irrigation Order	Time of Irrigation		From To	8:00AM 9:30AM	8:00AM 11:00AM	9:30AM 5:00AM	11:00AM 2:00AM	5:00AM 9:00AM	2:00AM 10:00AM	9:00AM 14:00PM	10:00AM 20:00PM	14:00PM 14:30PM	20:00PM 21:00PM	14:30PM 15:30PM	21:00PM 23:00PM	15:30PM 8:00AM	23:00PM 8:00AM		
	Water Requirement (ℓ/sec)			$247.0^{rai} \times 0.2^{\ell/rai} + 249^{rai} \times 0.085^{\ell/rai} = 51.5^{\ell/sec}$															
1	June	Nursery		15		16		17		18		19		20		21			
2		Land prepare			22/23		24/25		26/27		28/30		1/2		3/4		4/5		
3	July				6/7		8/9		10/11		12/14		15/16		17/18		18/19		
4		Transplant		20		21		22		23		24		25		26			
5				27		28		29		30		31		1		2			
6	Aug			3		4		5		6		7		8		9			
7				10		11		12		13		14		15		16			
8				17		18		19		20		21		22		23			
9				24		25		26		27		28		29		30			
10	Sep			31		1		2		3		4		5		6			
11				7		8		9		10		11		12		13			
12																			
13																			
14																			
15	Oct																		

IRRIGATION SCHEDULE

Service Unit — Intake No.5 — Rotation Block — No.5 — Wet Season

		1	2	3	4	5	6	7	Total
(1)	Rotation Unit								
(2)	Irrigation Area (rai) paddy	39.4	20.3	42.6	43.9	37.3	38.0	25.5	247.0
	other crops	—	22.9	—	2.0	—	—	—	24.9
(3)	Daily Water requirement (mm/day) paddy	10.8	10.8	10.8	10.8	10.8	10.8	10.8	
	other crops	—	4.6	—	4.6	—	—	—	
(4)	Converted to paddy Area (rai)	39.4	30.1	42.6	44.8	37.3	38.0	25.5	257.7
	Area $\times \frac{4.6}{10.8}$ + paddy Area								
(5)	Irrigation Interval (days)	7	7	7	7	7	7	7	
(6)	Irrigation Hours for every Unit (hrs)	25.5	19.5	28.0	29.0	24.5	25.0	16.5	
	7 days × 24hrs × $\frac{(4)}{257.7}$								

Intake No. 6

Irrigation Area : Paddy 140.7 rai + Other Crops — rai = 140.7 rai																Wet Season	
No. of Rotation Unit	7	Rotation Unit	1		2		3		4		5		6		7		
Area of Rotation Unit (rai)			P 27.9 O —		P 20.4 O —		P 21.8 O —		P 12.0 O —		P 17.6 O —		P 20.5 O —		P 20.5 O —		
Plot No.																	
Duration of Irrigation (hrs)			3.35	6.7.0	2.45	4.90	2.60	5.20	1.40	2.80	2.1.0	4.2.0	2.45	4.9.0	2.4.5	4.90	
Irrigation Order	Time of Irrigation	From To	8:00AM 17:30PM	8:00AM 3:00AM	17:30PM 18:00PM	3:00AM 4:00AM	18:00PM 20:00PM	4:00AM 8:00AM	20:00PM 10:00AM	8:00AM 12:00PM	10:00AM 7:00AM	12:00AM 6:00AM	7:00AM 7:30AM	6:00AM 7:00AM	7:30AM 8:00AM	7:00AM 8:00AM	
	Water Requirement(ℓ/sec)		1407 rai × 02 ℓ/rai + 0 rai × 0085 ℓ/rai = 281 ℓ/sec														
1	June	Nursery	15		16		17		18		19		20		21		
2		Land prepare		22/24		24/25		26/27		28/29		30/1		2/		4/5	
3				6/8		8/9		10/11		12/13		14/15		16/17		18/19	
4	July	Transplant	20		21		22		23		24		25		26		
5			27		28		29		30		31		1		2		
6			3		4		5		6		7		8		9		
7			10		11		12		13		14		15		16		
8	Aug		17		18		19		20		21		22		23		
9			24		25		26		27		28		29		30		
10			31		1		2		3		4		5		6		
11			7		8		9		10		11		12		13		
12	Sep																
13																	
14																	
15	Oct																

IRRIGATION SCHEDULE

Service Unit — Intake No. 6 — Rotation Block — No. 6 — Wet season

		1	2	3	4	5	6	7	Total
(1)	Rotation Unit								
(2)	Irrigation Area (rai) paddy	27.9	20.4	21.8	12.0	17.6	20.5	20.5	140.7
	other crops	—	—	—	—	—	—	—	
(3)	Daily Water requirement (mm/day) paddy	10.8	10.8	10.8	10.8	10.8	10.8	10.8	
	other crops	—	—	—	—	—	—	—	
(4)	Converted to paddy Area (rai)	27.9	20.4	21.8	12.0	17.6	20.5	20.5	140.7
	Area $\times \frac{4.6}{10.8}$ + Paddy Area	—	—	—	—	—	—	—	
(5)	Irrigation Interval (days)	7	7	7	7	7	7	7	
(6)	Irrigation hours for every Unit (hrs)	33.5	24.5	26.0	14.0	21.0	24.5	24.5	168
	7 days × 24 hrs × $\frac{(4)}{140.7}$								

Intake No.1

BLOCK No.	Field No.	ACREAGE
(Intake No. 1)		
1	31	14−1−27
	29	6−0−43
	30	4−3−50
	21	8−1−04
	22	4−2−74
		38−0−98
2	20	7−3−84
	19	7−1−46
	18	8−0−64
	1	15−1−03
	34	2−3−00
		41−1−97
3	32	3−0−81
	36	10−3−65
	28	16−1−70
	27	6−2−69
	37	6−3−63
		44−0−48
4	28	5−0−0
	23	14−3−28
	26	22−0−80
		42−0−08
5	24	6−0−73
	15	18−3−90
	16	5−2−72
	17	4−1−68
	2	4−3−54
	35	2−1−70
		42−2−27
6	12	6−1−50
	33	1−3−18
	13	5−2−06
	14	15−1−27
	5	5−1−39
	3	7−0−71
	4	0−3−59
		42−1−70
7	25	8−0−40
	11	6−2−53
	10	9−1−20
	6	15−3−86
		39−3−99

Intake No. 2

BLOCK No.	Field No.	ACREAGE	BLOCK No.	Field No.	ACREAGE
	72	2-3-64		71	10-3-60
	73	4-0-05		70	12-0-00
	7	3-3-67	4	59	5-0-05
	22	4-1-79		60	6-3-41
	5	5-0-23		61	11-1-83
1	70	14-0-73			
	69	6-0-08			46-0-89
	8	1-0-02		61	7-0-00
	9	0-0-80		55	16-2-68
	6	4-1-29	5	54	23-3-19
		S 14.5			
		46-0-30			47-1-87
	4	5-3-98		51	7-0-52
	3	6-0-92		52	5-3-70
2	2	8-1-66		53	6-2-11
	1	8-3-74	6	9	8-0-13
				8	7-0-80
		29-2-30		7	13-1-20
	67	6-3-69			
	66	7-1-82			48-0-46
	63	7-1-69		1	3-0-41
	65	3-3-25		2	3-2-81
3	64	4-2-06		3	8-1-63
	62	11-3-75		50	4-1-62
	68	6-1-41	7	49	4-0-41
				48	5-0-42
		48-1-67		47	10-0-04
				130	2-0-01
					40-3-35

Intake No. 3

BLOCK No.	Field No.	ACREAGE
1	16	16-2-66
	17	7-2-92
	18	6-1-16
	19	12-1-26
	23	1-0-15
		(S 12.3)
		44-0-15
2	103	9-3-11
	15	9-1-88
	14	9-3-47
	13	9-3-47
	12	8-3-62
	11	2-3-56
		(S 2.9)
		42-3-11
3		(8-2-12)
	V	(20-3-19)
	128	5-0-23
	104	11-2-75
	105	11-3-95
		(V 31.3)
		2-93
4	90	20-2-79
	89	5-0-63
	88	4-2-22
	87	4-3-82
	86	16-3-38
		52-0-84
5	102	11-0-74
	91	6-1-85
	134	4-1-81
	92	6-0-24
	93	4-1-10
	101	8-0-00
		40-1-74
6	101	18-1-05
	94	17-2-45
	133	6-2-92
	85	6-3-73
	84	8-0-28
		57-2-43
7	81	5-0-75
	125	9-0-97
	76	10-0-98
	125	9-0-97
	82	9-1-77
	75	3-2-60
	74	0-1-74

Intake No.4

BLOCK No.	Field No.	ACREAGE
1	2	5－0－98
	1	3－1－63
	3	9－2－63
	21	5－1－82
	20	8－3－34
	122	15－2－16
	120	6－0－86
	119	6－0－85
	118	4－3－13
	117	5－1－78
	116	4－2－33
	115	5－0－32
	114	4－3－78
	113	6－2－70
		92－0－31
2	110	17－0－54
	109	5－0－45
	112	6－3－10
	111	6－3－50
	106	7－2－28
	107	3－1－63
	108	5－0－31
	138	5－2－18
	96	4－2－98
	97	6－0－46
	98	5－3－26
	99	4－2－70
	100	9－3－54
		88－0－93
3	6	15－2－28
	5	15－1－08
	4	16－2－56
	7	17－1－37
	112	18－1－38
		83－0－67

BLOCK No.	Field No.	ACREAGE
4	111	10－0－97
	110	10－2－18
	137	1－3－63
	136	1－3－09
	135	2－0－16
	109	12－0－25
	108	17－0－58
	107	7－0－94
	106	9－0－43
	105	9－1－37
	104	8－3－36
		(S20)
		90－2－96
5	103	1－3－64
	102	30－2－57
	100	36－2－28
	78	4－0－07
	101	8－0－69
	95	10－1－30
		(S16.3)
		91－2－55
6	77	4－0－07
	76	2－3－25
	127	17－3－73
	80	27－1－63
	132	15－0－63
		67－1－31
7	75	2－0－84
	73	1－1－22
	74	1－0－82
	68	0－2－01
	72	1－2－83
	71	1－0－02
	70	1－0－02
	69	2－0－04
	78	10－1－36
	77	33－2－25
		54－3－41

Intake No.5

BLOCK No.	Field No.	ACREAGE
1	58	4－3－92
	56	20－0－33
	46	8－0－00
	45	3－1－47
	44	3－0－00
		39－1－72
2	42	22－3－64
	41	6－3－91
	131	4－2－34
	19	4－0－35
	20	4－2－74
		43－0－98
3	40	2－3－82
	39	5－0－33
	37	1－3－70
	36	5－0－00
	21	4－3－93
	22	4－2－74
	23	4－3－93
	24	4－3－93
	25	8－0－00
		42－2－38
4	36	5－1－46
	25	17－3－26
	35	16－0－32
	33	1－3－83
	26	3－0－49
	35	1－2－07
		45－3－43

BLOCK No.	Field No.	ACREAGE
5	46	10－0－51
	45	5－0－00
	44	6－0－39
	4	4－2－02
	5	5－3－08
	6	5－3－00
		37－1－00
6	43	5－1－52
	140	2－3－18
	9	2－2－70
	10	5－1－91
	11	5－3－51
	7	5－2－82
	8	10－0－44
		38－0－08
7	12	9－3－84
	18	15－2－01
		25－1－85
		271－3－44

Intake No. 6

BLOCK No.	Field No.		BLOCK No.	Field No.	
	1	5−2−78			
	14	5−3−18			
1	3	16−1−65			
		27−3−61			
	40	5−3−98			
	39	4−3−50			
2	38	5−0−38			
	37	4−1−59			
		20−1−45			
	4	21−3−37			
3					
		21−3−37			
4	3	12−0−0			
		12−0−0			
	138	1−3−19			
	32	7−0−22			
	141	0−2−96			
5	27	2−2−12			
	28	5−1−83			
		17−2−32			
	30	20−1−85			
6					
		20−1−85			
	30	7−0−0			
	29	1−0−39			
7	2	12−1−79			
		20−2−18			140−2−78

9. 英文報告書"Planing and Design Standards On-farm Works"

KINGDOM OF THAILAND

MINISTRY OF AGRICULTURE AND CO-OPERATIVES

ROYAL IRRIGATION DEPARTMENT

MAE KLONG PILOT PROJECT NO. 2

REPORT ON
PLANNING AND DESIGN STANDARDS
ON-FARM WORKS

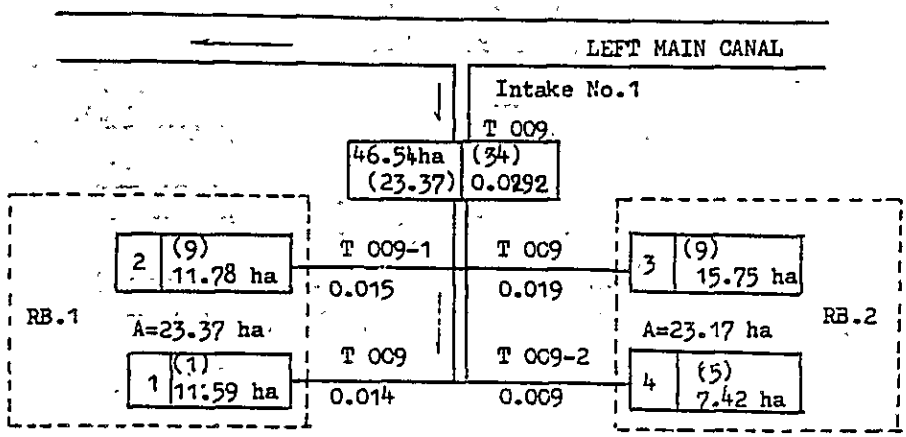
By

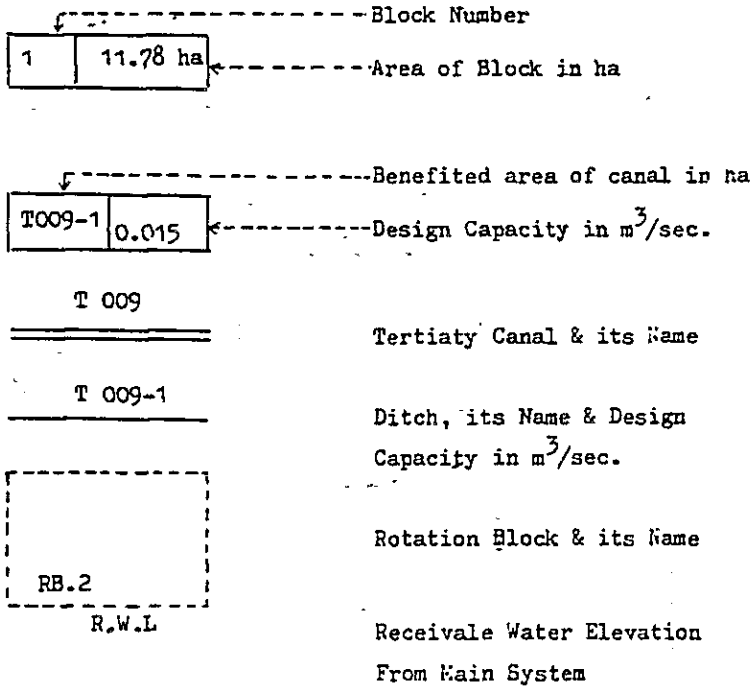
T. MIYATSU, EXPERT FOR LAND CONSOLIDATION

