タイかんがい農業開発計画
帰国専門家報告書(V)

（メクロン地区農業普及専門家：富高元徳）

昭和60年 6 月

国際協力事業団

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序　　文

本プロジェクトは昭和52年4月発足以来，タイ国における米の増産及び二期作地域の拡大に貢献することを目標に，圃場整備の促進，農業生産技術の改良・普及及び農民組織の強化を進めており，仕上げの段階にある。

この報告書は，農業普及分野の専門家として昭和58年11月16日から昭和60年3月31日までの間派遣された富高元徳氏の活動内容をまとめたものである。

ここに，同氏の御尽力に深く感謝するとともに，今後関係者の参考資料として幅広く利用されることを願うものである。

昭和60年6月

農業開発協力部長

田　内　　堯

帰国総合報告書

氏　　名　富高元徳

派遣プロジェクト名　タイかんがい農業開発計画

任務地　メクロン・パイロット・プロジェクト

指導分野　農業普及

派遣期間　昭和58年11月16日から昭和60年3月31日

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I はじめに

タイかんがい農業開発計画の概要についてはすでに多くの報告があるので，メクロン・パイロット・プロジェクトの概要について簡単に述べる。メクロン・パイロット・プロジェクトはタイかんがい農業開発計画のサブ・プロジェクトの1つであり，2つのパイロット地域と展示農場から成った。パイロット・プロジェクトは農業基盤の整備，水管理に関する助言，改良農業技術の導入，農民組織の育成・強化を目標とした。メクロン・パイロット・プロジェクトへの協力期間は昭和52年4月から昭和60年3月までの8年間であった。

パイロットNo.1（403.6ヘクタール，内展示農場9.9ヘクタール）では集約型の圃場整備を昭和54年から昭和56年にかけて行った。集約型は末端用排水路，農道の整備，圃場の均平作業，換地を含んだ。末端用水路による標準水係り面積は19.2ヘクタール，末端水路の長さは600メートルであり，農道は末端用水路沿いに，排水路は末端かんがい単位の両脇に通した。末端かんがい単位では，用水路の両側にそれぞれ12筆の水田を配し，1筆の水田面積は0.8ヘクタール（50メートル×160メートル）であった。（現実には1筆が3筆位に分かれている）。

パイロットNo.2（550.5ヘクタール）では粗放型の圃場整備を昭和56年から昭和57年にかけて行った。粗放型は末端用排水路と農道の建設を含み，これらは農地の所有界に沿って行われた。末端水路係りの標準的な面積はないが，平均で約30ヘクタールである。

展示農場はパイロットNo.1に昭和54年に建設された。展示農場は実用実験と農家圃場の観察を通じて改良技術の確立に努めるとともに，普及活動を通じてメクロン地域，特にパイロット地域の稲作の改良に重要な役割を果たした。

II 農業普及

パイロット地域農民への普及活動は，前任者である堤専門家の着任（昭和56年12月）後強化された。農業普及分野における主な業務は，モデル農家の任命と指導，稲作についての農民研修，水利組合の育成，品種および種子の更新，収量調査，「メクロン農業新聞」の発行等であった。展示農場での実用実験，農家圃場の観察を通じて蓄積された稲作技術を農家が導入できる形にして伝えるよう努力した。また，水利組合の育成は協同組合促進局を中心に王室かんがい局，農業普及局が協力して進められた。

1. モデル農家

改良稲作技術の展示と農民の実地研修を目的としてモデル農家への濃密指導を行った。パイロットNo.1ではタムアン農業普及所と協力して昭和57年乾期作から，パイロットNo.2ではタマカ農業普及所と協力して昭和57年雨期作から始めた。モデル農家は農業普及所から推薦され，

研修会を通じて農民の合意を得た。モデル農家数は作期・地域によって異なったか，農家当たり5ライか10ライ，パイロット地域当たり40ライを一応の基準とした。

改良稲作技術の展示および研修が順調に行われるよう，モデル農家に対して展示農場から生産資材の供与を行った。供与した資材は肥料（基肥としてライ当たり30キロの隣安，追肥としてライ当たり20キロの硫安），除草剤（ライ当たり5キロのサターンG），殺虫剤（スミチオン，フラダン1瓶ずつ）であった。

それぞれのモデル農家に対して播種日および栽培法に合わせた農作業のスケジュールを作り，農家はこれに合わせて圃場管理を行った。品種は一部在来種を併用した農家もあったけれど，多くの農家が高収量品種（特にRD－23）を栽培した。