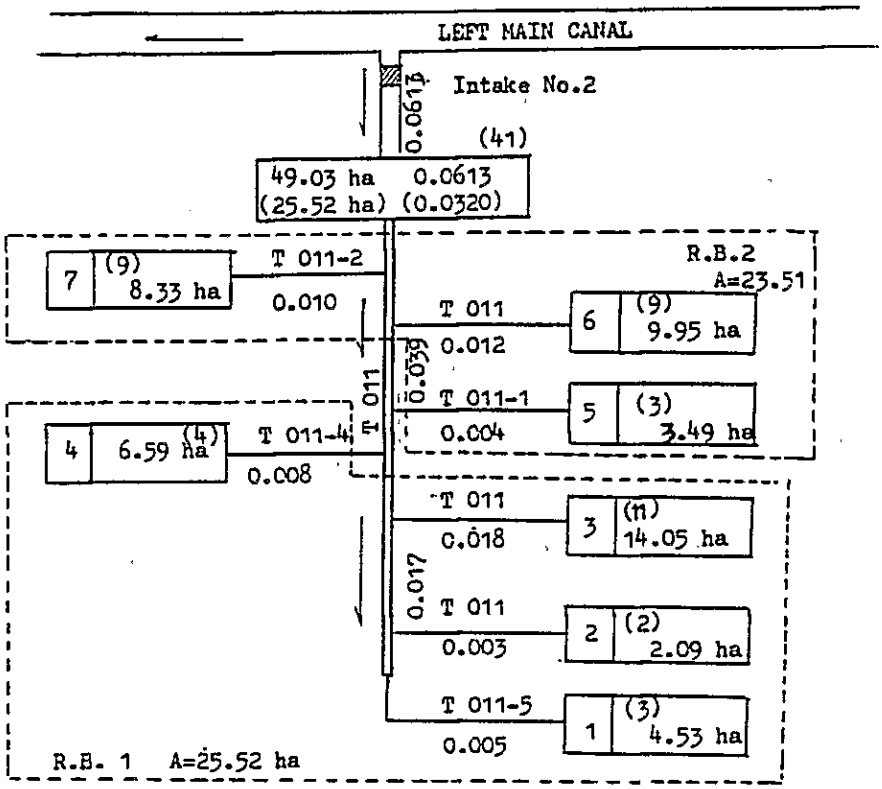
Fig -

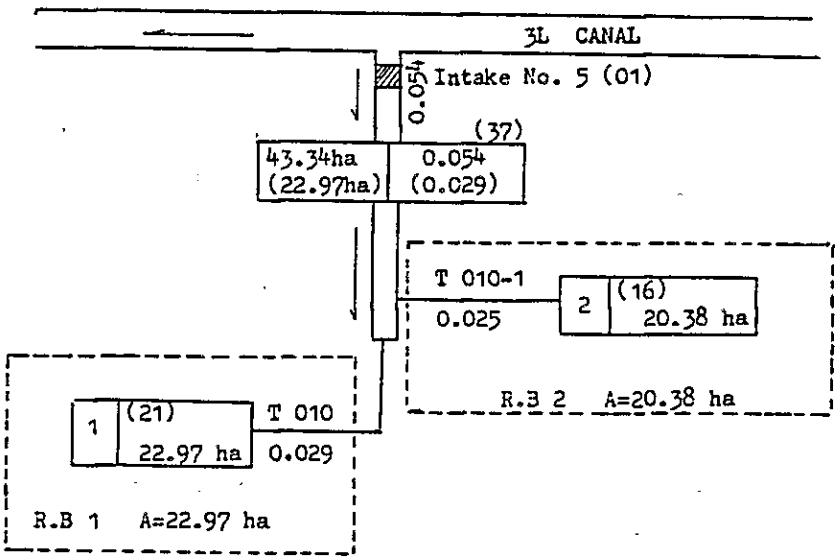
FLOW CHART OF IRRIGATION

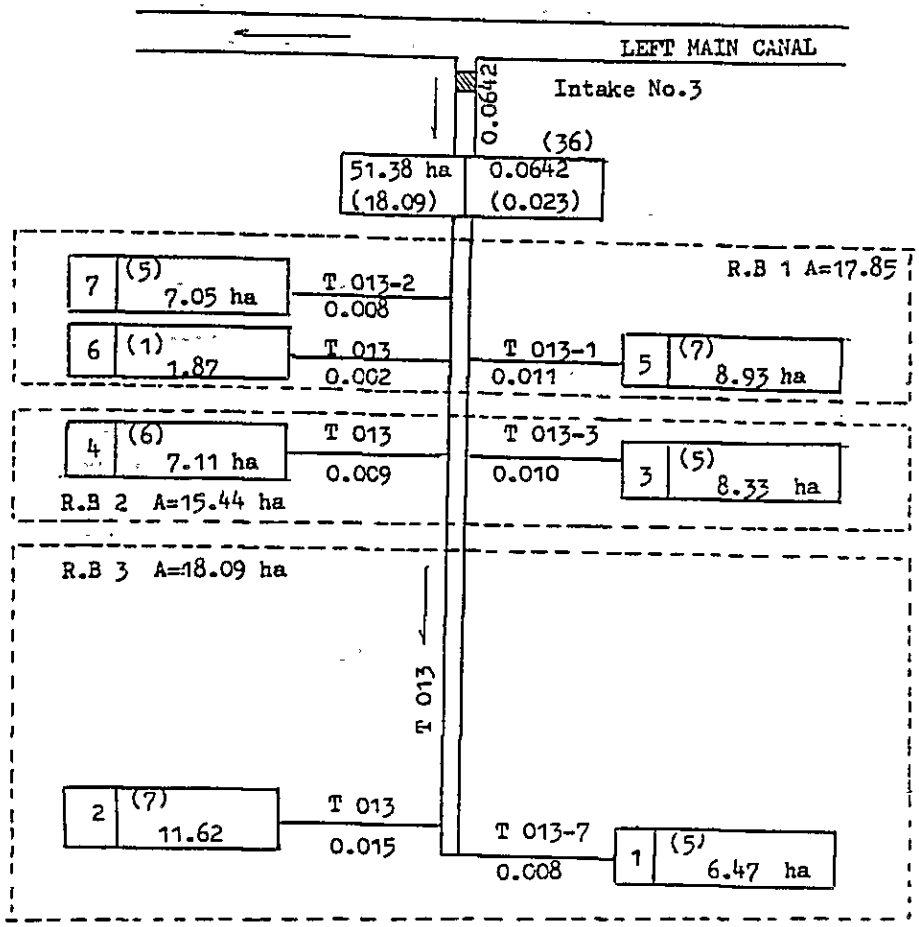
Service Unit : Intake No. 1

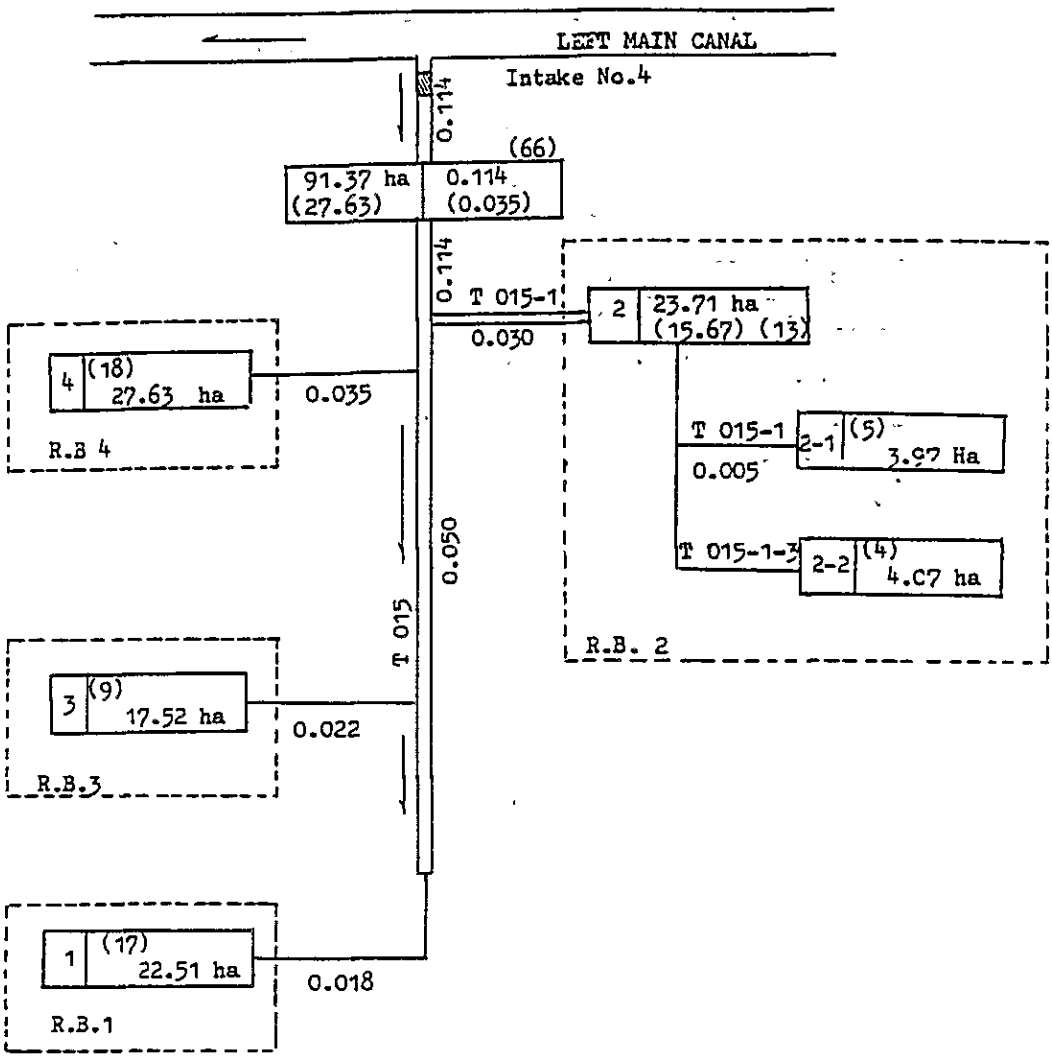


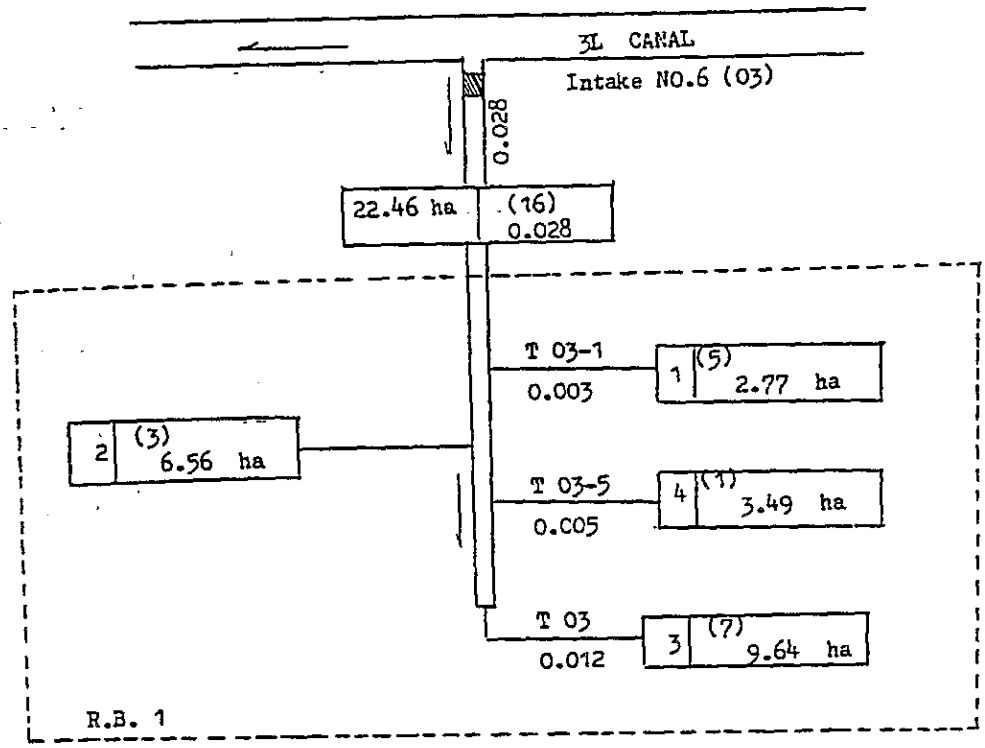



LEFT MAIN CANAL
Intake No.2
0.0613
(41)
49.03 ha 0.0613
(25.52 ha) (0.0320)
R.B.2
A=23.51
7 (9) 8.33 ha
T 011-2
0.010
T 011
0.012
6 (9) 9.95 ha
0.039
T 011-1
0.004
5 (3) 3.49 ha
T 011
4 6.59 ha (4)
T 011-4
0.008
T 011
0.018
3 (11) 14.05 ha
0.017
T 011
0.003
2 (2) 2.09 ha
T 011-5
0.005
1 (3) 4.53 ha
R.B. 1 A=25.52 ha


3L CANAL
Intake No. 5 (01)
0.054
(37)
43.34ha 0.054
(22.97ha) (0.029)
T 010-1
0.025
2 (16) 20.38 ha
R.B 2 A=20.38 ha
1 (21) 22.97 ha
T 010
0.029
R.B 1 A=22.97 ha


LEFT MAIN CANAL
Intake No.3
0.0642
(36)
51.38 ha
(18.09)
0.0642
(0.023)
R.B 1 A=17.85
7
(5)
7.05 ha
T 013-2
0.008
6
(1)
1.87
T 013
0.002
T 013-1
0.011
5
(7)
8.93 ha
4
(6)
7.11 ha
T 013
0.009
T 013-3
0.010
3
(5)
8.33 ha
R.B 2 A=15.44 ha
R.B 3 A=18.09 ha
T 013
2
(7)
11.62
T 013
0.015
T 013-7
0.008
1
(5)
6.47 ha


LEFT MAIN CANAL
Intake No.4
0.114
(66)
91.37 ha
(27.63)
0.114
(0.035)
0.114
T 015-1
0.030
2
23.71 ha
(15.67) (13)
4
(18)
27.63 ha
0.035
R.B 4
T 015-1
2-1
(5)
3.97 Ha
0.005
T 015-1-3
2-2
(4)
4.07 ha
R.B. 2
0.050
T 015
3
(9)
17.52 ha
0.022
R.B.3
1
(17)
22.51 ha
0.018
R.B.1


3L CANAL
Intake NO.6 (03)
0.028
22.46 ha
(16)
0.028
T 03-1
0.003
1
(5)
2.77 ha
2
(3)
6.56 ha
T 03-5
0.005
4
(1)
3.49 ha
T 03
0.012
3
(7)
9.64 ha
R.B. 1

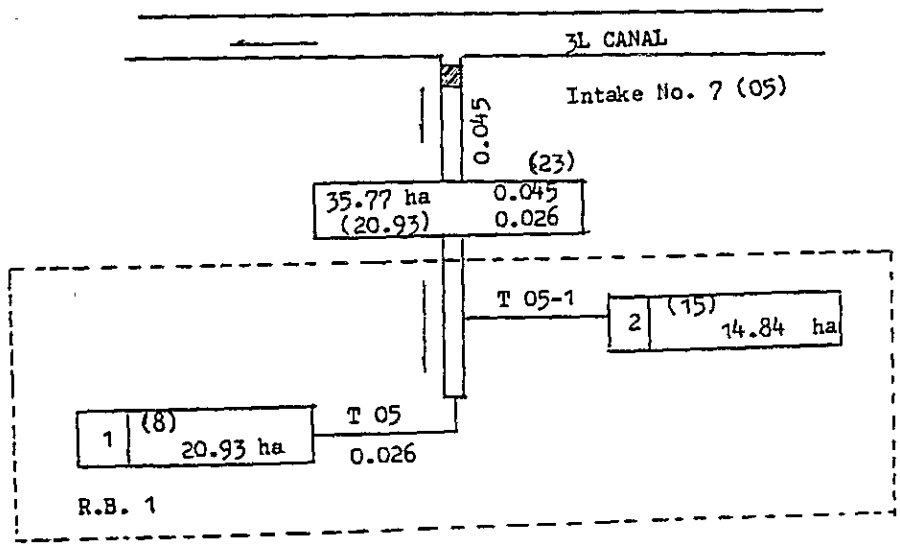

3L CANAL
Intake No. 7 (05)
0.045
(23)
35.77 ha
(20.93)
0.045
0.026
T 05-1
2
(15)
14.84 ha
1
(8)
20.93 ha
T 05
0.026
R.B. 1

Table of the Irrigation Canal

Route No.	Irrigation area (ha)	Water require -ment (m)	Canal distance (m)	Head (m)	Canal slope	Qc (m^3/s)	Canal size (m)			
							B	D	H	N
	(46.45)	(0.058)								
Intake No.1	23.37	0.029					0.40	0.30	0.50	
T CC9	(11.59)	0.014	430	0.143	1/3000	0.016	0.30	0.25	0.35	B1
T CC9 -1	(11.78)	0.015	495	0.165	"	"	0.30	0.25	0.35	"
	(15.75)									
T OC9	23.17	0.029	505	0.168	1/3000	0.029	0.40	0.30	0.50	B2
T OC9-2	(7.42)	0.009	210	0.07	"	0.016	0.30	0.25	0.35	"
			1,640							
	(49.03)	(0.061)								
Intake No.2	25.52	0.032								
	(14.05)									
T 011	25.52	0.032	955	0.191	1/5000	0.036	0.50	0.35	0.45	B1
T 011-5	(4.53)	0.005	75	0.025	1/3000		0.30	0.25	0.35	"
T 011	(2.09)	0.003	50	0.02	"		0.30	0.25	0.35	"
T 011-4	(6.59)	0.008	255	0.085	"		0.30	0.25	0.35	"
	(9.95)									
T 011	23.51	0.029	530	0.106	1/5000	0.036	0.50	0.35	0.45	B2
T 011-1	(3.49)	0.004	130	0.043	1/3000		0.30	0.25	0.35	"
T 011-2	(8.33)	0.010	285	0.095	"		0.30	0.25	0.35	"
			2,280							
	(46.17)	(0.058)								
Intake No.3	18.09	0.023								
	(11.62)	(0.015)	(465)	(0.155)	(1/3000)	(0.016)	0.30	0.25	0.35	
T 013	18.09	0.023			1/5000					B1
T 013 -7	6.47	0.008	125	0.042	1/3000		0.30	0.25	0.35	"
	(7.11)									
T 013	15.44	0.023	445	0.148	1/3000	0.029	0.40	0.30	0.40	B2
T 013-3	(8.55)	0.010	240	0.08	"		0.30	0.25	0.35	"
T 013	11.09	0.023	380	0.076	1/5000	0.026	0.50	0.30	0.50	B3
T 013-1	7.93	0.011	350	0.117	1/3000	0.016	0.30	0.25	0.35	"
T 013-2	7.05	0.008	220	0.073	"	0.016	0.30	0.25	0.35	"
			2.345							

Table of the Irrigation Canal

Route No.	Irrigation area(ha)	Water requirement(m)	Canal distance (m)	Head (m)	Canal slope	Qc (m^3/s)	Canal size (m) B	D	H	N
	(91.37)	0.114								
Intake No.4	27.63	0.035								
T 015	22.51	0.028	585	0.195	1/3000	0.029	0.40	0.30	0.40	B1
T 015	17.52	(0.022) (0.028)	530	0.106	1/5000	0.036	0.50	0.35	0.45	B2
T 015	19.56	0.0244	680	0.136	"	0.036	0.50	0.35	0.45	B3
	23.71	0.030								
T 015-1	(8.07)	(0.010)	685	0.137	"	0.036	0.50	0.35	0.45	"
T 015-1	15.67	0.020	605	0.121	"	0.021	0.40	0.30	0.40	B4
T 015-1-3	4.07	0.005	120	0.04	1/3000	0.016	0.30	0.25	0.35	"
T 015-1-1	3.97	0.005	210	0.07	"	"	0.30	0.25	0.35	"
			3,415							
	(43.35)	0.054								
Intake No.5	22.97	0.029								
T 010	22.97	0.029	660	0.216	1/3000	0.35	0.50	0.30	0.45	B1
T 010	17.67	0.022	480	0.096	1/5000	0.023	0.40	0.30	0.40	"
T 010-1	20.38	0.025	735	0.147	"	0.027	0.50	0.30	0.40	B2
			1,875							
Intake No.6	22.46	0.028								
L 7	9.64	0.012	320	0.11	1/3000	0.016	0.30	0.25	0.35	B1
L 7-1	2.77	0.003	350	0.12	"	"	"	"	"	"
L 7-3	2.56	0.008	225	0.075	"	"	"	"	"	"
L 7-5	3.49	0.005	230	0.077	"	"	"	"	"	"
			1,125							
	(35.77)	0.045								
Intake No.6	20.93	0.026								
L 9	20.93	0.026	430	0.086	1/5000	0.027	0.50	0.30	0.40	B1
L 9-1	14.84	0.019	420	0.084	"	0.021	0.40	0.30	0.40	B2
			850							
			13,530							

Table of the Irrigation Canal ability

$$Q = A.V \qquad V = \frac{1}{n} \cdot R^{2/3} \cdot I^{1/2} \qquad n = 0.04$$

No.	(1)	(2)	(3)=1x2+2^2	2.828D+B (4)	A/P (5)	(6)	(7)	(7)x(6)xI$^{1/2}$ 1/1000		1/1500		1/2000		1/3000		1/5000	
								$I^{1/2}$ = 0.0316		$I^{1/2}$= 0.0258		$I^{1/2}$= 0.0224		$I^{1/2}$= 0.0183		$I^{1/2}$= 0.0141	
	B	D.	A	P	R	$R^{2/3}$	1/n	V	Q	V	Q	V	Q	V	Q	V	Q
1	1.30	0.65	1.267	3.138	0.404	0.546	25	0.431	0.546	0.352	0.446	0.305	0.387	0.250	0.316	0.192	0.244
2	1.20	0.60	1.080	2.897	0.323	0.471	25	0.371	0.402	0.304	0.328	0.264	0.285	0.215	0.233	0.166	0.179
3	1.00	0.65	1.072	2.838	0.378	0.523	25	0.413	0.443	0.337	0.362	0.293	0.314	0.239	0.256	0.184	0.198
4	1.00	0.60	0.96	2.697	0.356	0.502	25	0.396	0.381	0.324	0.311	0.281	0.270	0.230	0.220	0.177	0.170
5	0.90	0.40	0.520	2.031	0.256	0.403	25	0.318	0.165	0.260	0.135	0.226	0.117	0.184	0.096	0.142	0.074
6	0.70	0.40	0.440	1.831	0.240	0.386	25	0.305	0.134	0.249	0.109	0.216	0.095	0.176	0.078	0.136	0.060
7	0.60	0.40	0.400	1.731	0.231	0.377	25	0.298	0.119	0.243	0.097	0.211	0.084	0.172	0.069	0.133	0.053
8	0.50	0.45	0.427	1.772	0.241	0.387	25	0.306	0.130	0.250	0.107	0.217	0.092	0.177	0.076	0.136	0.058
9	0.50	0.40	0.360	1.631	0.221	0.366	25	0.289	0.104	0.236	0.085	0.205	0.074	0.167	0.060	0.129	0.046
10	0.50	0.35	0.297	1.490	0.199	0.341	25	0.269	0.080	0.220	0.065	0.191	0.057	0.156	0.046	0.120	0.036
11	0.40	0.25	0.162	1.107	0.146	0.277	25	0.219	0.035	0.179	0.029	0.155	0.025	0.127	0.021	0.098	0.016
12	0.30	0.25	0.137	1.007	0.136	0.264	25	0.208	0.028	0.165	0.023	0.148	0.020	0.121	0.016	0.093	0.013
13	0.40	0.60	0.60	2.097	0.286	0.434	25	0.343	0.206	0.280	0.168	0.243	0.146	0.198	0.119	0.153	0.092
14	0.40	0.50	0.45	1.814	0.248	0.395	25	0.312	0.140	0.255	0.115	0.221	0.100	0.181	0.081	0.139	0.063
15	0.40	0.40	0.32	1.531	0.209	0.352	25	0.278	0.089	0.227	0.073	0.197	0.063	0.161	0.052	0.124	0.040
16	0.50	0.50	0.50	1.914	0.261	0.408	25	0.322	0.161	0.263	0.132	0.228	0.114	0.187	0.093	0.144	0.072
17	0.50	0.60	0.66	2.197	0.300	0.448	25	0.354	0.234	0.289	0.191	0.251	0.166	0.205	0.135	0.158	0.104
18	0.50	0.70	0.84	2.480	0.339	0.486	25	0.384	0.323	0.313	0.263	0.272	0.229	0.222	0.187	0.171	0.144
19	0.50	0.80	1.04	2.267	0.376	0.521	25	0.412	0.428	0.336	0.349	0.292	0.303	0.238	0.248	0.184	0.191

Table of the Irrigation Canal ability

$$Q = A.V \qquad V = \frac{1}{n} . R^{2/3} . I^{1/2} \qquad n = 0.04$$

No.	(1)	(2)	(3)=1x2+2²	2.828D+B (4)	A/P (5)	(6)	(7)	(7)x(6)xI^1/2 1/1000 I^1/2 = 0.0316		1/1500 I^1/2 = 0.0258		1/2000 I^1/2 = 0.0224		1/3000 I^1/2 = 0.0183		1/5000 I^1/2 = 0.0141	
	B	D	A	P	R	R^2/3	1/n	V	Q	V	Q	V	Q	V	Q	V	Q
20	0.50	0.90	1.26	3.045	0.414	0.555	25	0.438	0.552	0.358	0.451	0.311	0.392	0.254	0.320	0.196	0.247
21	0.60	0.90	1.35	3.145	0.429	0.569	25	0.450	0.607	0.367	0.495	0.319	0.430	0.260	0.351	0.201	0.271
22	0.80	0.80	1.28	3.062	0.418	0.559	25	0.442	0.565	0.361	0.462	0.313	0.401	0.256	0.327	0.197	0.252
23	0.80	0.90	1.53	3.345	0.457	0.593	25	0.468	0.717	0.382	0.585	0.332	0.508	0.271	0.415	0.209	0.320
24	1.00	1.00	2.00	3.828	0.522	0.648	25	0.512	1.024	0.418	0.836	0.363	0.726	0.296	0.593	0.228	0.457
25	1.00	1.20	2.64	4.394	0.601	0.721	25	0.562	1.485	0.459	1.212	0.399	1.053	0.326	0.860	0.251	0.663
26	0.40	0.30	0.210	1.248	0.168	0.304	25	0.240	0.050	0.196	0.041	0.170	0.036	0.139	0.029	0.107	0.0225
	0.50	0.30	0.24	1.348	0.178	0.316	25	0.250	0.06	0.204	0.049	0.177	0.042	0.145	0.035	0.111	0.0267

No.	Drainage name	Catchment area (ha)	Drainage discharge (m^3/s)	Canal distance (m)	Head (m)	Canal slope	Canal size (m) B	D	H	Qc m^3/s
1	D2	21.94	0.126	580	0.290	1/2000	0.50		0.60	0.166
	D2Ō							ø 600		
2	D4-1	9.34	0.054	410	0.205	1/2000	0.50		0.50	0.114
3	D4-2	2.09	0.012	100	0.05	1/2000	0.50		0.50	0.114
4	D4-4	6.73	0.039	200	0.10	1/2000	0.50		0.50	0.114
				460	0.23	1/200	0.50		0.50	0.144
5	D4	23.59	0.136	420	0.21	1/2000	0.50		0.60	0.166
	D4.	41.75								
	D4Ō	41.75						ø 800		
6	D6-1	2.18	0.013	180	0.09	1/2000	0.50		0.50	0.114
7	D6	16.97	0.098	-	-	1/2000	0.50		0.50	0.114
	D6Ō	19.15	0.110	535	0.270	1/2000	0.50		0.50	0.114
								ø 600		
8	D8-1	5.04	0.029	85	0.05	1/2000	0.50		0.50	0.114
				625	0.32	1/2000	0.50		0.50	0.114
9	D8	20.66	0.119	530	0.265	1/2000	0.50		0.60	0.166
	D8Ō	25.70	0.148					ø 600		
10	D10-1	8.02	0.046	430	0.215	1/2000	0.50		0.50	0.114
11	D10-5-2	8.11	0.047	260	0.13	1/2000	0.50		0.50	0.114
				665	0.230	1/2000	0.50		0.60	0.166
12	D10-7	23.37	0.135	380	0.190	1/2000	0.50		0.60	0.166

13	D10-7-2			205	0.11	1/2000	0.50		0.50	0.093
		63.00	0.362	1170	0.585	1/2000	0.50		0.90	0.392
14	D10 U	105.40	0.607	540	0.27	1/2000	1.00		1.00	0.726
15	D10 L	163.43	0.941	280	0.14	1/2000	1.00		1.20	1.053
	D10$\bar{0}$	163.43	0.941	40.0	0.20			ø 1000		0.941
	D12-1	19.69	0.113	740	0.37	1/2000	0.50		0.50	0.114
	D12-2	30.81	0.177	650	0.325	1/2000	0.50		0.70	0.229
	D12	57.67	0.332	340	0.17	1/2000	0.50		0.90	0.392
	D12$\bar{0}$	108.17	0.623					ø 1000		

9.785

Drainage Canal Ability

1. Drainage D 2 $\quad Q = 0.126 \quad I = 1/4000$

$A = b \times d_1 + (1.5 \times d_1) \times d = 0.625 \qquad d_1 = 0.5$

$P = b + (d_1 \times \sqrt{1 + 1.5^2}) \times 2 = 0.50 + 3.605 = 2.3025$

$R = A/P = 0.625/2.3025 = 0.271$

$R^{2/3} = 0.271^{2/3} = 0.418$

$V = \frac{1}{N} R^{2/3} \cdot I^{1/2} = 25 \times 0.418 \times 0.0158 = 0.165$

$C = A \times V = 0.625 \times 0.165 = 0.103$

$A = 0.5 \times 0.55 + (1.5 \times 0.55) \times 0.55 = 0.729$

$P = 2.483$

$R = 0.729/2.483 = 0.2936$

$R^{2/3} = 0.4417$

$V = 25 \times 0.4417 \times 0.0158 = 0.1745$

$Q = 0.729 \times 0.1745 = 0.126 \ m^3/s$

2. Drainage D 4 $\quad Q = 0.240 \quad I = 1/1670$

$A = 0.50 \times 0.60 + (1.5 \times 0.61) \times 0.61 = 0.863$

$P = 2.809$

$R = 0.863/2.809 = 0.307$

$R^{2/3} = 0.455$

$V = 25 \times 0.455 \times 0.0245 = 0.278$

$Q = 0.863 \times 0.278 = 0.240 \qquad m^3/s$

3. Drainage D 6 $Q = 0.110\ m^3/s$ $I = 1/3850$

$A = 0.50 \times 0.50 + (1.5 \times 0.50) \times 0.50 = 0.625\ m^2$

$P = 0.50 + 0.50 \times 3.605 = 2.3025$

$R = 0.625 / 2.3025 = 0.271$

$R^{2/3} = 0.418$

$V = 25 \times 0.418 \times 0.01612 = 0.16845\ m/s$

$Q = 0.625 \times 0.168 = 0.105\ m^3/s$

$A = 0.50 \times 0.51 + (1.50 \times 0.51) \times 0.51 = 0.645\ m^2$

$P = 0.50 + 0.51 \times 3.605 = 2.3385\ m$

$R = 0.645 / 2.3385 = 0.276$

$R^{2/3} = 0.4237$

$V = 25 \times 0.4237 \times 0.01612 = 0.170\ m/s$

$Q = 0.645 \times 0.170 = 0.110\ m^3/s$

4. Drainage D 8 $Q = 0.544\ m^3/s$ $I = 1/2850$

$A = 1.50 \times 0.75 + \{1.5 \times 0.75\} \times 0.75 = 1.969\ m^2$

$P = 1.50 + 0.75 \times 3.605 = 4.204\ m$

$R = 1.969 / 4.204 = 0.4684$

$R^{2/3} = 0.603$

$V = 25 \times 0.603 \times 0.01875 = 0.2826\ m/s$

$Q = 1.969 \times 0.2826 = 0.556\ m^3/s$

$A = 1.50 \times 0.74 + (1.50 \times 0.74) \times 0.74 = 1.931 \ m^2$

$P = 1.50 + 0.74 \times 3.605 = 4.1677$

$R = 1.931/4.1677 = 0.4633$

$R^{2/3} = 0.5987$

$V = 25 \times 0.5987 \times 0.01875 = 0.280$

$Q = 1.931 \times 0.280 = 0.540 \ m^3/s$

5. Drainage D 10 $\quad Q = 0.529 \ m^3/s \quad I = 1/3100$

$A = 1.50 \times 0.78 + (1.50 \times 0.78) = 2.0826$

$P = 1.50 + 0.74 \times 3.605 = 4.1677$

$R = 2.0826 / 4.1677 = 0.4997$

$R^{2/3} = 0.630$

$V = 25 \times 0.630 \times 0.0179 = 0.2817$

$Q = 2.0826 \times 0.2817 = 0.586$

$A = 1.50 \times 0.80 + (1.50 \times 0.80) \times 0.80 = 2.160 \ m^2$

$P = 1.50 + 0.8 \times 3.605 = 4.384 \ m$

$R = 2.160 / 4.384 = 0.4927$

$R^{2/3} = 0.6238$

$V = 25 \times 0.6238 \times 0.0179 = 0.279 \ m/s$

$Q = 2.121 \times 0.279 = 0.592 \ m^3/s$

6. Drainage D 10 upper part Q = 0.472 m^3/s I = 1/3000

A = b x d + 1.5.d x d

= 1.5 x 0.70 + 1.5 x 0.70 x 0.70 = 1.785 m^2

P = b + 3.605 x d

= 1.5 + 3.605 x 0.70 = 4.0235

R = 1.785/4.0235 = 0.4436

$R^{2/3}$ = 0.5816

V = 25 x 0.5816 x 0.01826 = 0.2655 m/s

Q = 1.785 x 0.2655 = 0.4739 m^3/s

O.K !

A = 1.5 x 0.69 + 1.5 x 0.69 x 0.69 = 1.749 m^2

P = 1.5 + 3.605 x 0.69 = 3.987

R = 1.749 / 3.987 = 0.4387

$R^{2/3}$ = 0.577

V = 25 x 0.577 x 0.01826 = 0.263 m/s

Q = 1.749 x 0.263 = 0.460 m^3/s

NO !

7. Drainage D 12 Q = 0.623 m^3/s I = 1/2840

A = 1.50 x 0.84 + (1.5 x 0.84) x 0.84 = 2.318 m^2

P = 1.50 + 3.605 x 0.84 = 4.528 m

R = 2.318 / 4.528 = 0.512

$R^{2/3}$ = 0.640

V = 25 x 0.640 x 0.01876 = 0.300 m/s

Q = 2.318 x 0.300 = 0.695 m^3/s

NO !

8. Drainage D 10 - 1 $Q = 0.135\ m^3/s$ $I = 1/2180$

$A = 0.50 \times 0.45 + (1.5 \times 0.45) \times 0.45 = 0.5287\ m^2$

$P = 0.50 + 3.605 \times 0.45 = 2.122$

$R = 0.5287/2.122 = 0.249$

$R^{2/3} = 0.396$

$V = 25 \times 0.396 \times 0.0214 = 0.212\ m/s$

$Q = 0.5287 \times 0.212 = 0.112\ m^3/s$

NO.1

$A = 0.50 \times 0.50 + (1.5 \times 0.50) \times 0.50 = 0.625$

$P = 0.50 + 3.605 \times 0.50 = 2.303$

$R = 0.625/2.303 = 0.271$

$R^{2/3} = 0.419$

$V = 25 \times 0.419 \times 0.0214 = 0.224$

$Q = 0.625 \times 0.224 = 0.140$

O.K !

$A = 0.50 \times 0.49 + (1.5 \times 0.49) \times 0.49 = 0.60515\ m^2$

$P = 0.50 + 3.605 \times 0.49 = 2.2665$

$R = 0.60515/2.2665 = 0.267$

$R^{2/3} = 0.4146$

$V\ 25 \times 0.4146 \times 0.0214 = 0.2218\ m/s$

$Q = 0.605 \times 0.2218 = 0.134\ m^3/s$

NO !

9. Drainage D 14 $Q = 0.047\ m^3/s$ $I = 1/1358$

$A = 0.50 \times 0.40 + (1.5 \times 0.40) \times 0.40 = C.44\ m^2$

$P = 0.50 + 0.40 \times 3.605 = 1.942\ m$

$R = 0.44/1.942 = 0.2266$

$R^{2/3} = 0.372$

$V = 25 \times 0.372 \times 0.0271 = 0.252\ m/s$

$Q = 0.44 \times 0.252 = 0.111\ m^3/s$

10. Drainage D 16 $Q = 0.080\ m^3/s$ $I = 1/750$

$A = 0.50 \times 0.35 + (1.5 \times 0.35) \times 0.35 = C.358$

$P = 0.50 + 0.35 \times 3.605 = 1.762$

$R = 0.358/1.762 = 0.203$

$R^{2/3} = 0.345$

$V = 25 \times 0.345 \times 0.0365 = 0.315\ m/s$

$Q = 0.358 \times 0.315 = 0.113\ x^3/s$

$A = 0.50 \times 0.30 + (1.5 \times 0.30) \times 0.30 = 0.285\ m^2$

$P = 0.50 + 0.30 \times 3.605 = 1.5815\ m$

$R = 0.285/1.5815 = 0.1802$

$R^{2/3} = 0.319$

$V = 25 \times 0.319 \times 0.0365 = 0.291\ m/s$

$Q = 0.285 \times 0.291 = 0.0829$

O.K

$A = 0.50 \times 0.29 + (1.5 \times 0.29) \times 0.29 = 0.271$

$P = C.50 + 0.29 \times 3.605 = 1.545$

$R = o.271/1.545 = 0.1754$

$R^{2/3} = 0.313$

$V = 25 \times 0.313 \times 0.0365 = 0.2856\ m/s$

$Q = 0.271 \times 0.2856 = 0.0774\ m^3/s$

NO. !

$A = 1.50 \times 0.82 + (1.50 \times 0.82) \times 0.82 = 2.2386 \ m^2$

$P = 1.50 + 3.605 \times 0.82 = 4.456 \ m$

$R = 2.2386 / 4.456 = 0.5024$

$R^{2/3} = 0.632$

$V = 25 \times 0.632 \times 0.01876 = 0.296$

$Q = 2.2386 \times 0.296 = 0.663$

NO.!

$A = 1.50 \times 0.80 + (1.50 \times 0.80) \times 0.80 = 2.160 \ m^2$

$P = 1.50 + 3.605 \times 0.80 = 4.384 \ m$

$R = 2.160/4.384 = 0.4327$

$R^{2/3} = 0.6238$

$V = 25 \times 0.6238 \times 0.01876 = 0.296$

$Q = 2.160 \times 0.292 = 0.631 \ m^3/s$

O.K !

$A = 1.50 \times 0.79 + (1.50 \times 0.79) \times 0.79 = 2.121 \ m^2$

$P \ 1.50 + 3.605 \times 0.79 = 4.348 \ m$

$R = 2.121/4.348 = 0.488$

$R^{2/3} = 0.619$

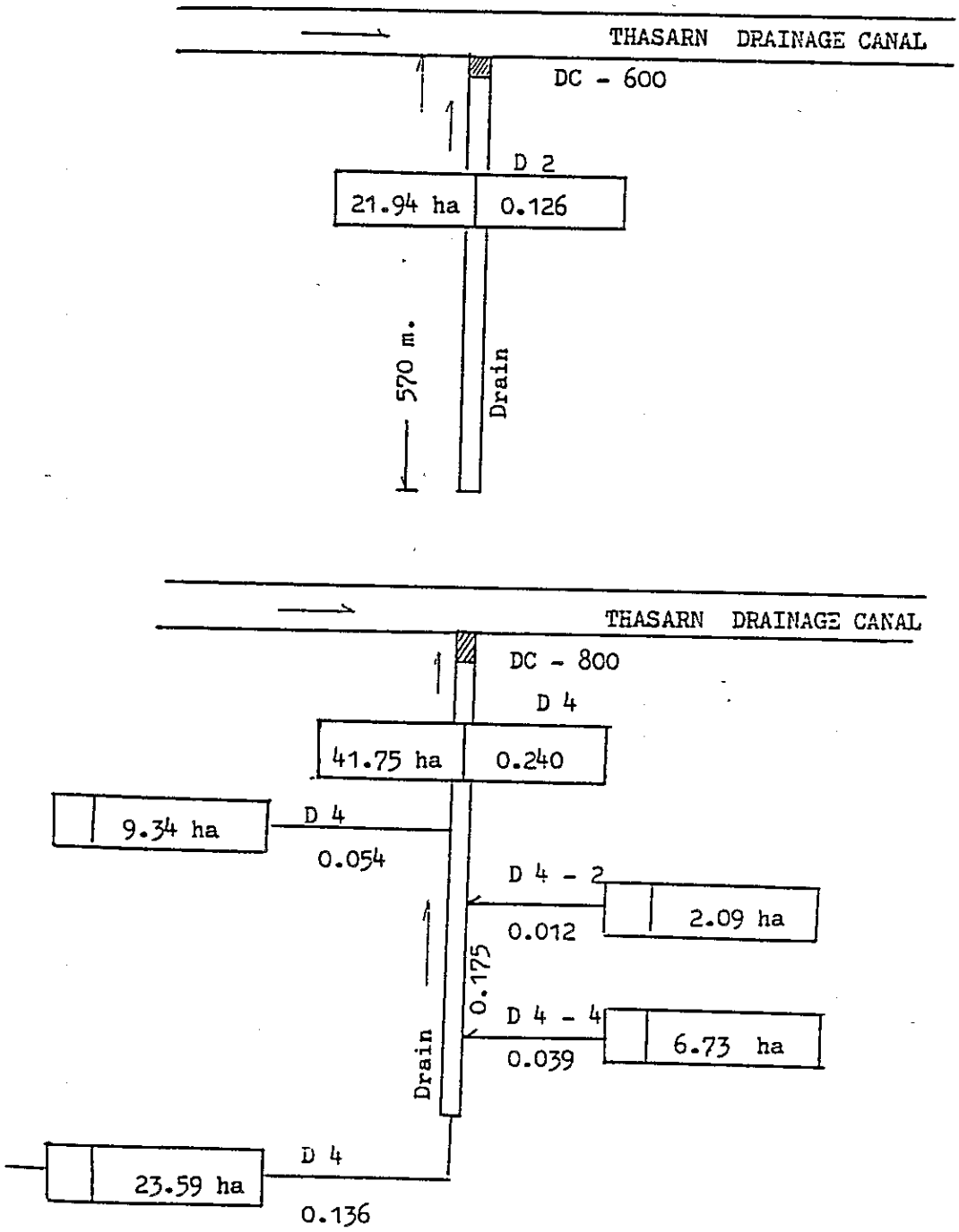
$V = 25 \times 0.619 \times 0.01876 = 0.290 \ m/s$

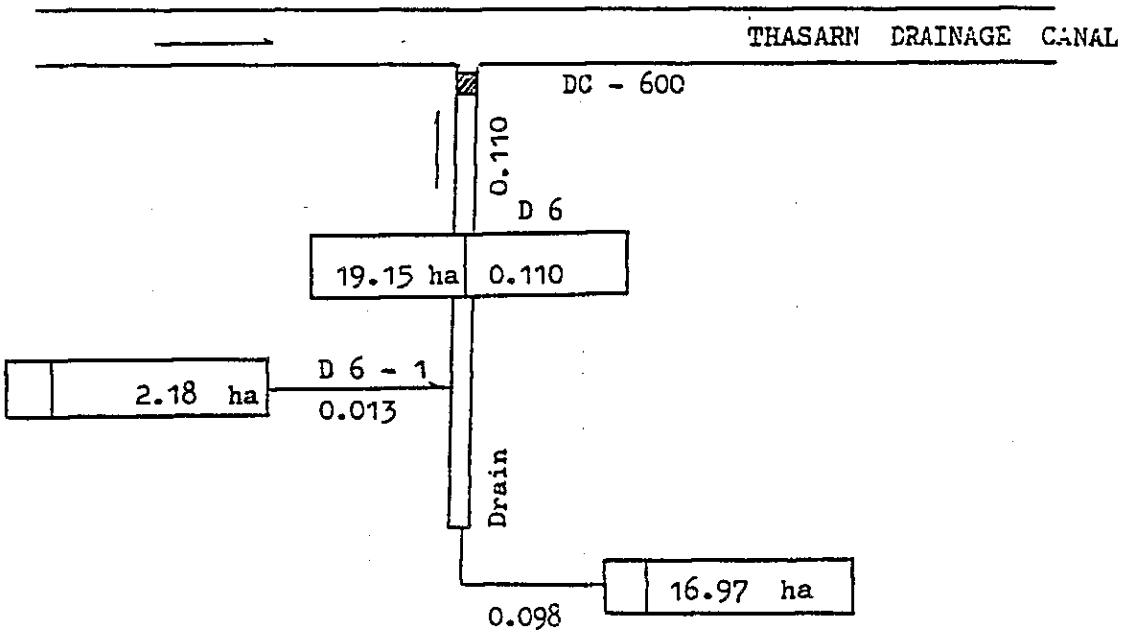
$Q = 2.121 \times 0.290 = 0.615 \ m^3/s$

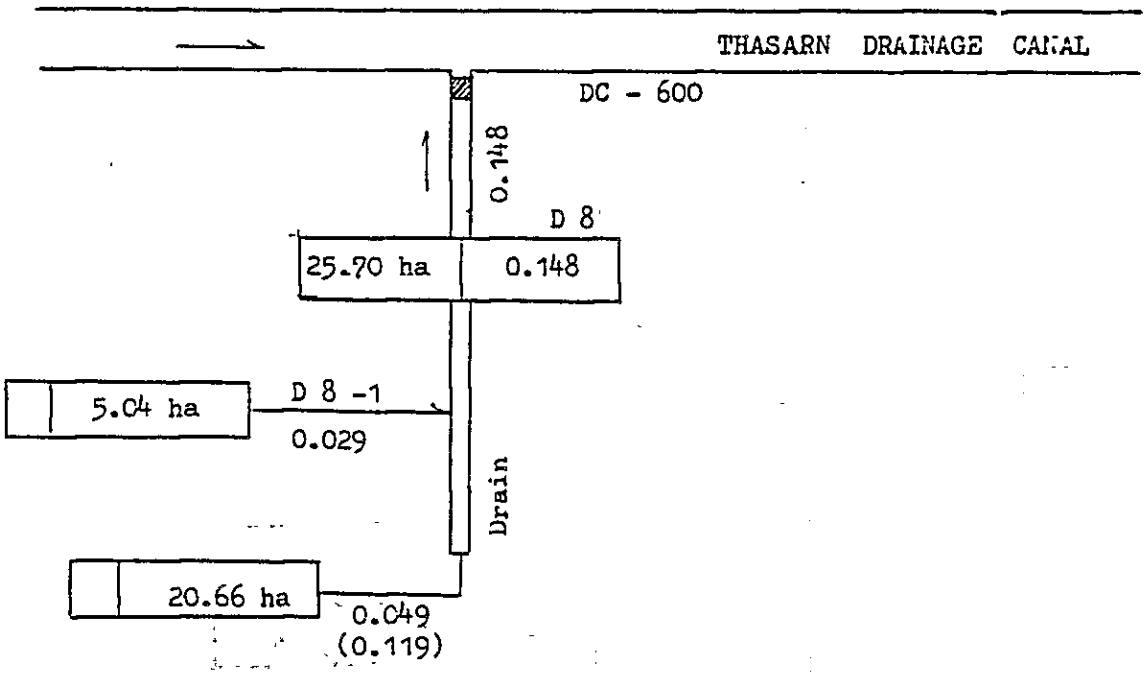
NO !

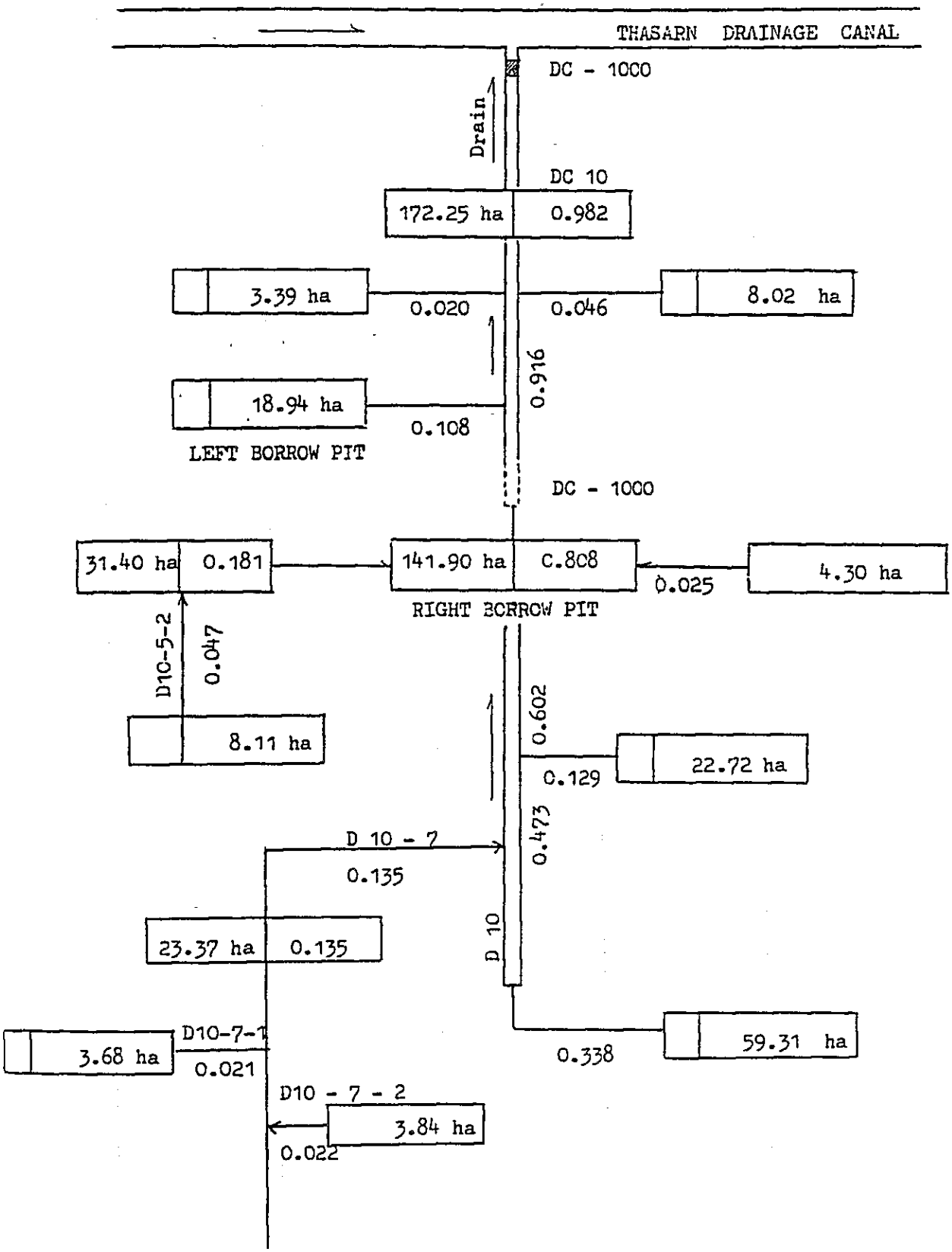
Fig -

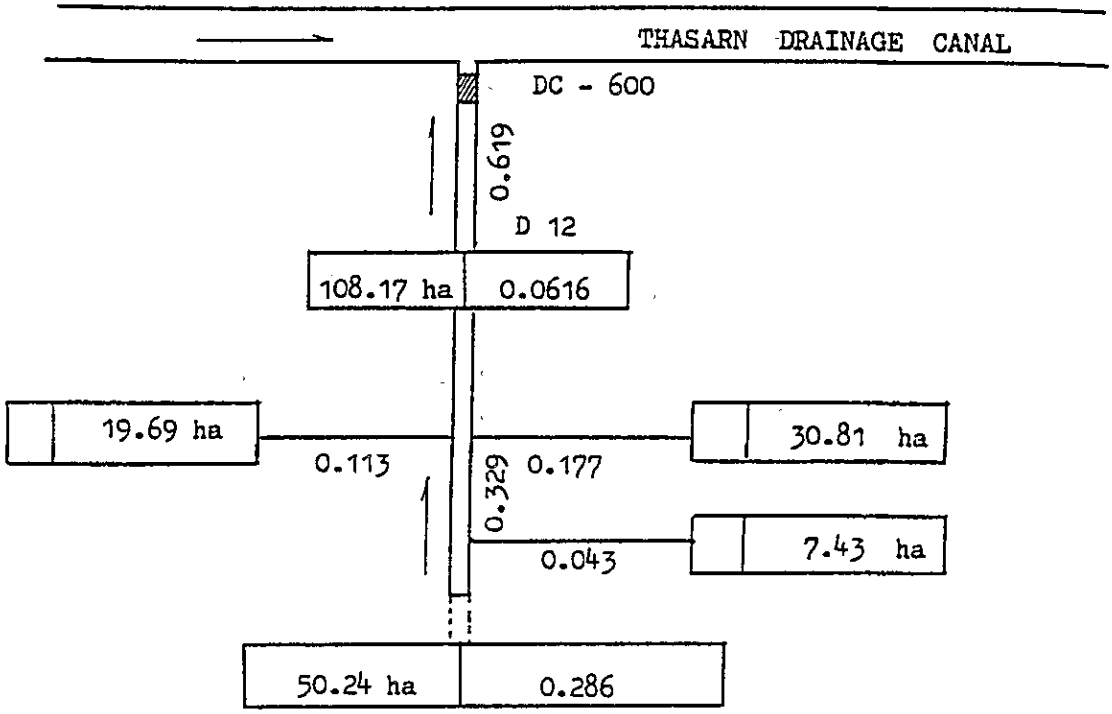
FLOW CHART OF DRAINAGE




THASARN DRAINAGE CANAL
DC - 600
0.110
D 6
19.15 ha
0.110
2.18 ha
D 6 - 1
0.013
Drain
16.97 ha
0.098