モデル農家の収量を表1に示す。冷害や水不足の影響で低収量の農家もあったが，全般的には満足できる結果であった。改良技術を経験によって身につけさせる試みは資材の供与も手伝って好評であった。また，多くの農家がモデル農家の稲作に興味を示し，農家間の意見交換が交修会を通じて行われた。

Table 1 Rice yields of model farmers

Pilot No. 1 area, 1982 dry season

Name of model farmer	Variety	Yield (kg/ha)	Planting method
La Doknangyam	Apple Tong	5,212	Transplanting
	RD-7	4,297	Direct sowing
Piboon Srisawan	RD-7	4,063	Transplanting
Sompean Boonsiri	RD-7	3,773	Direct sowing
1982 wet season			
La Doknangyam	RD-23	4,687	Direct sowing
	Luang Pratiew	3,860	Transplanting
Piboon Srisawan	RD-23	3,781	Transplanting
Sompean Boonsiri	RD-23	5,512	Direct sowing
1983 dry season			
Jae Sritong	RD-23	4,904	Transplanting
Tearn Jamsai	RD-23	5,059	Direct sowing
Mant Jaijing	RD-23	4,532	Direct sowing
Chow Modmed	RD-23	5,165	Transplanting
1983 wet season			
Jae Sritong	RD-23, 25 Luang Pratiew	2,944	Transplanting
Tearn Jamsai	RD-23	5,132	Direct sowing
Mant Jaijing	RD-23	4,065	Direct sowing
Chow Modmed	RD-23	3,763	Direct sowing
1984 dry season			
Nop Namdit	RD-23	3,530	Direct sowing
Mol Buaklai	RD-23	3,719	Direct sowing
Sopon Banmai	RD-23	4,888	Direct sowing
1984 wet season			
Pet Tongyam	RD-23	3,918	Direct sowing
Prink Nuch-im	RD-23	3,700	Transplanting
Seksun Wongprasert	RD-23	4,030	Direct sowing
Tawat Tedsana	RD-21, 23	4,117	Transplanting
Sompoch Boonsiri	RD-23	4,120	Direct sowing

Pilot No. 2 area, 1982 wet season

Name of model farmer	Variety	Yield (kg/ha)	Planting method
Samarn Sukrom	RD-23	4,715	Transplanting
Sujin Pun-pukdee	RD-23	5,212	Transplanting
Lump kabute	RD-23	4,337	Transplanting
1983 dry season			
Poom Srisamran	RD-23	6,751	Transplanting
Long In-thirat	RD-23	6,484	Transplanting
Samarn Sukrom	RD-23	5,859	Direct sowing
Kun Langma	RD-23	5,782	Direct sowing
1983 wet season			
Poom Srisamran	RD-23	5,172	Transplanting
Long In-thirat	RD-23	5,132	Transplanting
Samarn Sukrom	RD-23	3,447	Direct sowing
Kun Langma	RD-23	4,593	Transplanting
1984 dry season			
Ana Sukaram	RD-23	5,720	Direct sowing
Thaeo Nak-fam	RD-23	4,278	Transplanting
Samruai Onpun	RD-23	5,283	Direct sowing
Chun Tongchot	RD-23	5,296	Transplanting
1984 wet season			
Sroy Sungsa-ad	RD-5	3,591	Transplanting
Somsuk Duangsri	RD-23	4,488	Transplanting
Sert Intasopa	RD-23	3,911	Direct sowing
Chom Hua-leatt	RD-23	4,056	Direct sowing
Boon Sungca	RD-23	4,437	Direct sowing
Lek Pu-kong	RD-23	5,250	Transplanting
Cheo Pu-kong	RD-23	5,047	Transplanting
Punta Ku-achirakul	RD-23	5,022	Direct sowing

2. 農民訓練

水稲栽培についての研修会は昭和57年から始め，水利組合の育成も並行的に行った。これは農業普及所，協同組合促進事務所，王室かんがい局管理事務所と協力して開催し，展示農場は農業普及所と共に水稲栽培の技術普及を受け持った。末端水路の補修，水利費の徴収，水利組合長やモデル農家の任命，種子交換やかんがいスケジュール等についての討議も行い，政府職員と農民の協力関係を築く上にも役立った。研修会への参加農民数は延べ人数で表2の通りである。