THASARN DRAINAGE CANAL
DC - 600
0.148
D 8
25.70 ha
0.148
5.04 ha
D 8 -1
0.029
Drain
20.66 ha
0.049
(0.119)

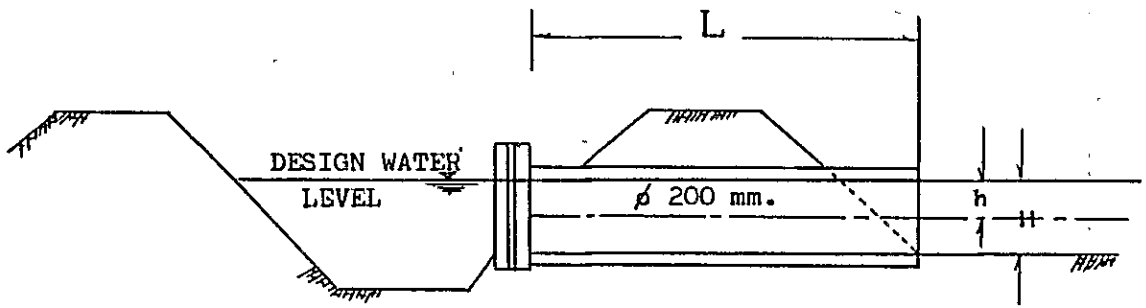

THASARN DRAINAGE CANAL
DC - 1000
Drain
DC 10
172.25 ha
0.982
3.39 ha
0.020
0.046
8.02 ha
0.916
18.94 ha
0.108
LEFT BORROW PIT
DC - 1000
31.40 ha
0.181
141.90 ha
0.808
0.025
4.30 ha
RIGHT BORROW PIT
D10-5-2
0.047
8.11 ha
0.602
0.129
22.72 ha
0.473
D 10 - 7
0.135
D 10
23.37 ha
0.135
3.68 ha
D10-7-1
0.021
59.31 ha
0.338
D10 - 7 - 2
3.84 ha
0.022



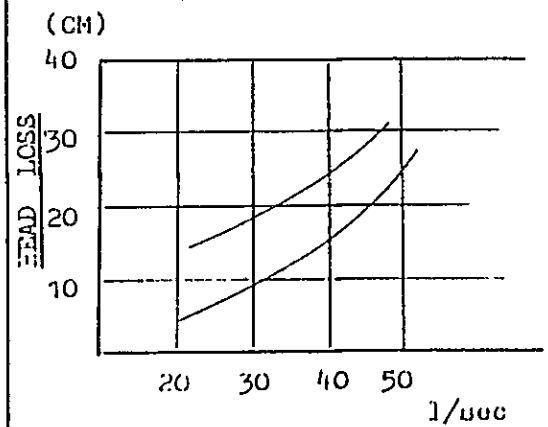
RIGNT BORROW PIT

Fig

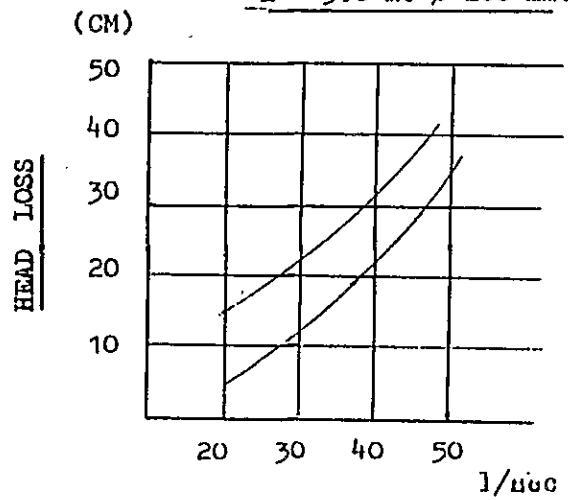
HEAD LOSS IN FARM INLET



L = 1.0 m. ø 200 mm.



L = 5.0 m. ø 200 mm.



Water Requirement

The peak water requirement would occur during the land preparation pariod of the dry season rice cultivation. Unit water requirement is calculated as follows :

puddling water requirement	150 mm. (150 mm.)
consumptive use of paddy after transplanting	3.97 mm./day (4.08)
land preparation period	48 days
field efficiency	75 %

Then, the unit water requirement during the last day of the land preparation period is obtained, assuming a constant pudding area (daily 1/48 of the area) and 47/48 of the area being dupplied with the consumptive use :

$$Dr = \frac{\left(\frac{1}{48} \times 0.150 \times \frac{47}{48} \times 0.00472 \right)}{Ef \times Ed \quad (0.8 \times 0.9)} = 10.75 \quad \text{mm/day}$$

$$\bar{W}_D = \frac{0.0108 \times 10.000}{86.400} = 1.25 \quad \text{l/sec/ha}$$

$N\bar{w}r = C\bar{V} + P$

- $N\bar{w}r$ = Net water requirement
- Cu = Condumptive Use of crops
- P = Parcolation

$\bar{W}r = (N\bar{w}r + L - E) / Ef$

- $\bar{W}r$: Water requirement
- Lp : Water for puddling
- E : Effective Rainfall

$Dr = \bar{W}r / Ed$

- Dr : Diversion Fequirement

peak season is few

$Nwr = 3.72 + 1 = 4.72$ mm.

- Cu = $Ep \times K = 4.18 \times 0.89 = 3.72$
- P = 1 mm.

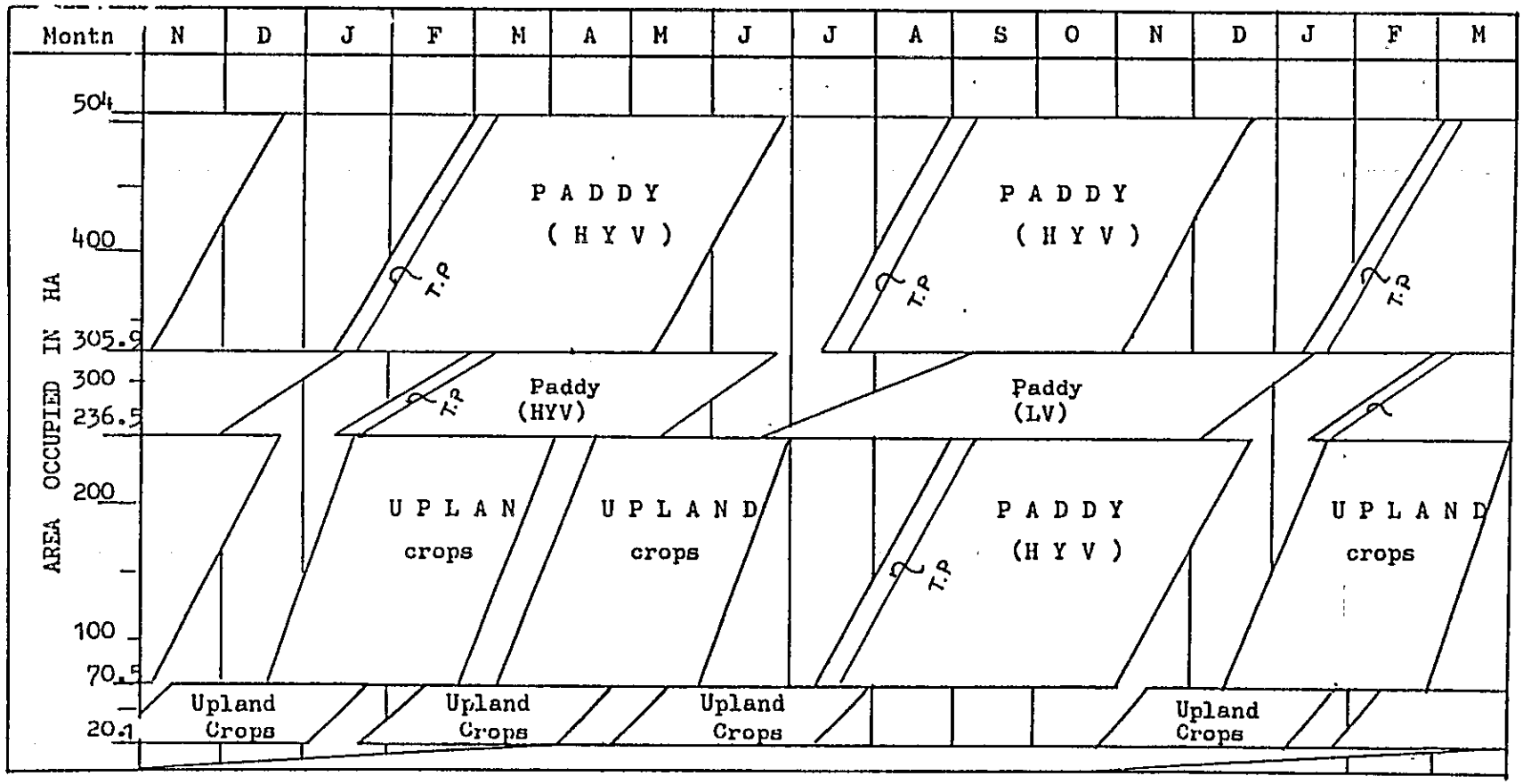
$$K = \frac{Ap \times K_1 + Au \times K_2 + As \times K_3}{Ap + Au + As}$$

$$= \frac{433.5 \times 0.95 + 50.4 \times 0.4 + 20.1 \times 1.00}{504}$$

$$= 0.89$$

- Ap : Area of puddy field
- K_1 : Crop of Coefficient (0.95)
- Au : Area of upland
- K_2 : Crop of Coefficient (0.40)
- As : Area of Sugar cane
- K_3 : Crop of Coefficient (100)

FIGURE ¥ = (PROPOSED CROPPING PATTERN (No. 2 AREA)



Notes : H Y V = High Yielding Varieties, L V = Local Varieties

T.P = Transplanting

Table of the Catchment water volume

Route No.	Catchment area (ha)	Drainage discharge (m^3/s)	Canal(m) distance	Head (m)	Canak slope	Canal section B	Canal section D	Canal section N	Q
D4	21.94	0.126	580	0.193	1/3000	0.50	0.60	1:1.C	0.135
D2-1	5.04	0.029	180	0.09	1/2000	0.50	0.50		
D2-A-2	8.02	0.046	470	0.235	1/2000	0.50	0.50		
D2-A-1	5.10	0.029	570	0.285	1/2000	0.50	0.50		
Main		0.832		0.135	1/1000	1.00	1.00		
D2-A	3.39	0.020	270	0.135	1/200	0.50	0.50		
	8.2	0.047	630	0.315	1/2000	0.50	0.50		
D2	20.7	0.119	530	0.265	1/2000	0.50	0.60		
D0	42.21	0.243	14.0	0.022			ϕ0.80		
D3-3	9.34	0.054	410	0.205	1/2000	0.50	0.50		
D3-2	5.62	0.032	80	0.04	1/2000	0.50	0.50		
D3-1	2.09	0.012	340	0.17	1/2000	0.50	0.50		
D3	23.59	0.136	780	0.39	1/2000	0.50	0.60		
D3	40.65	0.234	250	0.125	1/2000	0.50	0.80		
D30			14.0	0.019			ϕ0.80		
D4-1	2.18	0.013	180	0.09	1/2000	0.50	0.50		
	16.97	0.098	300	0.15		0.50	0.50		
D4	19.14		230	0.115	"	0.50	0.60		
D4									
D40	19.14	0.110	14.0	0.014			ϕ0.60		

Block No.	Catchment area (ha)	Drainage discharge (m3/s)
D12-1	19.69	0.113
D12-2	30.81	0.177
D12	7.43	0.043
D12	50.24	0.289
D12	57.67	0.332
D120	108.17	0.623
Total	388.16 ha	
	(337.94 ha)	50.24 ha

Table of the Catchment Area

Name of Drainage Route

D 2					
Field No.	Catchment area	Field No.	Catchment area	Field No.	Catchment
30	4 - 3 - 50				
31	14 - 1 - 27				
29	6 - 0 - 43				
23	14 - 3 - 28				
22	4 - 2 - 74				
24	6 - 0 - 73				
15	18 - 3 - 90				
21	8 - 1 - 4				
20	7 - 3 - 84				
19	7 - 1 - 46				
16	5 - 2 - 72				
18	8 - 0 - 64				
17	4 - 1 - 68				
2	4 - 3 - 54				
35	2 - 1 - 70				
34	2 - 3 - 1				
1	15 - 1 - 3				
Total	137 - 0 - 51 219,404 m^2 21.94 ha				

Table of the Catchment Area

Name of Drainage Route

D4		D4		D4 - 2		D4 - 4	
Field No.	Catchment area	Field No.	Catchment area	Field No.	Catchment area	Field No.	Catchment area
3	6 - 0 - 92	3	7 - 0 - 71	52	5 - 3 - 70	63	7 - 1 - 69
2	8 - 1 - 66	4	0 - 3 - 59	51	7 - 0 - 52	66	7 - 1 - 82
1	8 - 3 - 74	5	5 - 1 - 39			65	3 - 3 - 25
32	3 - 0 - 81	13	5 - 2 - 6	Total	13 - 0 - 22	64	4 - 2 - 6
36	10 - 3 - 65	14	15 - 1 - 27		20.888 m^2	62	11 - 3 - 75
28	21 - 1 - 70	12	6 - 1 - 52		2.09 ha	67	6 - 3 - 69
27	6 - 2 - 69	33	1 - 3 - 18				
37	6 - 3 - 63	6	15 - 3 - 86			Total	42 - 0 - 26
26	22 - 0 - 80						67.304 m^2
25	8 - 0 - 40	Total	58 - 1 - 58				6.73 ha
11	6 - 2 - 53		93.432 m^2				
10	9 - 1 - 20		9.34 ha				
9	8 - 0 - 13						
8	7 - 0 - 80						
7	13 - 1 - 20						
Total	147 - 1 - 86						
	235.944 m^2						
	23.59 ha						
Total	41.76 ha						

Table of the Catchment area

Name of Drainage Route

D 6							
Field No.	Catchment area	Field No.	Catchment area	Field No.	Catchment area	Field No.	Catchment area
55	16 - 2 - 68	50	4 - 1 - 62				
53	6 - 2 - 11	49	4 - 0 - 41				
54	23 - 3 - 19	48	5 - 0 - 42				
147	10 - 0 - 4						
130	2 - 0 - 1	Total	13 - 2 - 45				
1	3 - 0 - 41		21.780 m^2				
2	3 - 2 - 81		2.18 ha				
3	8 - 1 - 63						
8	10 - 0 - 44						
7	5 - 2 - 82						
6	5 - 3 - 0						
5	5 - 3 - 8						
4	4 - 2 - 2						
Total	106 - 0 - 14						
	169.656 m^2						
	16.97 ha						
Total	19.15 ha						

Table of the Catchment area

Name of Drainage Route

D 8		D 8 - 1					
Field No.	Catchment area	Field No.	Catchment area	Field No.	Catchment area	Field No.	Catchment area
61	18 - 1 - 83	46	18 - 0 - 51				
60	6 - 3 - 41	45	8 - 1 - 47				
56	20 - 0 - 33	44	5 - 0 - 0				
58	4 - 3 - 92						
44	4 - 0 - 39	Total	31 - 1 - 98				
42	22 - 3 - 64		50.392 m^2				
43	5 - 1 - 52		5.04 ha				
140	2 - 3 - 18						
9	2 - 2 - 70						
10	5 - 1 - 91						
11	5 - 3 - 51						
12	9 - 3 - 84						
18	15 - 2 - 1						
19	4 - 0 - 35						
Total	129 - 0 - 54						
	206.616 m^2						
	20.66 ha						
Total	25.70 ha						

Table of the Catchment area

Name of Drainage Route

D 10 (low land)		D 10 - 1		D 10 - 3		D 1C (up land)	
Field No.	Catchment area	Field No.	Catchment area	Field No.	Catchment area	Field No.	Catchment area
26	3 - 0 - 49	20	4 - 2 - 74	41	6 - 3 - 91	24	1 - 0 - 82
35	16 - 0 - 32	21	4 - 3 - 93	131	4 - 2 - 34	1	3 - 1 - 63
33	1 - 3 - 83	22	4 - 2 - 74	40	2 - 3 - 82	2	5 - 0 - 98
		23	4 - 3 - 93	39	5 - 0 - 33	20	8 - 3 - 34
Total	21 - 0 - 64	24	4 - 3 - 93	37	1 - 3 - 70	21	5 - 1 - 82
	33.856 m^2	25	25 - 3 - 26	36	10 - 1 - 46	3	9 - 2 - 63
	3.39 ha					4	16 - 2 - 56
		Total	50 - 0 - 53	Total	31 - 3 - 56	7	17 - 1 - 37
			80.212 m^2		51.024 m^2	120	6 - 0 - 86
			8.02 ha		5.10 ha	119	6 - 0 - 85
						110	17 - 0 - 54
						112	18 - 1 - 38
						111	10 - 0 - 97
						110	10 - 2 - 18
						109	12 - 0 - 25
						108	17 - 0 - 58
						107	7 - 0 - 94
						106	9 - 0 - 43
						105	9 - 1 - 37
						104	8 - 3 - 36
						102	30 - 2 - 28
						100	36 - 2 - 28
						101	8 - 0 - 69
						95	10 - 1 - 30
						96	4 - 2 - 98
Total	11.41 ha						

Table of the Catchment area

Name of Drainage Route

D 10 (up land)		D 10 - 5		D 10 - 5 - 2		D 10 - 2	
Field No.	Catchment area	Field No.	Catchment area	Field No.	Catchment area	Field No.	Catchment area
97	6 - 0 - 46	11	2 - 3 - 56	104	11 - 2 - 75	78	10 - 1 - 36
98	5 - 3 - 26	12	8 - 3 - 62	103	9 - 3 - 11	77	16 - 2 - 13
99	4 - 2 - 70	89	5 - 0 - 63	15	9 - 1 - 88		
101	26 - 1 - 5	88	4 - 2 - 22	14	9 - 3 - 47	Total	26 - 3 - 49
94	17 - 2 - 45	87	4 - 3 - 82	13	9 - 3 - 47		42.996 m^2
127	17 - 3 - 73	93	4 - 1 - 10				4.30 ha
81	5 - 0 - 75	92	6 - 0 - 24	Total	50 - 2 - 68		
80	27 - 1 - 63	134	4 - 1 - 81		81.072 m^2		
125	9 - 0 - 97	91	6 - 1 - 85		8.11 ha		
132	15 - 0 - 63	90	20 - 2 - 79				
76	10 - 0 - 98	86	16 - 3 - 38				
77	17 - 0 - 12	133	6 - 2 - 92				
75	2 - 0 - 84	85	6 - 3 - 73				
73	1 - 1 - 22	84	8 - 0 - 28				
74	1 - 0 - 82	125	9 - 0 - 97				
69	2 - 0 - 4	82	9 - 1 - 77				
70	1 - 0 - 2	74	0 - 1 - 74				
71	1 - 0 - 2	75	3 - 2 - 60				
72	1 - 2 - 89	Village	20 - 3 - 19				
6	15 - 2 -28						
5	15 - 1 - 8						
135	2 - 0 - 16	Total	145 - 2 - 22				
136	1 - 3 - 9		232.888 m^2				
137	1 - 3 - 63		23.29 ha				
103	1 - 3 - 64						
78	4 - 0 - 7						
Total	512 - 2 - 72						
	820.288 m^2						
	82.03 ha						

Table of the Catchment area

Name of Drainage Route

D 10 - 7							
Field No.	Catchment area	Field No.	Catchment area	Field No.	Catchment area	Field No.	Catchment area
18	6 - 1 - 16						
17	7 - 2 - 92						
16	16 - 2 - 66						
122	15 - 2 - 16						
118	4 - 3 - 13						
117	5 - 1 - 78						
116	4 - 2 - 33						
115	5 - 0 - 32						
114	4 - 3 - 78						
1C2	11 - 0 - 74						
1C5	11 - 3 - 95						
113	6 - 2 - 72						
112	6 - 3 - 10						
111	6 - 3 - 50						
1C6	7 - 2 - 28						
1C7	3 - 1 - 63						
1C8	5 - 0 - 31						
137	5 - 2 - 18						
1C0	9 - 3 - 54						
Total	146 - 0 - 17 233.668 m^2 23.37 ha						

Table of the Catchment area

Name of Drainage Route

D 12		D 12 - 1		D 12 - 2			
Field No.	Catchment area	Field No.	Catchment area	Field No.	Catchment area	Field No.	Catchment area
118	1 - 3 - 75	27	2 - 2 - 12	19	24 - 0 - 94		
31	1 - 0 - 15	28	5 - 1 - 83	18	7 - 3 - 13		
32	1 - 0 - 68	30	27 - 1 - 85	17	2 - 1 - 58		
33	2 - 0 - 57	29	1 - 0 - 39	16	19 - 0 - 64		
34	3 - 2 - 60	1	5 - 2 - 78	15	28 - 2 - 53		
35	3 - 0 - 6	143	5 - 3 - 18	14	21 - 1 - 65		
36	3 - 3 - 0	2	12 - 1 - 72	12	13 - 2 - 67		
37	4 - 1 - 59	3	28 - 1 - 65	13	13 - 2 - 13		
38	5 - 0 - 38	4	21 - 3 - 37	11	9 - 3 - 25		
39	4 - 3 - 50	5	12 - 1 - 44	10	9 - 1 - 64		
40	4 - 3 - 98			9	8 - 2 - 83		
32	7 - 2 - 22	Total	123 - 0 - 33	8	9 - 2 - 5		
138	1 - 3 - 19		196.933 m^2	7	8 - 3 - 24		
			19.6 ha	6	15 - 1 - 90		
Total	46 - 1 - 67						
	74.268 m^2			Total	192 - 2 - 18		
	7.43 ha				308.07 m^2		
					30.81 ha		

Table of the Catchment area

Name of Drainage Route

D 14							
Field No.	Catchment area	Field No.	Catchment area	Field No.	Catchment area	Field No.	Catchment area
68	6 - 1 - 41						
69	6 - 0 - 8						
70	26 - 0 - 73						
5	5 - 0 - 23						
22	4 - 1 - 79						
7	3 - 3 - 67						
8	1 - 0 - 2						
73	4 - 0 - 5						
72	3 - 0 - 30						
71	10 - 3 - 60						
59	5 - 0 - 5						
4	5 - 3 - 98						
6	4 - 1 - 29						
9	0 - 0 - 80						
Total	86 - 2 - 0 138.400 m^2 13.84 ha						

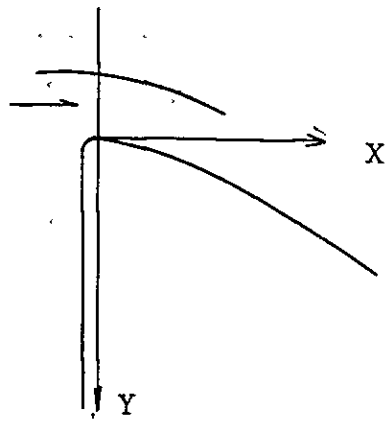
Table of the Catchment Area

Name of Drainage Route

Field No.	Catchment area	Field No.	Catchmmat area	Field No.	Catchment area	Field No.	Catchment area
41	0 - 2 - 40	64	9 - 0 - 72	95	3 - 0 - 14		
42	3 - 3 - 17	65	5 - 0 - 36	96	2 - 0 - 1		
115	0 - 2 - 38	66	8 - 2 - 74	97	4 - 1 - 74		
43	0 - 2 - 40	67	20 - 0 - 38	94	1 - 3 - 17		
44	0 - 3 - 19	47	2 - 2 - 31	126	1 - 2 - 94		
45	1 - 2 - 20	80	2 - 0 - 51	127	1 - 2 - 93		
46	1 - 1 - 59	81	0 - 3 - 59	128	1 - 2 - 93		
48	2 - 1 - 58	82	22 - 3 - 37	129	1 - 2 - 93		
49	3 - 1 - 31	83	12 - 1 - 45	130	1 - 2 - 67		
50	4 - 2 - 23	84	24 - 1 - 50	131	1 - 2 - 67		
119	5 - 0 - 36	85	9 - 2 - 58	168	1 - 2 - 93		
52	14 - 3 - 9	86	6 - 2 - 12	169	1 - 3 - 74		
54	11 - 2 - 71	87	5 - 0 - 76	170	1 - 3 - 74		
54	13 - 0 - 65	88	4 - 2 - 69	171	1 - 3 - 74		
55	1 - 1 - 99	89	4 - 1 - 21	172	1 - 3 - 74		
56	1 - 2 - 56	79	1 - 1 - 19	132	1 - 0 - 40		
57	2 - 2 - 18	91	15 - 0 - 18	133	3 - 1 - 47		
121	2 - 0 - 11	92	7 - 2 - 96	0	35 - 1 - 89		
58	2 - 1 - 77	93	6 - 0 - 95				
59	2 - 3 - 38	98	7 - 2 - 2				101 - 3 - 45
60	11 - 1 - 41						176 - 2 - 59
61	4 - 0 - 48	0	176 - 2 - 59				35 - 1 - 89
62	4 - 2 - 34					0	313 - 3 - 93
63	4 - 1 - 97						502.372 m^2
0	101 - 3 - 45						50.24 ha

Table of Nap curve

X	$Y=\frac{X^{1.8}}{34.378}$ (ft)	X (m)	Y (m)
1.0 (ft)	0.029	0.30479 (m)	0.0088
0	0	0	0
0.1	0.000046	0.0305	0.00014
0.2	0.0016	0.609	0.00048
0.4	0.0056	0.122	0.0017
0.5	0.0083	0.152	0.0025
0.6	0.0116	0.182	0.0035
0.7	0.0153	0.213	0.0047
0.8	0.0195	0.244	0.0059
1.0	0.0291	0.305	0.0089
1.5	0.0603	0.457	0.0184
2.0	0.1013	0.609	0.0309
3.0	0.2101	0.914	0.064
4.0	0.353	1.219	0.107
5.0	0.527	1.523	0.160
6.0	0.732	1.829	0.223
7.0	0.966	2.133	0.294
8.0	1.228	2.438	0.374
9.0	1.518	2.743	0.463
10.0	1.835	3.048	0.559
15.0	3.808	4.572	1.161
20.0	6.391	6.095	1.948
25.0	9.550	7.620	2.911
30.0	13.260	9.144	4.041
35.0	17.500	10.667	5.334



Trace of Water Surface

Elst : El 47.500 Vst = 3.093 n = 0.013

dst : 0.970 hvst = 0.488 n^2 = 0.000169

Elst + dst + hvst = 48.958

Q = 6.00 m^3/s

(1)	(2) Δl	(3) b	(4) d	(5) A	(6) v	(7) hv	(8) P	(9) R	(10) $R^{4/3}$	(11) $Sf=n^2v^2/R^{4/3}$	(12) Sf	(13) $hl=Sf\times\Delta l$ $+hl$	(14) Elf1	(15) Elf1+d+hv	(16) Elf1+d+hv +hl	(17) Error
No. 40		2.00	0.97	1.940	3.093	0.488	3.94	0.492	0.388	0.00416			47.500	48.958		
No. 40+1.5	1.500	2.00	0.75	1.500	4.000	0.816	3.50	0.429	0.323	0.00837	0.00626	0.0094	47.350	48.916	48.925	0.033
		2.00	0.74	1.480	4.05	0.838	3.48	0.425	0.319	0.00870	0.00643	0.0096	47.350	48.928	48.938	0.017
		2.00	0.73	1.460	4.11	0.861	3.46	0.422	0.316	0.00903	0.00659	0.0099	47.350	48.941	48.951	0.007 OK
No. 40+3.0	1.500	2.00	0.62	1.240	4.84	1.196	3.24	0.383	0.278	0.01433	0.01162	0.0175	47.200	49.016	49.034	-0.093
		2.00	0.655	1.310	4.58	1.070	3.31	0.396	0.291	0.0122	0.0106	0.0169	47.200	48.925	48.936	-0.005 OK

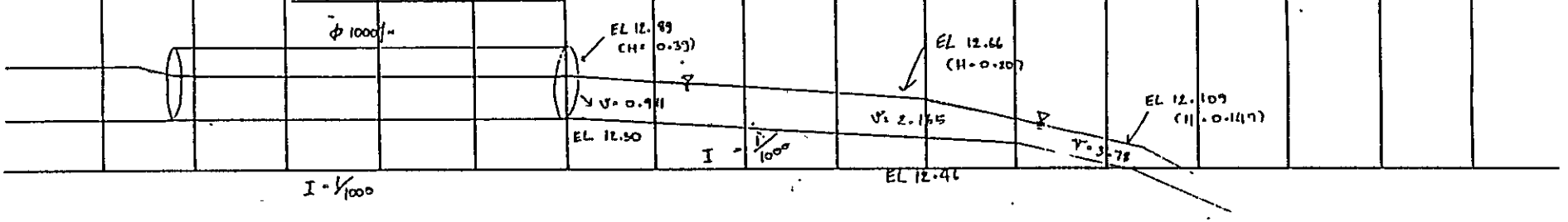
Trace of Water Surface

Elst : EL 12.50 Vst = 0.8799 Q = 0.563 m^3/s

hvst= 0.0395 N = 0.014

dst : 0.39 Elst+dst+hvst = s^2= 0.000196

(1) st	(2) l	(3) b	(4) d	(5) A	(6) v	(7) hv	(8) P	(9) R	(10) $R^{4/3}$	(11) $Sf=n^2v^2/R^{4/3}$	(12) Sf	(13) $hl=\Sigma\{\frac{l}{A}\}Q$	(14) Elf1	(15) $Elf1+d_{+hv}$	(16) $Elf1^{d+}$	(17) Error>0.01
0+0.00		1.0	0.39	0.6181	0.911	0.04233	2.406	0.2569	0.1633	0.000996			12.50	12.9323		
0+1.00	1.0	1.0	1.35	0.53375	1.0548	0.05676	2.26175	0.236	0.1458	0.001496	0.00122	0.0013	12.49	12.8968	12.8981	0.0342
		1.0	0.39	0.6181	0.911	0.04233	2.406	0.2569	0.0633	0.000996	0.000996	0.001	12.49	12.922	12.9233	0.009 OK
0+4.00	4.00	1.0	0.39	0.6181	0.911	0.04233	2.406	0.2569	0.1633	0.000996	0.000996	0.0040	12.46	12.8923	12.896	0.0396
			0.20	0.260	2.165	0.2392	1.721	0.151	0.0804	0.0114	0.00621	0.0248	12.46	12.8992	12.924	0.0083 OK
0+7.00	3.0	1.0	0.15	0.15	3.753	0.719	1.30	0.115	0.0562	0.0131	0.01225	0.0368	11.96	12.829	12.8658	0.0334
		1.0	0.12	0.12	4.6917	1.123	1.24	0.0968	0.0444	0.0972	0.05428	0.163	11.96	13.203	13.366	-0.442
		1.0	0.14	0.14	4.0214	0.825	1.28	0.10937	0.0523	0.0606	0.0360	0.1080	11.96	12.9250	13.033	-0.109
		1.0	0.145	0.145	3.8827	0.7692	1.29	0.1124	0.0542	0.0545	0.03296	0.099	11.96	12.8742	12.9732	-0.0492
		1.0	0.148	0.148	3.804	0.7383	1.296	0.1142	0.0554	0.0512	0.0313	0.0939	11.96	12.8463	12.9402	-0.0162
		1.0	0.149	0.149	3.7785	0.7284	1.298	0.1148	0.0558	0.05015	0.0308	0.0924	11.96	12.8374	12.9298	-0.0058 OK



Trace of Water Surface

Elst : El 12.75 Vst = Q = 0.110 m^3/s
dst : 0.360 hvst = n = 0.014
Elst+dst+hvst=
n^2 = 0.000196

A = BxD+1.5DxD
P = 3.605 D +B
R = A/P

(1) St	(2) Δ l	(3) b	(4) d	(5) A	(6) v	(7) hv	(8) P	(9) R	(10) $R^{4/3}$	(11) $Sf=n^2v^2/R^{4/3}$	(12) Sf	(13) hl=Sfxδl +Δhl	(14) Elfl	(15) Elfl+d+hv	(16) Elfl+d+hv +hl	(17) Error > 0.01
													12.75	13.114		
0+00.00		0.50	0.36	0.3744	0.2938	0.0044	1.7978	0.2082	0.1234	0.000137						
0+4.00	4.00	0.50	0.13	0.1088	1.011	0.052	1.041	0.1045	0.0492	0.00407	0.0021	0.0084	12.71	12.912	12.9204	-0.1936
	4.00	0.50	0.10	0.065	1.692	0.1461	0.8605	0.0755	0.0319	0.0176	0.00886	0.0355	12.71	12.9561	12.9916	-0.1224
	4.00	0.50	0.08	0.0496	2.218	0.251	0.7884	0.0629	0.0250	0.0385	0.0193	0.077	12.71	13.041	13.118	0.004 OK

(H = 0.36)

(H = 0.08)

φ 600 m/m

b = 0.798

b =

b = 0.918

1/1000

松谷要寿専門家報告書

指導分野 ： かんがい排水

派遣期間 ： 昭和５６年 １ 月 ８ 日
～５８年 １ 月 ７ 日

任務地 ： メクロン・パイロット・プロジェクト

REPORT OF AGRICULTURE ENGINEERING ACTIVITIES

Jan. 1981 - Jan. 1983

Y. MATSUYA

Irrigation & Drainage Expert, I.A.D.P

Mae Klong Pilot Project, RID

Contents of Report

December , 1982

On presentation of my report

This report is written by putting my observations and experiences during about 2 years'service (from January 8, 1980 to the present) in order.

In consequence, some parts of the contents may be made by my own misunderstanding because of lacks of communication.

At any rate, the purpose of this report is by no means to make a complaint on the Project but only express my heartily desire on how the work should be better performed. The contents of the report are not quite different to what I was always thinking, when I have been in Japan.

As for the agriculture which takes the place of the basic industry of the country, there are many difficult problems lying across the way. Both Thailand and Japan are placing much hope on the activities of engineers to solve the problems. When we think about such matter, we must seriously struggle our way to go through it.

Fortunately, I have been blessed with good staffs. Sometimes I might make complaint or make difficult demand but all of you were still listensing with attention and exchanged the opinion with me.

I, therefore, thank all of you very much and am very happy to have a chance to present this report.

Yours faithfully,

Yoji Matsuya

Yoju Matsuya

Irrigation & Drainage expert
Mae Klong Pilot Project, RID

CONTENTS OF REPORT

I. OUTLINE OF CIVIL ENGINEERING ACTIVITIES

IN

MAE KLONG PILOT PROJECT

I. Outline of Civil Engineering Activities in Mae Klong Pilot Project.

The Pilot Project consists of the Pilot Project No.1 and the Pilot Project No.2.
The Pilot Project No.1, I plared to be constructed by the intensive method for land consolidation, while the Pilot Project No.2 by extensive method.

1. Location

The Mae Klong Pilot Project (No.1 of about 409 ha, No.2 of about 552 ha) was set up for agriculture development of the lessrainted area.
The Mae Klong No.1 Pilot Project is located in the right bank of the Mae Klong River, about 130 km. from Bangkok and belongs to Tambol Banmai, Amphoe Tha Muang, Changwat Kanchanaburi, and the No. 2 Pilot Project is located in the left bank of the same river, about 110 km. from Bangkok, and belongs to Tambol Ta Khram-en, Amphoe Tharue, Changwat Kanchanaburi.

(Refer to the attached map)

2. Outline of working (Refer to ANNEX 1)

The Mae Klong Pilot Project belongs to the Great Mae Klong Project of Large Project Construction Division, Royal Irrigation Department, Ministry of Agriculture and Cooperatives.

The area of the Pilot No.1 benefits 409 ha and it was planed that the irrigation and drainage ditches were provided along the every plot by consolidating and exchanging of farm lands and a plot in 0.8 ha (160 m.x 50 m.) was built as basis.

The work of construction was completed in 1981 and, at the present, the lands of that area under planting. On the other hand, the Pilot No.2 benefits 552 ha among which the work of area of 315 ha was executed in the dry season of 1981, and the remaining 237 ha was executed in 1982.

The facilities such as irrigation ditch and farm road are provided along the boundary of land without land leveling and land reallocation. As the cost of construction, the area No.1 cost 20,300 ฿/ha (forced account) while the area No.2 cost 13,700 ฿/ha for work of operating directly and 17,200 ฿/ha for work of by contractor.

Moreover, the Trial Farm of about 10 ha. was established in the area of No.1, the demonstration for applicability test in cluding various improved techniques seed multiplication, mechanized and intensive farming in double cropping etc., have been also executed in this Trial Farm.

3. Operation of the Project

i. On-farm construction

i-1. Pilot Project No.1

The intensive land consolidation was completed in 1981.

Total Gross area			408.7 ha
Details			
Paddy field			367.8 ha
Ditch	19.7 km.		
Drainage	17.4 km.		25.9 ha
Road	28.3 km.		
Trial Farm			9.9 ha
Others (Building lot, Fish pond etc.)			5.1 ha

i-2. Pilot Project No.2

The extensive land consolidation was completed in 1982

Total Gross area		551.5 ha
Details		
Paddy & sugar cane field		522.5 ha
Ditch Drainage Road		28.0 ha
Others		1.0 ha

ii. Building lots

The building lot (4 ha) and buildings were constructed in 1981.

Item	No.
Management office	1
General work shop	1
Milling	1
General work house	1
Threshing house	1
Agricultural instrument warehouse	1
Rice warehouse	1
Agricultural Machinery shed	2
Repairing shop	1
Garage	1
Oil storage and car washing court	1
Canteen	1
Shower - WC	1
Grain drying house	1
Temporary pumping station	2

4. Progress for 1979 - 1982

a. Civil Engineering Activities

i. Land Consolidation

Pilot No.1

Area on force account	36.9	ha	1979	100%
	116.8	ha	1980	100%
	240.0	ha	1981	100%
Total	393.7	ha		
Irrigation ditch	19.7	km	1979 - 1981	100%
Drainage	17.4	km	"	100%
Road	28.3	km	"	100%

(construction cost 20,300 ฿/ha)

(reduction rate of farm land 5.9%)

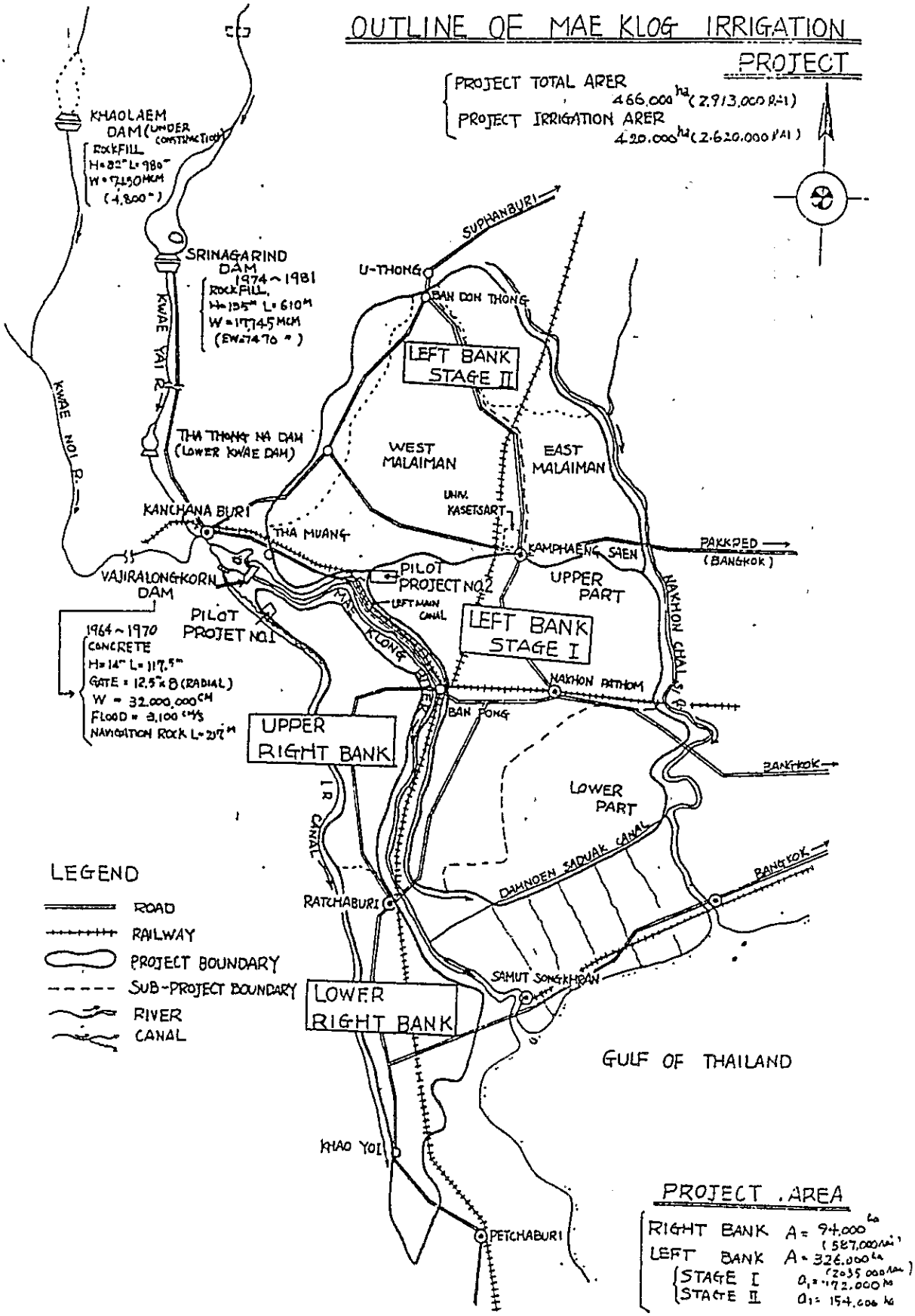
Pilot No.2

Area on force account	70.4	ha	1981	100%
Area by contract	243.8	ha	1981	100%
(Sub-total)	(314.2	ha)		
Irrigation ditch	12.8	km	1981	100%
Drainage	7.5	km	1981	100%
Road	8.6	km	1981	100%

(Construction cost : Force account 13,700 ฿/ha
Contract 17,200 ฿/ha)

Area on force account	236.3	ha	1982	
Irriqation ditch	12.5	km	1982	100%
Drainage	9.6	km	1982	100%
Road	7.5	km	1982	100%

(Construction cost	15,000	฿/ha		
Total area	550.5	ha	Density	(m/ha)
Total irrigation ditch	25.3	km	46.0	
Total drainage ditch	17.1	km	31.6	
Total road	16.1	km	29.2	


OUTLINE OF MAE KLOG IRRIGATION PROJECT
PROJECT TOTAL AREA 466,000 ha (2,913,000 RAI)
PROJECT IRRIGATION AREA 420,000 ha (2,620,000 RAI)
KHAOLAEM DAM (UNDER CONSTRUCTION)
ROCKFILL
H=82m L=980m
W=7,150MCM
(4,800 m³)
SRINAGARIND DAM
1974~1981
ROCKFILL
H=135m L=610m
W=17,745MCM
(EW=7470 m³)
KWAE YAI R.
KWAE NOI R.
THA THONG NA DAM
(LOWER KWAE DAM)
KANCHANA BURI
THA MUANG
VAJIRALONGKORN DAM
1964~1970
CONCRETE
H=14m L=117.5m
GATE = 12.5m x 8 (RADIAL)
W = 32,000,000CM
FLOOD = 3,100 CMS
NAVIGATION ROCK L=217m
PILOT PROJET NO.1
PILOT PROJECT NO.2
LEFT MAIN CANAL
KLONG
U-THONG
SUPHANBURI
BAN DON THONG
LEFT BANK STAGE II
WEST MALAIMAN
EAST MALAIMAN
UNIV. KASETSART
KAMPHAENG SAEN
PAKKRED (BANGKOK)
UPPER PART
LEFT BANK STAGE I
NAKHON CHAI AIR
NAKHON PATHOM
BAN PONG
UPPER RIGHT BANK
R CANAL
BANGKOK
LOWER PART
DAMNOEN SADUAK CANAL
RATCHABURI
SAMUT SONGKHRAM
LOWER RIGHT BANK
GULF OF THAILAND
KHAO YOI
PETCHABURI
LEGEND
ROAD
RAILWAY
PROJECT BOUNDARY
SUB-PROJECT BOUNDARY
RIVER
CANAL
PROJECT AREA
RIGHT BANK A = 94,000 ha (587,000 rai)
LEFT BANK A = 326,000 ha (2035,000 rai)
STAGE I Q1 = 172,000 m³/s
STAGE II Q1 = 154,000 m³/s