Table 2　Farmers meeting in last 3 years

		Number of meetings	Total farmers attended
1982	Pilot No. 1	4	185
	Pilot No. 2	5	120
1983	Pilot No. 1	6	131
	Pilot No. 2	6	149
1984	Pilot No. 1	7	249
	Pilot No. 2	11	465

3. 水利組合の育成

水利組合の育成は昭和57年に始まった。現在パイロットNo. 1で5水利組合，No. 2で2水利組合が組織され，それぞれのパイロット地域をカバーしている。水利費は年間ライ当たりパイロットNo. 1で70バーツ，No. 2で40バーツである。農民の組織化は水係りの悪い圃場が残っていたパイロットNo. 1で難航したが，昭和59年初めに水路の補修工事が行われ，ほとんどの農家が水利費を納めるようになった。昭和59年に徴収された水利費はNo. 1で161,850バーツ，No. 2で103,300バーツであった。水利費は末端水路の補修費に当てられ，補修工事に出た農家に還元されている。水利組合の育成はパイロット地域外で末端水利施設の整備を終えた地域でも進行中である。

4. 品種および種子の更新

品種および種子の更新は，メクロン地域の稲2期作化に大きく貢献した。展示農場の実用実験で品種の特性を調査した後，優良品種と認められたものを増殖し，農家の籾と交換した。昭和57年までRD－7を最も多く交換したが，それ以後RD－23がこれに代わった。RD－23は昭和56年に登録された品種で，ラギット・スタント・バイラスへの抵抗性と高収量性のため急速に広まった。農家と交換した種子量を表3に示す。

Table 3　Amount of seed exchanged

1980　:　1.0 ton of RD-7, RD-9 and RD-11

1981　: 11.5 tons of RD-7 and RD-9

1982　: 22.3 tons of RD-7 and RD-23

1983　: 18.9 tons of RD-23 and RD-21

1984　: 11.1 tons of RD-23

1985　: 21.5 tons of RD-23 (as end of January)

5. 収量調査

4平方メートルの円形サンプルで作期毎，パイロット地域毎，約100サンプルを収穫し，収量の変化を見た。表4にその結果を示す。パイロット地域（カンチャナブリ県）のプロジェクト開始前の籾平均収量はヘクタール当たり2.2トンあったが，プロジェクト開始後，乾期作で4.4トン雨期作で3.6トン程度となった。しかし収量のばらつきが見られ，平均2.5トンに満たない農家もある。

収量調査はまた高収量品種（RD－品種）の栽培地域の拡大を示した。表5に示すように乾期作は全て高収量品種で占められている。雨期作についても感光性の在来種から非感光性の高収量品種へ急激に変わりつつある。これは乾期作の影響が雨期作に現われていることを示している。

収量調査とは別に調べた栽培法の変化を表6に示す。田植え中心であったパイロット地域の稲作は，特に乾期作において直播き地域が拡大している。昭和59年乾期作ではNo.1で9割，No.2で6割の地域が直播きであった。播種の前後にほとんど降雨を見ない乾期作は直播きに適している。雑草防除が直播きを安定化させる課題である。

Table 4 Average yields at different crop seasons (kg/ha)

1. Pilot area No. 1.

	Dry season			Wet season		
	Highest	Lowest	Average	Highest	Lowest	Average
1980	6,100	1,325	4,125	4,625	1,625	3,134
1981	6,250	1,750	3,862	4,825	2,165	3,294
1982	6,042	1,258	3,639	5,728	1,409	3,432
1983	7,703	3,003	5,253	5,675	2,060	3,699
1984	7,026	1,431	4,184	7,388	1,648	3,680

2. Pilot area No. 2.

	Dry season			Wet season		
	Highest	Lowest	Average	Highest	Lowest	Average
1981				4,943	2,270	3,556
1982	5,750	2,062	3,558	5,550	1,289	3,738
1983	6,751	2,078	4,485	5,508	2,101	3,684
1984	6,099	1,894	4,551	6,228	2,673	4,373

Table 5 Percent of RD varieties planted area

	Pilot No. 1 area		Pilot No. 2 area	
	Dry season	Wet season	Dry season	Wet season
1981	100	25	100	10
1982	100	49	100	35
1983	100	70	100	60
1984	100	70	100	90

Table 6 Percent of Direct Sowing Area

	Pilot project No. 1		Pilot project No. 2	
	Dry season	Wet season	Dry season	Wet season
1981	5 %	10 %	2 %	5 %
1982	10	15	4	10
1983	45	30	30	20
1984	90	55	60	45