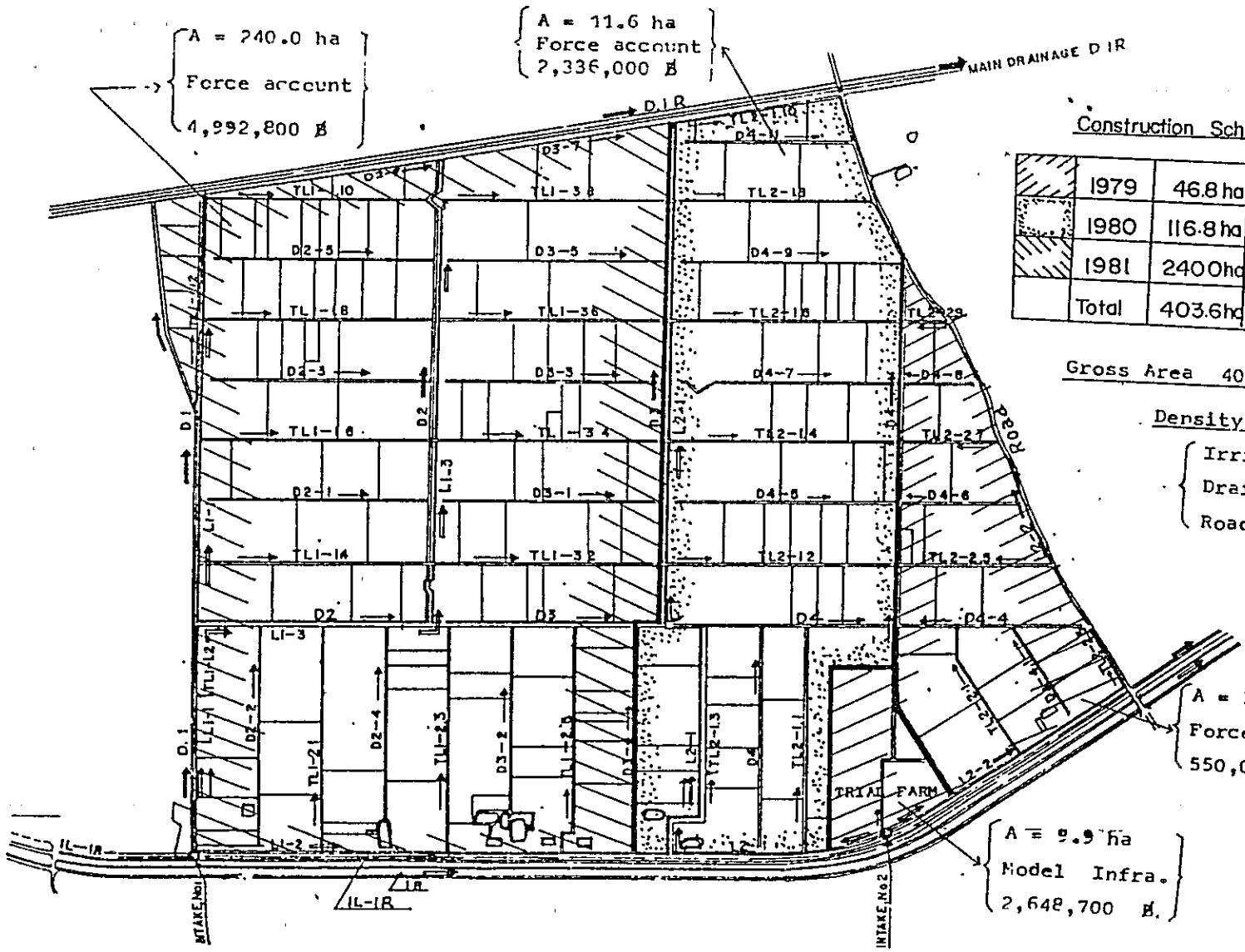
ANNEX 1.

Actual performance of Mae Klong Pilot Project work

4.8 — { 4 = the fourth month of a year; 8 = the eighth day of a month

Item No.	Description	Quantity	1977	1978	1979	1980	1981	1982	1983	1984	1985
(1)	R/D of I.A.D.P.		4.8					3.16 sign 4.7			3.31
(2)	Mae Klong P/P No.1	403.6 ha									
2-1	Trial Farm	9.9 ha									
2-1-1	Civil work										
	farm	6.4 ha			3 — 6	6 8 repairing					
	building lot	3.5 ha			1 — 4						
2-1-2	Building	14 bldg.					11 — 4 pump sta.				
2-1-3	Emergency work	6 place				7 8 deep well	1 2 No.2 1 4 drying house 10 No.1	2 rat fence 6 7 water tank			
2-2	Land Consolidation	393.7 ha			3 — 6 36.9 ha	2 — 6 116.8 ha	1 — 5 240.0 ha				
(3)	Mae Klong P/P No.2	550.5 ha									
3-1	Land Consolidation	550.5 ha					11 — 6 314.2 ha	2 — 6 236.3 ha			
(4)	Expert										
4-1	Civil work										
4-1-1	Irrigation & Drainage			11.2 MR. OKUBO			1.15 MR. MATSUYA 1.8		1.7		
4-1-2	Land Consolidation			11.2 MR. MIYATSU			10.30				
4-2	Agronomy				12.15		MR. MISAWA	12.14			3.31
4-3	Agricultural extension							12.11 MR. TSUTSUMI	12.10		

Mae - Klong Pilot Project No. 1



Construction Schedule

	1979	46.8 ha	Incloude Trial Farm 9.9ha
	1980	116.8 ha	
	1981	240.0ha	
	Total	403.6ha	

Gross Area 408.7 ha.

Density

Irrigation ditch	50.0 m/ha
Drainage	44.2 "
Road	71.9 "

ROAD AND CANAL NETWORK OF MAE KLONG NO.2 PILOT PROJECT

CONSTRUCTION SCHEDULE

YEAR	AREA	
1981	314.2 Ha	
	CONTRACT	243.8 Ha
	FORCED ACCOUNT	70.4 Ha
1982	236.3 Ha	
TOTAL	550.5 Ha	

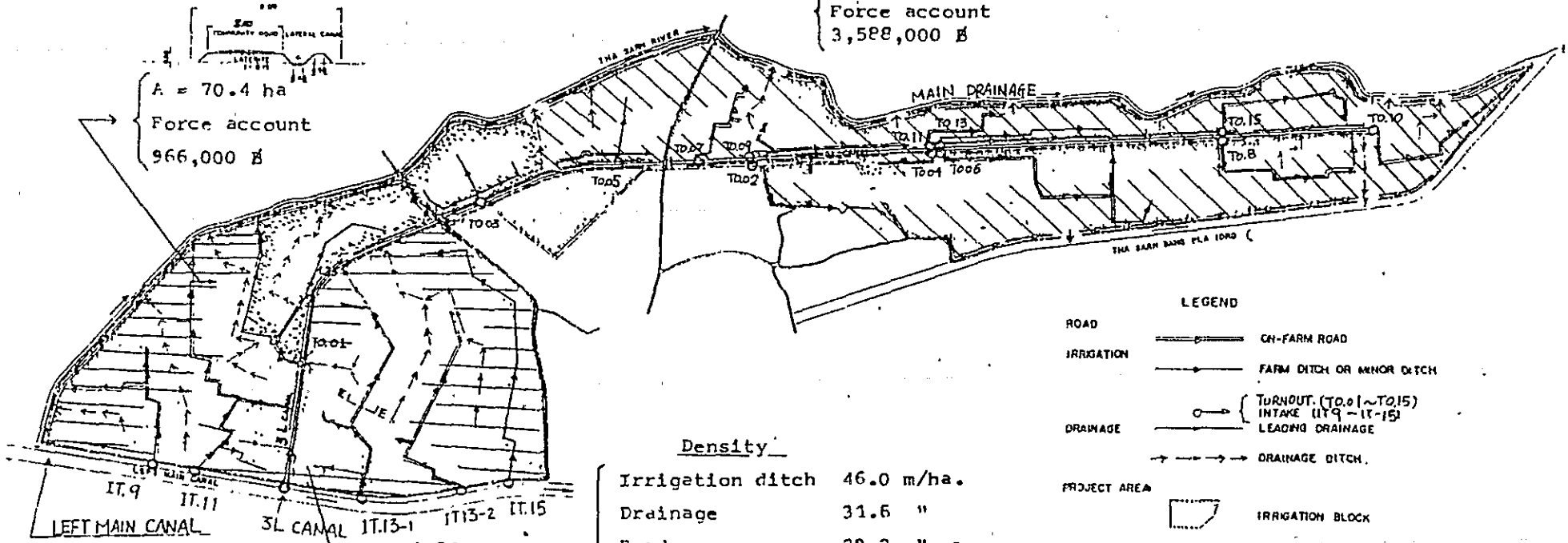
SECTION E-E

Gross Area 551.5 ha.

1982

A = 236.3 ha.
Force account
3,588,000 ฿

A = 70.4 ha
Force account
966,000 ฿



LEGEND

ROAD
- ON-FARM ROAD

IRRIGATION
- FARM DITCH OR MINOR DITCH
- TURNOUT. (TO.01~TO.15)
- INTAKE (IT.9 ~ IT.15)

DRAINAGE
- LEADING DRAINAGE
- DRAINAGE DITCH.

PROJECT AREA
- IRRIGATION BLOCK

Density

Irrigation ditch	46.0	m/ha.
Drainage	31.6	"
Road	29.2	"

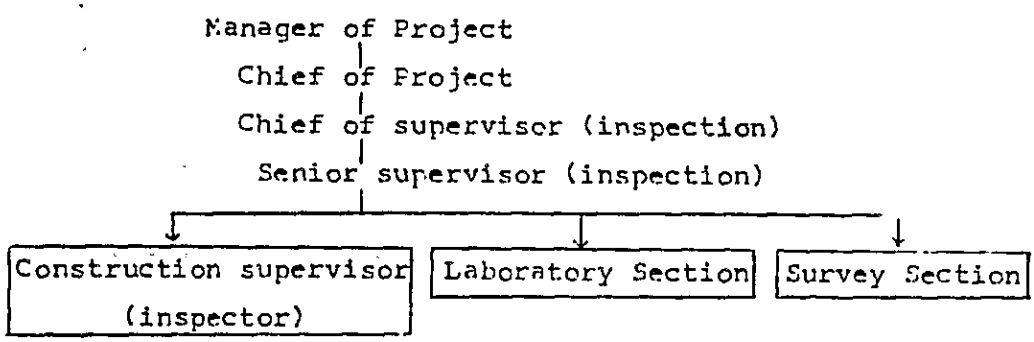
1981

Pilot Infra.
A = 243.8
Contract
4,194,059 ฿

II. THE PROBLEM AND COUNTER-MEASURE FOR LAND CONSOLIDATION

held as the task of the Survey Division, the supervisor does not check and adjust the places to be improved and let the result to be applied for next work ; when the data has been obtained, it is in the time of commencing the rainy season crop and it will be not easy to repair.

(4) Inspection ..... The inspection of the construction site is not so strict. Sometimes it is done by only observation. The organization in the case of force account (contract) is as following chart :



In case of problem occurred.

(a) Force account ..... They send problem to senior supervisor or chief of supervisor to solve it. But when problem which is important and necessary to be allocated the new budget occured, it will be submitted to Chief of Project or Manager to take the counter-measure.

(b) Contract ..... In accordance to the contract, in case of the matter caused by the contractor, the contractor will be ordered to repair immediately. The method to handle the problem is similar to that in the case of force account.

Further, there are various committees in the MCAC member of which may request the improvement about the progress in affairs of the project concerned.

However, their works are those with the entire affairs as object and, as to the works from the plan for individual small works to process of business administrating, each project will check itself.

2-2. As the charges (duty) have been divided, some business can not be performed systematically. So that the works should be performed connecting vertical and horizontal part.

(1) After the design drawing has been received from the design division, the project office of construction site will make estimate and establish the plan of works ... . construction supervisor.

(2) Stake out of center line ..... land department.

(3) Stake out of range for construction .... survey section.

(4) Arrangement of heavy machine and operation .... tractor section.

(5) Various test ..... research and laboratory section.

(6) Design for the alteration ..... designer.

(7) Resurvey according to the alteration design .... survey section and land department.

(8) Work supervision ..... construction supervisor and his assistant.

It is proposed to make simple change of route or design among staffs who works at the construction site.

2-3. To understand the design drawing and the specification and check up them with the project site.

Most cases are applied without confirming on whether they are fit to the project site. Further, the number, location,

size of the structures ought to be determined according to the conditions of the site (for example : location, height of bottom for farm inlet or a part size of structures etc.) but they are executed indiscriminately.

2-4. Relation with the farmers'house concerned shall be made close. Most case of changes caused by the objection or demand of the farmers (specially, in extensive).
The work needing repair, reconstruction after the work has been completed will be too late in both of budget and time.

As to explanation to the farmer, though the designer and the supervisor of construction sector explain to them on the necessary matters, the staff or Provincial Land Consolidation Office obtain the agreement from the farmers. Now the reason caused their disapproval are as follows :

(1) They may lose land ..... especially, in the extensive the unfairness between the individual person is great.

(2) The burden for the work is heavy ... although there is no duty to pay money in the Pilot Project but this matter in the general project is heavy.; intensive over 30%, extensive 16%.

(3) Lack of understanding ... They do not understand the purpose and effect.

(4) In the case of absentee landlord, the landlord can not be sought ..... The landlord in most case is absent for other city or foreign country.

(5) The water is sufficient at this time so that the works are not necessary ..... farmers of upstream side of the irrigation canal.

(f) Disinterest, disbelief of the officer, no answer.

The common counter-measure to the question mentioned above are as follows :

(a) Do not easily accept the demand of farmers ... it will give great effect to other farmers if acceptable.

(b) The authority has accepted the appropriate demand but sometimes it gives no reflexion in the design, execution of work. This is one of the reasons to cause dissatisfaction of farmers.

(c) For the case has not obtained the agreement, no water is supplied.

(d) Changing of center line suspension of construction will be performed.

2-5. The heavy machine operator should be trained for on-farm development.

The dimensions of banking, compaction, excavation etc. may be much affected by the work of operator.

As to the works, the suitable attachement shall be used and arrangement of machine and man power suited to the process, is necessary in accordance with the construction period and structures.

The most problem specially occurred on the site are as follows:

The compaction of banking is insufficient.

Plan, special specification ..... 85% x maximum dry density.

minimum compaction thickness 15 cm (after compaction)

2-6. Grasp of numerical value after completion of work, especially, grasp of area shall be exactly performed.

Both of the present condition survey and final survey are not so exact and the farmers request resurvey (it is said whether it makes the land reduction by over 7%) to which it can not be fully answer. According to law, the government will compensate for the land reduction over 7% but, on account of budget and procedures, the law is actually hard to apply. In case of the land reduction over 7% is found from the result of resurvey, the part over 7% is made with a counter-measure by cutting or shifting the center to the crosside.

2-7. The construction and management side shall also comprehend the function of facility, operation and maintenance of water.

Rotation irrigation, water level to be retained (on the inlet), counter-measure to the out of commanded area, standard regulation of lay out etc. which has been considered from the view point of design ought to be applied after completion of work. Sometimes following matters is seen on the on-farm level.

(1) Exceeding intake the water
(up stream side) ..... wasteful drainage
(2) Insufficiency of water
(down stream side) .... pumping up from drainage ditch

} Schedule of farming are unequal.

After completion of facility, the construction side will send the document concerned (①design map ②list of structures ③data of estimate ④plan of water management of control etc.) to Irrigation Regional Office and the O & M Office concerned will accept them but, in this time, it is necessary to comprehend the contents and check to see each of the documents whether they are practicable.

On result of lack of understanding, the activities of block the drainage canal and causing water to be used as irrigation water (there may be the case of considering it as one of the means for the transposition period toward practical O & M

execution) is mistaken to be a purpose on O & M.

2-8. The important of land leveling shall be understood from the veiw point of following field :

(1) Plot size of farm land

(2) Leveling machine, method, accuracy

(3) On farming

(4) On water management

Land leveling is a quite important factor for paddy cultivation. The ideal farm plot is that with good land leveling and plentiful irrigation water.

II-2. Problem and causes on extensive land consolidation work in Mae Klong P/P No. 2 (Aug. 1982).

1). Land consolidation area of 1982 Y..

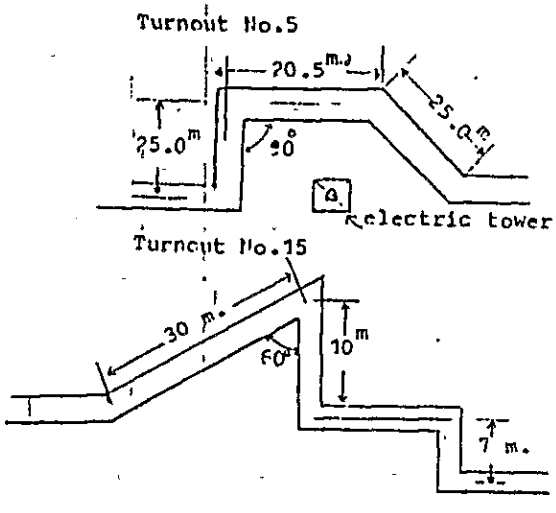
The extensive land consolidation work of Mae Klong P/P No.2 is under the RID force account and A=236 ha area has been completed on Feb. --- end of June. Continuing to the up stream side of A=314 ha area, it was completed in 1981, this work of down stream area has been on this year and the farmers who wait for the completion of this work have commenced their rainy paddy crop.

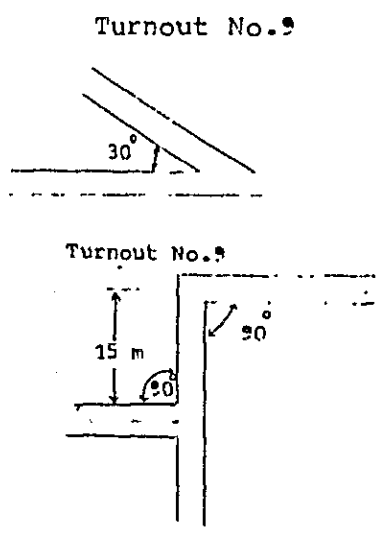
Considering the progress up to the present, the example held as the problem on the construction site and the causes and improvement points are as follows :

1. Turnout No.5. Total length of ditch $\Sigma\ell$ = 950 m. (Max. length = 500 m.)

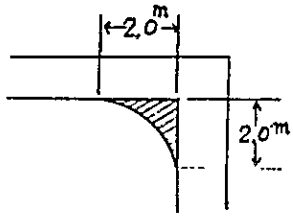
1-1. As the road is curved, small size motor car can not pass through and compaction or finishing is also not good.

(a) The top width of the road is in 3.0 m. and the route is made in accordance with the design. For land consolidation in extensive method, as both of the road and canal for drainage go through the boundery of farm land, and in any way it can not be avoid to make in curve. The route as following mentioned take place.





Should the route can not be change, it is necessary to construct the extension area at the corner part of road for transportation. On the design point, it is taken in as per the following method as from this year on.



However, it appears that the construction sector has dropped the assuring of top width of 3.0 m. and the extension area at the corner from their execution so that the construction sector shall take the responsibility.

In the case of intake No.5, although there is a big electric tower for transmission of power, it was not specified on the drawing map. Above all, the designer had designed the road without confirming the present condition of the proposed construction site.

In fact, it should be noticed on the stage of construction and change the route of road.

(b) Compaction of road.

As to the banking, on design, it has been instructed as general item as follows :

" The compaction of banking will be made to minimum thickness 15 cm. (after compaction) and affirm the compaction density to 85% of maximum dry density."

Deformation of road on the site is caused by insufficiency of compaction. The construction sector shall be responsible.

In the time of compaction, generally, the soil transported by the dumping car or scrap bulldozer are raked out by bulldozer or motor grader and com-

pacted with bulldozer and roller. The compaction work shall be sprinkled with water cart in order to get compaction effect. The special problem here is to assure the sprinkling and compaction effect.

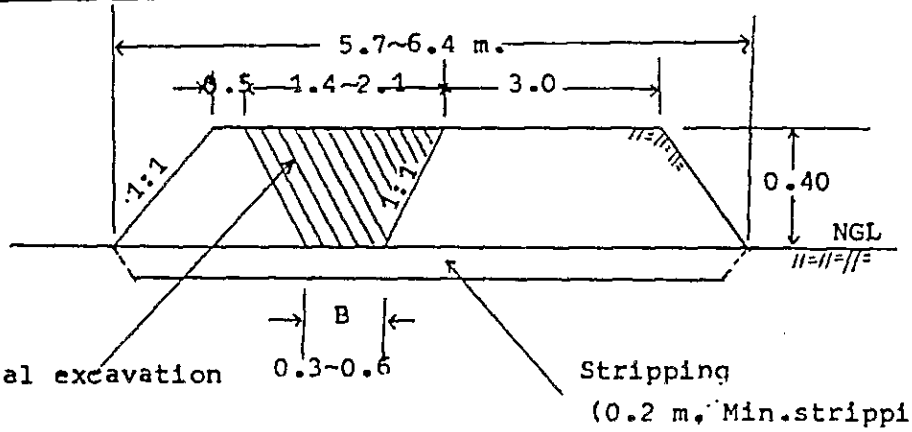
The question is that whether the supervisor of construction sector understand that 85% of maximum dry density is the compaction density and, unfortunately, for this point, the supervisor has executed the work only basing on his experience without affirming the compaction.

According to the laboratory test, the maximum dry density is as follows :

No.1	Sample	Max.	Dry	Density	1.767	kg/m^3
No.2	"	"	"	"	1.674	"
No.3	"	"	"	"	1.682	"
No.4	"	"	"	"	1.632	"

Average 1.689 kg/cm^3

Typical Banking Section



In general, the banking section will be as mentioned above and it is necessary to pay attention to the efficiency of compaction, especially, for the canal side.

Further, as to the curved part on the route ahead, on account of the movement of machine, compaction may be difficult to be performed. It is necessary to use self-propelled small roller (vibration roller or tamper in about 0.5 - 2.0 T) in order to fully compact the bank-

ing for substitution of the 6-10 T Road Roller or Tire Roller used at the present.

1-2. When the road is higher than the field surface reaching a height of 60 cm., the machine is unable to go in and out of the field and, also, it can not go in and out of the field from the canal side.

(a) In cereral, road surface is banked to be 40 cm. higher than the surface of field so that it will be no any obstacle but, for this case, in order to get rid of the difference in level of the surface of field or small hill, the farmer engage other construction company to cut the soil and the surface of field become 20 cm. - 30 cm. lower.

As the extensive land consolidation has not been performed, this is resulted in that the farmers try to improve the leveling of surface of field. So that the design, construction sector are hoped to give assistance to them.

(b) In order to make machine able to enter the field from the canal side, the concrete pipe is laid underground (road way crossing) on the owner's boundary and make downward road to the field by making banking with top width of 5.0 m. The construction sector holds the length as insufficient but as it is the boundary of a part of land, should it be a large farm plot, it is necessary to go across the middle dike. So that a part of farmers complain as inconvenience.

1-3. The concrete lining at the curved conner of the irrigation ditch is damaged.

(a) Although the concrete lining is in thickness of 5 cm., owing to the compaction work is insufficient, it is easy to be damage. Attention shall be paid to the con-

crete mixing and curing of canal.

1-4. As the farm inlet is situated at the corner, it is feared that the earth and sand may pile up.

(a) The situation of inlet shall be placed on the part in straight line and, also on the highest part (upstream part) of a part of plot.

1-5. The surplus soil produced from the work of canal excavation can not be filled in any place.

(a) Most of the canal excavation is brought to backhoe after banking compaction but, in this case, a part of the soil is used banking the dike and the other part is scattered about the vicinity.

This appearance may be caused by the unfamiliarity of machine operator but, in fact, it is necessary to move the surplus soil after work.

1-6. The water does not flow to the downstream part, especially, the water flow is bad on the curved line.

(a) As for the curved part of the canal, the upstream side is made to concrete lining in 1.0 m. and downstream side 2.0 m. to protect the soil erosion and bend loss of water head.

(b) As to that the water does not flow to the downstream part, there are various causes, here we will give problem from the farmers'side as follows :

(1) The earth and sand pile up in the ditch causes the indefinite slope and, also, the weed grow briskly thus the water flow is hindered. These defect can be disposed by daily operation and maintenance.

(2) On the design of the irrigation water, it is originally considered to make to rotation irrigation but the farmers do not understand its meaning and they think it as the usual matter.

They take in the water as they like and without co-operation to each other.

The water management will be stated in another chapter.

1-7. The condition of excavation on the drainage ditch is bad and the water way is damaged by the water pressure.

(a) Owing to unfamiliarity of the machine operator as well as that, for the back-hoe attachement, is should use the bucket fit to the excavation section but, in this case, the ordinary bucket is used so that the traces of the claws are left on both of the side and bottom. The finishing is bad.

2. Turnout No.7 $\Sigma \ell$= 650 m. ($\ell_{max.}$ = 500 m.)

2-1. The condition of roads are bad and the pavement of laterite soil (especially, the soil near by the farm inlet) is washed out by rain fall.

(a) The main cause is that the compaction of the banking has been insufficiency before the work of pavement ; the shoulder is broken by the rain fall and inside part of the canal was washed out; the wall and the surrounding of the inlet are washed out. All these may be the responsibility of the construction sector.

The next is the case of the pavement of laterite soil. In design, the laterite pavement does not touch any point of design. The supervisor of the construction has used the same method as last year and paved the laterite soil in 10 cm. but, for the function of the road, it must be considered about the design.

2-2. The curve, dividing point of ditch are unlining and washed out.

(a) On the design, although there are concrete lining, the lining is not made in execution time so that the work has to be reconstruction.

2-3. The dike of the ditch is too high or without good compaction so that much soil come down.

(a) In the whole, the compaction condition of this road is the worst. This is owing to that the time of execution, the rain has often fallen and the machine have been not able to get in. The laterite soil has been put on in imperfect condition as it be and worked with roller for excavation the ditch.

However, since the work has been late, the work of banking has been executed in about April thus the design sector, approval of the farmers and plan about the work might be affected. It appears cracks grow on a part of the road.

(b) The soil produced from excavation of ditch is highly piled on the dike of ditch without compaction so that it is easy to come down.

2-4. There are roads on the both sides of plot No. 176 but one side is not necessary.

(a) The execution is made according to the design and this case has been based on the request of the farmers so that it may be no problem. From the view of cultivation, if this part is in convenient situation, it shall be accepted.

3. Turnout No.9 Σl= 1,120 m. ($l_{max.}$ = 820 m.)

Item 3-1, 3-2, 3-3. ditches are too high and also in bad compaction so that they are damaged.

(a) With regard to the points mentioned, as I have stated above, on account of the irrigation ditch being high, the farm land is not on the same level so that some parts of land may be high or low respectively. It is necessary to supplement them by means of water management (back water by the weir or rotation irrigation) and, on the other hand, it is necessary

to make counter-measure by operation and maintenance by cutting the weed or digging the accumulated soil.

(b) Now let us touch the matter of soil. The soil of both the Pilot No.1, No.2 are composed of silt in 60% and classified to clayish silt and sandy silt. As to dynamical nature, the internal friction (ϕ) is in approx. 10° and viscosity (c) is in about 0.4 kg/cm^2 and, also, absolute specific gravity about 2.62 ; interim specific gravity, about 1.54 (RID Division of Research & Laboratory). This soil is though as Maximum Allowable Average Velocity in about 0.45-0.6 m/s.

On the other hand, the average velocity of water reaching 0.5-0.9 m/sec. is quite enough to prevent the subsidence of silt in the water way and growth of aquatic living which caused obstacle to water flow can be prevented on the average velocity will not be less than 0.75 m/sec.

On account of the figure mentioned above, for the farm ditch of Pilot No.1 when the designed amount of flow is made to Q = 0.024 m^3/s, decline is in 1:4,000 and the velocity become to V = 0.15 m/s (in the condition of un-line ditch). This figure shows that ditches have to be cleaned by means of cutting the weed and digging the piled soil.

4. Turnout No. 13 $\Sigma \ell$ = 485 m. (ℓmax. = 485 m.)

4-1. The irrigation water does not reach to the plot No. 39. Before work of land consolidation, the water used to flow in from 3L irrigation canal.

(a) Before the work, water used to flow in from other direction but, on result of designed irrigation canal has been lead, owing to some places are in the high land, the water can not reach.

On the case of extersive land consolidation, the surface of paddy field have been left as it is, a part of the Project in high place become poor to irrigate the water. For avoiding this defect, the irrigation

canal line should be lead through the high situation, as far as the surface of fields are adjusted, this problem will be left as problem forever.

On the other hand, owing to the farm land owner have rejected, the construction of irrication canal can not be executed. This is the owner had caused the defect for themselves. The BID also express as that it has no responsibility to supply irrigation water to those rejecters.

5. Turnout No.15 Σl = 1,270 m. ($l_{max.}$ = 1,270 m.)

5-1, 5-2. Road is not good. The earth and sand accumulate in the canal make it shallow. Water can not reach the downstream area.

(a) The cause is similar to the problem rentioned above.

6. Turnout No. 10 Σl = 1,270 m. ($l_{max.}$ = 1,050 m.)

6-1. The irrigation canal dike on a part of the route is low and the water overflows the dike; when the irrication water become less, the water flow is poor.

(a) The bottom slope of ditch is indefinite; because there are some blocks of low field, it can be held as problem from the execution.

6-2. A part of upstream of irrigation canal have been washed out, when heavy rain has fallen (July 7th).

(a) The cause is similar to the problem mentioned above; it is under repairing at the present.

7. Turnout No.2 Σl = 1,430 m. ($l_{max.}$ = 1,160 m.)

7-1. Since the bottom of the irrigation ditch is indefinite, the irrigation water does not flow well.

(a) The problem is similar to those mentioned above.

7-2. If it is according to design, the water level of turnout No.2 of 3L canal should be 14.55 M.S.L. but, on the result of flow test, the depth of the irrigation canal terminal is only in 20 cm. compared with the designed depth of 35 cm. The water quantity in the turnout is supposed as insufficient.

(a) Comparing with the designed maintenance level of EL 14.55 m., the present full supply level in 3L canal of 14.25 m. is lower for 30 cm. and it is in the state of unable to take in water as designed.

As to this matter, the design should have instructed as it should lined canal raising of 30 cm. but they do not instruct and left it as it is; as for the work of this part, the Kam Phaeng Saen C & M Office performs it and the control of water level is also arranged by the zone man (h = 30 cm., l = 500 m.). The inharmony in planing, design, construction is the cause of defect.

7-3. On of the land consolidation work, the water can not reach to the out of project area. The water had been supplied to this area from the turnout through the old water way.

(a) In explanation meeting for farmers, this area has been explained as it is near by the resident quarter and is unsuitable to construct irrigation ditch for paddy field; it is excluded from the project (out of command).

As it is impossible to make water arrangement toward the uncommanded area, the Kam Phaeng Saen Office may consider the counter-measure in the future.

8. Turnout No. 6 Σl = 1,660 m. ($l_{max.}$ = 1,140 m.)

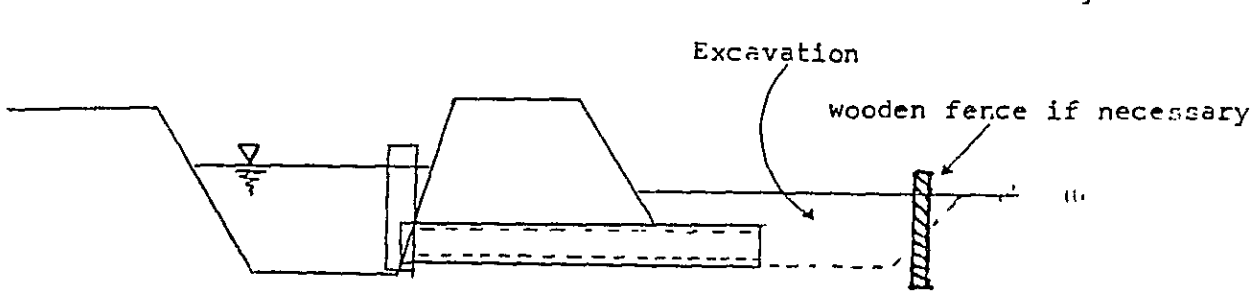
8-1. The dike of irrigation ditch joining the concrete lining is damage by rain fall. Although it is once repairing it still in poor condition.

(a) The width of dike is made to 50 cm. and has been repaired but the part joining the concrete is easy to be washed out so that it is necessary to give full execution.

8-2. The irrigation ditch is lower than surface of paddy field in 3 parts so that it is unable to take in the water.

(a) Topographically, the case mentioned above will occur to the paddy field in high situation which is similar to the situation of 4-1 as mentioned the last paragraph.

As a counter-measure, the following method is made in the plots and the daily management by farmers themselves is necessary.



8-3. The laterite soil on the corner part of the road is not leveled.

(a) The motor grader or roller is difficult to work on the curve part of the farm road in whole width of 3 m; some are worked with man power.

On that case, the work is settled by grading with man power later.

9. Turnout No.8 $\Sigma \ell$ = 1,755 m. (ℓmax. = 1,370 m.)

9-1. Owing to insufficiency of compaction, the drainage canal is damaged.

(a) The drainage canal is excavated on the present foundation and the soil produced from excavation is piled

on both sides of drainage and compacted by pressing with the bucket. Should it be not use the bucket fit for the cross section of drainage ditch, the soil will loose and easy to be washed out by rain fall.

9-2. The surplus soil is left on the Plot No.253.

(a) In the time of finishing the work of road, the farmers have commended to cultivate and the work has been unable to perform; surplus soil have been left. When the work has been done in June, a part of farmers are to commence their rainy season crop; since they have already required the irrigation water for cultivation, the surplus soil should be arranged by the construction level.

Should the work was arranged on the schedule, there would be no problem.

9-3. A part of the farm land, topographically, can not supply the water.

(a) It is similar to problem as mentioned before.

9-4. For plots unable to supply water, we convince the farmers and able to irrigate through the drainage canal.

(a) As to supply water, it is necessary to investigate the cause and study the method of solution and try to execute them.

As to irrigation from the drainage canal, there are problem on utilizing various facilities, especially, the flood in the time of rain fall or submerging water in the harvest season will be the harmful influence and it should be avoided.

However, in case the method of solution will need considerable cost and takes long time, a temporary relief means may be considered but this method is contrary to object of aim of land consolidation provided it is made to permanent one.

2). Land Consolidation area of 1981 Y.

Among the land consolidation area in 314.2 ha which have been executed in 1981, the 243.8 ha. is executed by contract and the remainings is under the Force account of RID. The work has been commenced (contract) from the late in November and completed on middle part of June of following year and, soon after, it is the rainy season crop. On the time of the irrigation canal has been lead through and farming begun, the farmers side has made various request for improvement.

Under the participating of the contractor, the investigation has been made; some of them have been repaired and improved except a part of the remaining work have been left to the farmers themselves and the other were left for repair and improvement after the rainy season. The expenses for those works were donated from the Pilot Infrastructure Development Fund of Japanese side.

The scope of the works of improvement reaches to over 50 items. The typical ones are picked out as follows :

1. Intake No.1 Total length of road $\Sigma \ell$ = 1.700 m. (longest road route ℓmax. = 1,000 m.)

   1-1. Additional 15 places of farm inlet (Ø 200 mm. concrete pipe) are needed. Further, 1 place of farm inlet is short on the opposite side of plot No. 32.

   (a) As to the farm inlet being the irtake of each plot, in pririciple, should it exceeds minimum 1 place for each possessor or for benefited area over 10 rai (1.6 ha.), the farm inlet will be added (this is a specially fixed regulation). The installing location must be the highly situated point on the upstream side but it will be considered upon the wish of the farmers, topography, formation of land and determined according to the condition of field; although what is specified for these point on the design drawing, request for adding and

change of location still occured.

So that it is necessary to contact the cultivators and fully grasp the irrigation effect.

1-2. To move the concrete pipe (Ø 400 mm.) for diversion from T 009 to T 009-2.

(a) Same as the previous item, it has not fully grasped the location but executed the works.

1-3. It is necessary to line by concrete the irrigation canal between T 009 and T 009-1 and add 2 pipes of Ø 400 mm. (diversion point of T 009-1).

(a) The downstream side of intake 009 is lined (ℓ = 5m); on immediate downstream of it, there is diversion point of T 009-1 and the diversion ℓ = 5 m. is unlined. So that it is washed out by velocity of water thus this division is also necessary to be concrete lining. The necessity shall be considered according to the present situation.

(b) The present pipe Ø 400 mm. is short and the crossing with road is narrow so that it become obstacle for transportation. This point is similar to that mentioned in last item.

1-4. The extension of banking in about 400 m. and in height of 20 cm. is necessary.

(a) As the dike of the irrigation ditch has neither made compaction nor extra banking, it has sunk and, has been washed out so that the banking shall be constructed again.

1-5. The terminal part of the T 009 shall be exterded for about 20 m. so as to connect to the road already constructed.

(a) The role of road on the land consolidation takes

the same importance as construction of irrigation and drainage canal, it is not only utilized for the farming but also for mainterance and control on the irrigation facility as well as daily life; the local life will change more, the effect of road become greater. Should the road is limited; especially, for this project, the road is only in full width of 3 m. thus the effect will be lessened to a half.

In case of intensive method, as the road is curved irregularly, we must join it to the already constructed road or join it to the neighboring road per planing so as to make the road will not become a blind lane.

2. Intake No. 001 $\Sigma\ell$ = 2,365 m. (ℓmax. = 1,555 m.)

2-1. In order to put in the gate, the wall (concrete work) is necessary.

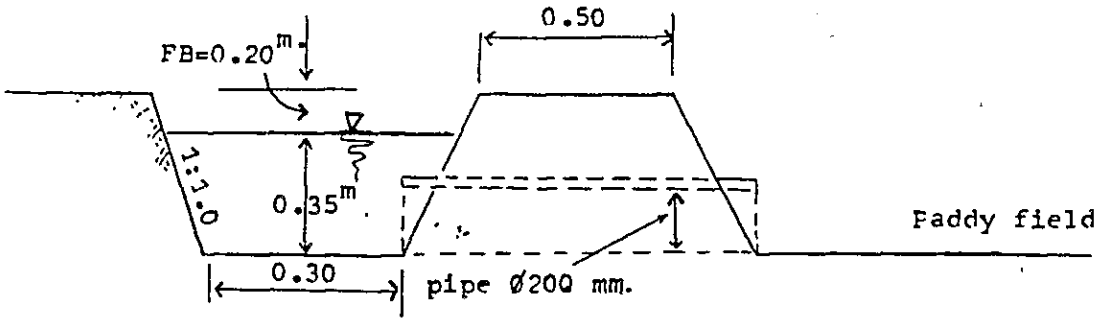
(a) On the drawing, it has been specified as to set the wall in front of the pipe on the place needs diversion but it is overlooked.

2-2. It is necessary to lower the height of the farm inlet of plot No. 60 for 0.10-0.15 m.

(a) The matter relating to general irrigation canal, farm inlet, field surface are shown per the following drawing; the water management is not performed; as the gate is always opened there is claim requesting that the zone man or the farmers on the downstream shall be limited to take in the water.

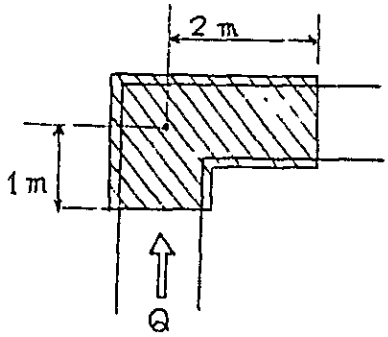
Although it is necessary to perform the appropriate water management but it is not through going; should it be limited with structure, the method of hightening the height of farm inlet bottom or lessening the section of intake pipe will be used.

In such a case, as the intake pipe has been situated on the part of too high location, the farmers complain on it.



2-3. The concrete lining is necessary for the curved part of irrigation canal for 10 points.

(a) On the placing, the concrete lining are as following but it has been prepared immediately after has being claimed at the construction site.



Concrete lining
Upstream side 1 m.
Downstream side 2 m.

3. Waste way.

3-1, 3-2.

The downstream of waste way were washed away by the following of Tha Sarn Bang Pla drainage canal. Further, the stone pitching bed of other waste way are already washed out so that reconstruction, repair are necessary.

(a) On the waste way, the part crossed with the road is made with concrete pipe, the midstream, stone pitching and the downstream, plain concrete. Further, the protection work of stone pitching on the slope surface is executed on the upstream and downstream (ℓ 1.0 m.) of jet flow part. But, 3 months after construction, the midstream part and downstream have been broken down by flood under the heavy rain.

The cause can be said as that the base of construction and the soil filled back around are gradually

washed away. The insufficiency of compaction is one of the other causes. The other cause is that, on the section in which the drainage turns to jet flow, the section has been changed (abruptly) so that the water has jumped up the wall and washed away the stone pitching of both sides. Further, the other cause is considered as that there has been stone pitching on the bed of the midstream part but that has been washed away by the jet flow. So that it shall have reconsideration per the design.

4. Intake T 015 Σl = 1,740 m. ($l_{max.}$ = 1,740 m.)

4-1, 4-2, 4-3.

The compaction of irrigation canal dike 75 m., reconstruction on dike of l 250 m. and cleaning of the drainage canal are necessary.

(a) Owing to insufficiency of compaction and imperfection of finishing shape, the function of irrigation canal is remarkably lowered.

(b) In the meantime, the earth and sand accumulate and make the irrigation section narrow on some places so that the farmers management of themselves is necessary.

5. Underdrain.

5-1, 5-2, 5-3, 5-4. To join 2 concrete pipe Ø 400 mm. and make banking.

(a) On the explanation meeting for the execution of works held for the farmers themselves, the farmers have requested to construct the underdrain of the drainage canal for connecting the designed new road to the previous small road. The farmers explanation meeting and the promise on the time of obtaining consent is not effected in the execution.

6. New establishment of Tha Sarn Bang Pla Road.

In order to connect the present main road to farm road constructed for the work of land consolidation organically, it is necessary to build a road (ℓ=2,430 m. b=3-4 m.) on the dike of left bank of Tha Sarn Bang Pla drainage canal.

(a) As mentioned above, since it is necessary to make the road fully carry out its function, the gentle dike has been completed in short time (in 60 days) by using bulldozer and grader.

7. Turnout 01

7-1. In order to prevent the seepage of irrigation water, to make lining is necessary,

(a) Since this irrigation ditch is excavated on the banking made about 1 m. higher than the surface, various problems take place.

One of the problems is that the road going in and out of the farm land is in sharp slope and the machine cannot go in smoothly. The outlet in the paddy field side of farm inlet is washed out by the rising high water. Further, on dry season, December to February, after the time of water flows, the soil has been dried and cracks took place; when the water flows which leak and wash away the dike of ditch. The repair is terrible.

In that respect, last time, I have instructed as that the irrigation canal in high situation topographically will be lowered by means of drop or division box on the time of design and execution but the instruction do not vivified; we can learn a lesson from this omission.

III. WATER MANAGEMENT OF MAE KLONG PILOT PROJECT

III. Water management of Mae Klong Pilot Project

III-1. The existing state of water management

1. Pilot Project No. 1 (intensive land consolidation)

1-1. State of irrigation

The irrigation water for this project is supplied by the 1L-1R Canal. It is the water which is pumped up through the head regulator (5.5 km. up-stream from the Project) of 1R main canal which runs parallel to the former.

1L-1R irrigation lateral covers the irrigation area of about 1,290 ha (8,100 rai) and this Project occupies down-stream side in 403.6 ha (about 31%) counting from the middle part area, on the up-stream side, there is still area of 560 ha.

The pumps used in 1L-1R are in 3 pumps (one as spare) and, for the irrigation of Q = 1.04 m^3/sec., the water is supplied by 3 pumps operated in turn with one stand by as spare. Both of the capacity of pumps and section of canal are designed for supplying the supplementary irrigation water on the rainy season crops and, for use in the land consolidation on the right bank area in future, the flow section are now being extened.

For supplying irrigation water for this Project, 2 intakes (intake No.1, No.2) are being constructed on 1L-1R canal.

1-2. The questions on the irrigation water

(1) As the pumps are made for the purpose for supplementary irrigation water (0.83 l/ha), its absolute quantity is less and they have not been considered for the crop of dry season.

(2) Since the water is pumped up, the power rates and fee for operation and maintenance are needed.

(3) There are 10 inlets on the up-stream of the Pilot Project and 5 inlets, on the downstream but the irrigation water

can not be well distributed.

(4) The pumps are declined and the trouble is apt to occur. Owing to repair of pump, the water supply is often cut off. The 3 pumps are in shift of 8 hours each and 2 pumps are always operating but, on account of trouble, this cycle can not be maintained thus the water supply becomes short.

(5) After the pumps are operated, the irrigation water will take 4 hours to reach the Project and, further, water will take another 2 hours to reach the terminal of the Project so that, owing to that the quantity of irrigation water changes (by unstable operation of pumps), the insufficiency of irrigation water is taking place.

1-3. The counter measure up to the present

(1) As to the land consolidation of right bank area of the Mae Klong Irrigation Project, the construction works of the area including this Project in about 80,000 ha (500,000 rai) have being commenced from 1982 and, for irrigating the dry season crop, the construction of new pump station is planed.

However, pending to construction of the new pump station, as the step to meet the requirement of irrigation water for the crops of dry season, the following methods are being employed :

(a) Although in the dry season, the Tha Maka Office has allotted the power rates for the Pilot Project and operates the pumps.