6. メクロン農業新聞

昭和59年1月から「メクロン農業新聞」（タイ語）を700部発行し，協力期間終了までに11号出した。稲作に関する情報を農家と関係機関に渡し，研修会の資料としても使用した。基本的には英語で原稿を作りタイ語に訳したが，カウンターパートを始めタイ側関係者からの原稿も幾つか出た。「メクロン農業新聞」の英語版を付録につける。

7. 稲作栽培暦

メクロン地域に合った稲作技術を栽培暦の形にまとめ2,000部発行して農家と関係機関に配布した。栽培の三沢専門家，カウンターパートたちと協力し，稲2期作を行なう上でのポイントを1枚にまとめた。

8. その他の活動

昭和59年乾期作にパイロットNo.1，No.2で農業機械の演示をやった。昭和59年雨期作にはNo.2で10ライの採種圃を設けた。展示農場はまた各種の訓練に直接的・関係的に協力した。末端水管理者の訓練，農村青年の訓練，新兵訓練などを行い，また施設や機材も有効に利用された。

メクロンかんがいプロジェクトは現在王室かんがい局の最大のプロジェクト（投下資金的に）であり，多くの訪問者があった。年間500人から700人の訪問者が展示農場に来た。外国からの訪問者も多く，各種の意見交換を行った。

Ⅲ メクロン地域における稲作の変遷と現状

昭和59年8月に2パイロット地域を含む5地域で168農家（42農家×3地域，21農家×2

地域）を対象に，メクロン地域の稲作の変遷と現状について調査した。調査に当たってはできるだけ昭和57年に調査した農家をフォローした。調査結果は“Historical Change and Present Situations of Rice Farming in Some of Mae Klong Area”として付録につけ，ここでは要約を記す。

調査地域の耕地面積は農家当たり平均21ライから39ライであり，その内水田は15ライから30ライである。1地域は稲単作地帯であるが，他の4地域は稲と砂糖キビが主作物である。小作地は全耕地面積の5パーセントから31パーセントであり，水田では9パーセントから44パーセントを占めている。水田の小作料は地域間・農家間で異なるが，ライ当たり籾で年間250キロ（雨期150キロ，乾期100キロ），220キロ（雨期150キロ，乾期70キロ），150キロ（雨期100キロ，乾期50キロ），雨期1作100キロを収穫後に払う例が多い。砂糖キビ畑の小作料ライ当たり年間200バーツから500バーツである。所帯人数は平均4.5人から6.7人で，その内農業従事者は3.3人から4.3人である。農作業の相互扶助は広く行われ60パーセントから93パーセントの農家が，年間60人日から84人日の労働交換を行っている。

メクロン地域の稲作の変遷に最大の影響を与えたのはヴァジラロンコンダムの建設（1972年完成）に続く用排水路網の整備である。特に末端用排水路の整備は，それまでの雨期1作地帯から年2期作地帯への変化につながっている。調査地域の内，末端用排水路の整備を終えた4地域ではほとんどの農家が2期作を行っているが，まだ整備の行われていない1地域は雨期1作地帯である。

2期作の導入は品種の変更を伴った。在来種はその感光性の特性から乾期作には向かず，乾期作の品種は全て高収量品種で占められている。雨期作の品種も1部高収量品種に置き代わり，昭和58年雨期作ではパイロットNo.1で47パーセント，No.2で62パーセントが高収量品種で占められた。年2期作が可能な4地域では昭和59年までにほとんどの農家が高収量品種を栽培した経験を持っているが，まだ雨期1作である地域では，昭和59年に初めて約2割の農民が高収量品種を栽培した。

2期作化はまた栽培様式も変化させている。元来田値え方式が一般的であったメクロン地域の稲作は，直播き方式へと変わりつつある。この傾向は特に乾期作，パイロット地域に強く見られる。昭和58年雨期作に年1作地帯では全ての農民が田植えだけを行ったのに対し，昭和59年乾期作にパイロットNo.1の9割の農家が直播きのみを行った。

本田準備と脱穀作業は，昭和58年までに調査地域の全農家で機械化された。耕転機の所有率は43パーセントから57パーセントであり，砂糖キビ栽培の盛んな1地域では17パーセントの農家がトラックタを所有している。3地域の農家は脱穀機を所有しておらず，他の地域でそれぞれ2パーセント，10パーセントの農民が所有している。農業機械を所有していない農民たちは契約によって本田準備，脱穀を行い，本田準備ではライ当たり約200バーツ，脱穀ではトン当たり30キロから40キロの籾を払っている。