(b) As urgent counter, the Japanese government has given assistance to construct temporary pump station in 2 places so as to supply the water to the Pilot Project. Several pumps were granted by the Governement of Japan.

(c) As to the water management of 1L-1R lateral, the Tha Maka O & M Office has performed the works and excluded the operation

by the individual farmers, especially, in dry season, it is managed to make the water to flow in the Pilot Project only.

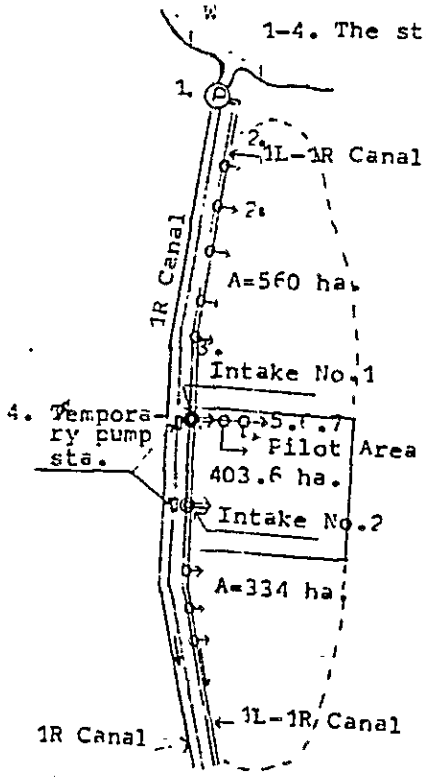
(d) Besides the temporary pump of 1R canal, as supplementary pump, 7 vertical pumps are prepared for hiring out to the farmers.

(e) As counter measure against the short of irrigation water on the vicinity of the terminal of canal, the water of drainage canal has been dammed up to maintain the water level to the same as the surface of paddy field. However, it is performed in the dry season only and is placed as a trial method for the transitional period until the farmers can manage water by themselves.

(f) To make use of water more efficient by performing reasorable distribution and intake of water through water management.

As to the counter measures mentioned above, the work of item (f) shall be placed on on-farm level which shall be in responsibility of the farmers themselves to execute but, for the present state, as it has been poorly performed so that it shall be the most important item in the future for projects in which land consolidation is completed.

1-4. The staffs and the irrication facilities at the present



No.	Irrigation facilities	Cperation & Maintenarce
1	Pump of 1L-1R canal	Officer(Zone man) of O&M Office in RID
2	Lateral canal (1L-1R) & intake	Ditto & his assistants
3	Intake No.1 & No. 2	Ditto
4	Temporary pump No. 1 & No. 2	Employee of O & M Office of farmer
5	Sub-lateral & division box	unsettled
6	Ditch	Ditto
7	Farm inlet	farmers

Condition of Management

No.1 : The staffs of C & M Office are regularly staying and always operate the pumps. According to the condition of rain fall, the operation may be suspened and although the farmers on downstream may request but, for protection of the engines, it is not executed more than present schedule.

No.2,3 : The assistance (common irrigator) designated by the zone man manages the gate operation and flow of irrigation canal, but the farmers will operate as they like on the time of short of water or in the night which can not be inspected.

No.4 : As for the operation, when the operator comes, the C & M Office will give the assistance of fuel but, in relation to the man power and budget, the farmers shall ensure (take charge) of the expense for operator and fuel.

No.5,6,7 : On this stage, on-farm level shall be in the scope to be performed by the farmers themselves but, the organization of farmer's group and actual activities are not satisfactory.

2. Pilot Project No.2 (Extensive Land Consolidation)

2-1. State of Irrigation

The irrigation water for this Project is supplied the 3L lateral which intake water from the main irrigation canal of left bank. The irrigation water is taken from the inlet by gravity and supplied into plots. Quantity of irrigation water is stable. This Project has an irrigable area in about 550 ha and the irrigation system is independent. The function of drainage are also considered to be favourable condition.

However, since both of the quantity of irrigation water and the scale of facility have been made for the purpose of supplementary irrigation water in the rainy season, the water level will drop in the dry season, it is not always in the good condition to intake water any time. Crops of dry season have also been partially cultivated in this Project before the construction of land consolidation.

2-2. The question on irrigation water

(1) The irrigation water for the crop of dry season can be taken in from the regulator about 3 km. upstream of the left main canal by means of the water level rises. The water level is not constant owing to the irrigable area of downstream.

(2) Since it is able to make gravity irrigation, it has taken in the water more than necessity for the plan. As the reason of it, the water management on the rotation irrigation is neglected. The surplus water is drained to the drainage so that the idea of plan of water distribution of project made for the total area has not been put to best use.

(3) As the new irrigation routes are adapted along the present area without land leveling and arranging the new plots, they are made bent and the length has to be extended than necessity thus the high farm land is poor to catch the water. Further, the irrigation canal is not always join in all plots (in principle, it is over 70% in the case of this Project, it joins in over 90%). For some part of plots, the irrigation is still remaining in the state of plot to plot.

2-3. The counter measure up to the present

This project is blessed with more favourable irrigation conditions than Pilot No. 1 so that the crop of dry season has been partially performed from the past. Accordingly, the farmers have agricultural experience throughout the year and they unceasingly contact with the zone man about the operation of the 3L lateral so that there may be no any critical situation.

(1) The regulating gate on the downstream is operated by the Kam Phaeng Saen Office of which this Project is put under the control and the connection with the intake gate of Vajiralongkorn Dam is made by system of communication through radio.

(2) With regard to the question of (1), (2), they can not be helped taking counter measure by water management of on-farm level.

As mentioned above, when we compare this Project with the Pilot No.1, although irrigation for the crop of dry season is performed, there has been no any critical problem. There is only one Japanese expert in charge of water management without counterpart and furthermore, the the reason of that the pilot No.2 is under the different O & M Office of Pilot No.1 which is at distance of about 15 km. etc. so that activity of water management has not been performed particularly.

2-4. The staffs and irrigation facility at the present

The works of oper and close of the gates for intake of 3L lateral, intake 9-15 and in number of 13 turnouts in 3L lateral are operated and controlled by the zone man and his assistant. On the matter of open and close, the farmers will show their wishes through the farmers'representative (there is 1 group for each irri-

gation ditch each of which selects a representative) to the zone man who will perform under the instruction of Nam Phaeng Saen Office.

Each irrigation ditch, diversion and farm inlet are performed by the farmers themselves and the present state of O & M is in the same system like that of Pilot No. 1.

With regard to the insufficiency of water, it is quite less than that of Pilot No.1 but the farmers of the downstream have made complaint.

III-2. The Progress of Cultivation & Water Management on Nae Klong Pilot Project

1. Pilot No.1

Year	Month	Construction & farming work	Counter-measure to irrigation & situation	Drift of farmers & result of yield	Remark
1979	March	Begining land consolidation works. (A = 36.9 ha)			
	June	Land consolida-tion completed			
	July	Commencing 1st rainy season crop.	○ Water flows in 1L-1R canal		
	Sept.		○ Paddy planting in the area completed land consolidation was finished.	No special great operation	Dry season crop Planting : Jan. - Mar. Harvesting : May. - June Rainy season Planting : June. - Aug. Harvesting : Oct. - Dec.
	Nov.		○ " " harvested		
1980	Feb.	Becining land consolidation works. (A = 116.8 ha)			

Year	Month	Construction & farming work	Counter-measure to irrigation & situation	Drift of farmers & result of yield	Remark
1980	March	Commencing 1st dry season crop (A = 36.9 ha)	○RID install water pump in the canal and perform irrigation to this project A = 43.3 ha (36.9 ha + 6.4 ha). ○Operation, fuel were provided by RID Problems (1) Capacity of water pump was too small. ϕ4" (2) Trouble always occured in pump and short of water continuously took place. (3) Level of a part of field were bad. (4) Owing to performing 1st dry season crop made on the farm land on condition of irrigating & drainage separated, the farmers could not correspond to water management or change from the usual habit.	As it was the 1st dry season crop, some farmers gave up the cultivation halfway because of lack of irrication water. Finally, the planted rate was 40 %. Number of farmers' house concerned Planting house 16 houses 8 " Cultivated area 36.8 ha Planted area 17.8 ha Planted rate 48 % Average yield 4,125 kg/ha (highest - lowest) 6,100 - 1,325 kg/ha.	
1980	June	Land consolidation completed Harvesting crop of dry season.			
1980	July	Commencing 2nd rainy season crop (A = 153.7 ha)	○Water flows into 1L-1R Canal.	Number of farmers : 53 farmers Planted area 146.24 ha Rate of planting 100 % The yield before and after execution of land consolidation	

Year	Month	Construction & farming work	Counter-measure to irrigation & situation	Drift of farmers & result of yield	Remark
				Before execution (42 plots) / After execution (48 plots)	
1980	Sept.		○ Meeting between C & M Office and expert. "on the counter-measure to water source for dry season crop 1981"	Average yield (kg/ha) 2,988 / 3,301 highest " 4,625 / 4,593 lowest " 1,625 / 2,083	
		Rainy season crop harvest.	○ Prepare the study data of use of water in planting and irrigation fee for dry season crop 1981 (see ANNEX 1).		
1981	Jan.	Commencing land consolidation (A = 240 ha)			
	Feb.	Commencing 2nd dry season crop (A = 144 ha)	○ Commenced irrigation by pump on Feb. 10th. ○ RID installed the pump (ø12" pump) and granted pump (ø6" pump) and, on this time, the RID bore the fee of operating, maintaining and fuel ○ Meeting of counter-measure to water management on Feb.17th. (between the staff of Thai side and expert) (1) Seizing plots in which farmers desire dry season crop. (2) The RID will perform installation and operation of pump.	○ According to the investigation of C & M Office, the land desiring for dry season crop was in 130 ha (90%) among the 144 ha.	

Year	Month	Construction & farming work	Counter-measure to irrigation & situation	Drift of farmers & result of yield	Remark
	March		(3) On the operation of intake and diversion gate, C.& M Office staff will check them once a day. (4) The cooperative Promotion Dept. will propel the organization of farmers'group of water management. ○Meeting of counter-measure to water management on March 24th. For the continucus operation of pump on the farmers side. (1) Goverment will subsidize fuel in 7,000 litre and the amcunt upward shall be born by farmers and should the farmers will not agree the pump will be suspended. (2) Since, if fee charge or the farmers be paid by cash or crop, it will cause local problem, it is concluded to collect the actual thing of light oil after harvesting. ○Farmers'water management meeting on March 27th (attended by RID 10 persons and farmers 40 persons)	○The interest on irrigation water was little; much drained water wastefully into drainage; irrigation condition between the upstream and downstream of canal appeared disorderly. ○Tendency of damming up the drainage water for irrigation have been found. ○The representative of farmers (Amphoe Office) requested the RID to continue the operation of pump. Rate of planting area. It was in 102 ha (70%) among 144 ha. The RID has make agreement to bear the fuel charge for pump operation.	

Year	Month	Construction & farming work	Counter-measure to irrigation & situation	Drift of farmers & result of yield	Remark
			The officer side and farmers incorporated in the above mentioned matters (Contract shown ANNEX.2.).	Representative of farmers side ..... Amphoe Officer Representative of Government side ..... RID pumping engineer. Witness ..... Electric engineer and O & M zoneman	
			As other matters : (1) Pump will be operated 16 hours a day and the farmer side will check the time and fuel.		
			(2) The water management will be divided into 9 irrigation unit each of which will select a representative to perform the water management. The O & M Office operate lateral canal.	60% of the cultivator were tenant farmers.	

Year	Month	Construction & farming work	Counter-measure to irrigation & situation	Drift of farmers & result of yield	Remark
			Various irrigation unit were executed on system of turning water. As the irrigation on turning water system was supervised by the zone man, it was progressed well at the beginning.	A part of the farmers participated in the irrigation of turning water system and actually, the zone man performed the work.	
1981	April		OThe irrigation system per above mentioned method was continued. To keep smooth irrigation was difficult. (1) Change of the section of canal or incline. (2) The water flow was neglected on plant growing. (3) The water turning system was no longer kept strictly.	The farmers would fix the beginning and stop of pump operation according to the weather and irrigation condition and the chairman of the representative will give notice to the zone man or pump operation. In case of any problem, it would be reported to the zone man and the O & M Office would undertake the settlement. The farmers'representative did not come to the field any longer. The result of dry season crop 1981. Number of farmers'house ... . 53 houses Planted area ..... 102 ha Planted rate 70%	
1981	May	Land consolidation completed.	Stop of pump operation on May 18th.		

Year	Month	Construction & farming work	Counter-measure to irrication & situation	Drift of farmers & result of yield	Remark
1981	June	Harvesting dry season crop		Transplanting / Direct sowing Average yield 3,983kg/ha / 3,641kg/ha highest 6,250 " / 5,000 " Lowest 2,750 " / 1,750 "	
	July	Begining 3rd rainy season crop..	Commencing 1L-1R pump operation on July 1st. OTo propose to clean the water canal (digging the soil and cut the weed) and gather the farmers'representative (July 7th-9th)	OIn order to clean the water canal, the 9 farmers representatives were summoned to the meeting but 7 of them attended ; on August 3rd there has fixed the schedule for execution with the farmers'representative respectively. Actually few ditches were worked.	
	Aug.		OFarmers meeting on Aug.6th. Arranging the 240 ha (in charge of irtake No.1) on which land consolidation was completed to be the same as intake No.2, each irrigation unit will elect representative (12 persons) and Chairman of water management group (1 person). (see ANNEX 3) OThe fee of pump fuel for dry season in charge of intake No.2 was 88.75 ฿/rai (average fee). OThe zone man and Cooperatives Promotion Officer explained the matter of water management in the Pilot.	OThe authority summoned 139 persons to attend the meeting but 79 persons only attended. OFor sharing the pump fuel charge, the area harvested were surveyed at the field under the witness of farmers'representative. OThe officer side had proposed the fuel fee as 100 ฿/rai but it was rejected by the farmers.	
	Sept.		Owing to much rain fall, insufficiency of water did not take place.	OThe farmers paid little interest in water management and little person attended.	

Year	Month	Construction & farming work	Counter-measure to irrigation & situation	Drift of farmers & result of yield	Remark
			Paddy planting of intake No. 2 completed.	○ The wooden gates for diversion and farm inlet were all stolen and substituted with stone and earth.	
				○ The collection of fuel fee in 88.75 ฿/rai did not executed (The responsible persons were obscure).	
	Oct.		○ Preparing comparative table for the List of Results and original plan scheduled on water fee of dry season crop 1981. (ANNEX 4)	Collection of fuel fee did not executed.	
	Nov.				Rain fall on Nov. 6th - 8th in 240 mm
				Number of farmers'houses ..... 143 houses	
	Dec.	Harvest of 3rd rainy season crop.		Planted area 368 ha. Paddy 360 ha. (98%) Sugarcane 8 ha. (2%)	Damage on facility took place.

Year	Month	Construction & farming work	Counter-measure to irrigation & situation	Drift of farmers & result of yield	Remark
1982	Jan.		○Meeting of water management on Jan. 7th (making previous arrangement with O & M Office) "on the irrigation of dry season 1982. ○Meeting of water management on Jan.14th (making previous arrangement with Project Office). "Same as above" (1) The electric fee for pump operation on 1L-1R canal was approved and the cultivation of dry season was possible. (2) The O & M Office prepared 2 units of ϕ8" temporary pumps and would operate the pump in the nursery period only under the control of that office. (3) For implementing insufficiency of water, the farmers were requested to prepare closing gate for terminal of drainage canal and clean the water ways.	Improved variety / Local variety Average yield: 3,336.4 kg/ha / 3,282.0 highest: 4,570.0 / 4,825.0 lowest: 2,512.0 / 2,165.0 ○On the intake No.1 farmers meeting held on Jan. 20th, they proposed that they desire to pay irrigation fee in (60 kg/rai) for paddy.	
	Feb.	Commencing 3rd dry season crop	○Installation of pump as above mentioned (Feb.4th) ○Performance the close on drainage and begining to lift up the water (Feb. 10th, 11th).	○The Chairman of water management group, positive representative of farmers, expressed as that as to let the farmers themselves perform the work according to the plan of water management will be difficult, the chairman will	

Year	Month	Construction & farming work	Counter-measure to irrigation & situation	Drift of farmers & result of yield	Remark
			O Water management meeting (official & farmers) on Feb. 11th. O Farmers meeting on Feb. 24th. O The water management program (draft) was presented to the farmers representative but they did not accepted. (ANNEX 5)	collect at 60 kg/rai (fuel charge 50 kg/rai + personnel expense 10 kg/rai) after harvest and it engaged the special worker in 7 persons to deal with the work seriously. The chairman would supply the fuel charge by raising loan from a private rice milling factory.	
1982	March		O Water flows really into 1L-1R canal (Mar. 5th). Owing to repair of 1L-1R canal, water flow was made late but it will be less dependance on the pump hereafter. O The terminal area of this project has been insufficiency of water from the past and it will be many problems for covering the whole area in dry season crop. As it is afraid that the water management as it is will be not able to cover the whole 4 blocks (about 75 ha in 20%) and we consider as necessary to use special means. (including pumping up or improving the facility)	O The special water management workers in 7 persons under the direction of chairman progressing better water management (the operation of quantity of division of water was performed under the decision of the chairman depending on the request of farmers and progress of farming work) was processed. O Planting completed in 90% on the end of March. Number of farmers'house .... 143 houses Farm land area .... 367.8 ha. Planted area ..... 328.4 ha.	

Year	Month	Construction & farming work	Counter-measure to irrigation & situation	Drift of farmers & result of yield	Remark
				Paddy 311.7 { Transplanting 207 ha(66%); Direct sowing 104.7"(34%) } Sugar cane 16.7 Planted rate 89%	
1982	April			○Although the water management was processed in system at the begin-ing but, owing to water flowing well in the 1L-1R canal and rain fell much thus when it is after the nursery & planting season, the water management became loose. ○Cleaning of water way not be per-formed but maintenance and control were made by only partial readjust-ment (repair of broken parts) and the farmers were in the same state as they have been.	Rain fall in 200 mm. on April 2nd - 15th.
	May		○Trouble always occurred to pump for 1L-1R and the water flow was susperded. When the weather was continuous good it showed insuffi-ciency of water. Temporary water liftire was made from 1R canal but irrigation wa-ter was not adequate because of lack of fuel for pump.	○Although the chairman has raised loan to buy the fuel, owing to that the dept was accumulated much thus the fund was short and made pumping up unable. A part of the farmers used small pump by their own effort. Growth of rice were unequal and it is thought that to collect man-agement fee equally would be dif-ficult. The chairman also admitted the difference in crop.	

Year	Month	Construction & farring work	Counter-measure to irrigation & situation	Drift of farmers etc.	Remark
			○The weed crow briskly.		
1982	June	On the harvest of 3rd dry season crop.	○The authority instructed that drainage gate which has been executed in dry season crop shall be suspended immediately and wooder gate shall be taken off.	○The chairman of water management group begun to collect the management fee. There were difference of 40 kg, 50 kg and 60 kg according to the yield but the rate of collection was about 50%.	
	July	A part of rainy season crop were commenced.		○Although the drainage wooden gate was taker off, they made dam of branches of wood, sand and earth for sustitution immediately and cause trouble to a part of the farmers of direct sowing.	
	Aug.		○The farmers meeting was held on August 30th under the sponsorship of Cooperative Promotion Dept. (present in 49%). The authority explained about the collection of C & M fee. For next year crop, according to the "payment for water supply and Maintenance on Pilot Project Area". The fee appeared to be about 90฿/rai. (see ANNEX 6,7)	○The irrication ditches were cleaned by a part of farmers. Yield of 3rd dry season crop Transplanting / Direct sowing Kg/ha Average yield 3,600 / 3,588 highest 6,042 / 5,696 lowest 1,250 / 2,181	

Year	Month	Construction & farming work	Counter-measure to irrigation & situation	Drift of farmers etc.	Remark
1982	Aug.			○Promotion of collection of C & M fee on date of Sept. 6th. Pay item 126,190 ฿ Income 108,288 ฿ Balance (debt) 17,902 ฿ Rate of collection 86% The chairman had held the debt menticned above as his personal debt.	
	Nov.		○Meeting between Thai officials and Japanese experts on the counter-measure of the water supply for next dry season crop (Nov.24th). O & M Livision in RID decided to join the works executed Japanese experts to survey and find a effective water management. In this connection, the meeting was held to keep the sufficient water for Pilot No.1. (see ANNEX 8)		
	Dec.		○Meeting on the water management (see ANNEX 9)		

2. Pilot No.2

Year	Month	Construction & farming work	Counter-measure to irrigation & situation	Drift of farmers & result of yield	Remark
1980	Nov.	Commencing work of land consolidation (A = 314.2 ha)			
1981	June	Works completed			
	July	Commencing 1st rainy season crop	○Water flowing in 3L canal.		
			○Investigation and make into table the problem on irrigation facilities.	Because the irrigation was insufficient, the farmers expressed their desire for reconstruction, improvement of facility.	
		Commencing repair work.		Yield of rainy season crop Improved variety (22 plots) / Local variety (27 plots) Average yield Kg/ha: 3,308.4 / 3,556 highest: 4,362.0 / 4,942 lowest: 2,332.0 / 2,270	
	Nov.	Harvesting 1st rainy season crop			
1982	Feb.	Repair work completed.			
		Commencing land consolidation work (A=236.3 ha)	○Farmers meeting was held on Jan. 28th "on water for dry season crop"		
		Commencing the 1st.dry season crop	○Water flows into 3L canal on Feb. 3rd.		
			○The irrigation water can flow until downstream.	○Farmers rejecting the land consolidation were 13 persons at first time and 5 persons at last.	

Year	North	Construction & farming work	Counter-measure to irrigation & situation	Drift of farmers & result of yield	Remark
1982	April				April 12th - 15th heavy rain fall
	May		The work was in delay owing to rain fall.	○According to resolution of meeting, all the persons shall clean the water way before the water will flow but the effect was only in about 30 %.	
	June	Land consolidation work completed. Harvest of 1st dry season crop.		Yield of dry season crop Transplanting (20 plots) / Direct sowing (66 plots) Average yield 3,587kg/ha / 3,459kg/ha highest 5,750 " / 4,759 " lowest 2,063 " / 2,184 "	
	July	Commencing 2nd rainy season crop.	○To investigate at filed for the problem after the works were completed. ○Accompanying the investigation mentioned the repair works were commenced. ○Farmers meeting "collection of water management fee" (Cooperative Promotion Dept. sponsored). The contents of meeting is nearly the same as it of No.1 (see ANNEX 6)	○Soon after the works were completed, there were complaint on insufficiency of water from a part of farmers in the down-stream. Since it was participation at field, 70% of farmers attended but their reaction to the collection of irrigation fee were unequally. ○The representative of water management groups were fixed.	

Year	Month	Construction & farming work	Counter-measure to irrigation & situation	Drift of farmers & result of yield	Remark
1982	Aug.		Kam Phaeng Saen Office observed the irrigation facilities and made a list about the repair or improvement.		