多くの農家は主な水源をかんがい水に頼っているが，補助的にポンプを利用する農家がパイロ

ットNo.1で46パーセントにのぼった。これは同地域の第1次支線水路へのかんがい水が幹線水路からポンプで揚水されており，ポンプの故障がかんがい水の供給に影響を与えていると思われる。また，集約型の圃場整備を行なったパイロットNo.1は用排水路が適当に配置されており，自家用のポンプを利用するのに適していることも1因だろう。

昭和58年雨期作では52パーセントから98パーセントの農民がライ当たり78バーツから136バーツの肥料を使用した。これはライ当たりの窒素レベルで，高収量品種で6.1キロから9.0キロ，在来種で2.5キロから7.4キロであった。59年乾期作では全農家が施肥を行い，ライ当たりの投下金額で平均113バーツから161バーツ，窒素レベルで6.9キロから8.9キロであった。農薬は雨期・乾期作とも5割から9割の農民が使用し，ライ当たり平均雨期作で13バーツから30バーツ，乾期作で21バーツから57バーツであった。農薬の使用目的としては雑草防除が多かった。

昭和58年雨期作の平均収量はライ当たり465キロから571キロ，米価（籾）はキロ当たり3.1バーツから3.3バーツ，ライ当たり純収益は943バーツから1,447バーツであった。59年乾期作の平均収量は576キロから718キロ，米価は3.0バーツから3.2バーツ，純収益は1,411バーツから1,750バーツであった。

農家当たりの純収入は平均39,000バーツから96,000バーツであり，その内稲作からの収入が36パーセントから77パーセント，砂糖キビ栽培からの収入が0パーセントから56パーセントを占めた。また，純収入に占める農業収入（稲，砂糖キビ，畑作，家畜）は82パーセントから96パーセントであった。

農民の組織化は地域間差があり，水利組合加入農家はパイロット地域で98パーセントから100パーセント，パイロット地域外で0パーセントから62パーセントであった。農業協同組合加入農家もパイロット地域で多く（55～60パーセント），パイロット地域外で少ない（14～48パーセント）。パイロット地域への普及活動は地域外に比べて活発に行われている。これは会議やセミナーに出席する農家（パイロット地域で86～98パーセント，地域外で57～69パーセント），政府職員の訪問を受ける農家（パイロット地域で57～60パーセント，地域外で43～48パーセント），政府機関に農法について相談する農家（パイロット地域で33～43パーセント，地域外で5～24パーセント）等に見られる。

生活水準は全般的に向上し，71パーセントから98パーセントの農家が5年前に比べて良くなったと答えた。生活水準の向上に貢献した主な要因は，米の増収，水利施設，米価，農業技術の進歩であり，輸送，機械化，農業普及をあげた農家もいた。農業融資の利用は地域間，農家間で差が見られるのが，昭和57年以前の借金が残っている農家はなかった。

Ⅳ　農家水田における水管理

農家水田における水管理の調査を昭和59年の乾期作に行った。この調査は村尾短期専門家（水管理，派遣期間昭和59年1月10日～3月31日）の指導の下に行ったが，同専門家が試験途中で帰国されたため，以後三沢専門家（栽培）と協力して継続した。調査結果は“Report of Practical Water Management Experiment on Rice Cultivation at Mae Klong Pilot Project in 1984 Dry Season（M. Tomitaka and K. Misawa）”として付録につけ，ここでは要約を記す。

水稲栽培の要水量を農家段階で見る目的で，メクロンかんがいプロジェクトのパイロットNo. 1地域にある2つの末端用水路係り（36.4ヘクタール）で，昭和59年乾期作（3月3日～8月1日）に実験を行った。更に一般的な末端水路係り（19.1ヘクタール），用排水を管理した水田（0.8ヘクタール）と幹線排水路で付随的な調査を行った。

実験地域の内，18.1ヘクタールは6ブロックに分け，準備用水は荒起こしと代かき用に別途供給し，週単位の輪番かんがいを苗立ち後に導入した。別の18.3ヘクタールは4ブロックに分け，準備用水の供給開始から週単位の輪番かんがいを導入した。前者を集中的な水管理を行った地域，後者をやや集中的な水管理を行った地域と呼ぶ。一般的な地域の水管理は農家の慣行に任せた。

準備用水の供給には23日間（549.5時間）かかり，集中的な水管理を行った地域で270.3ミリ，やや集中的な水管理を行った地域で281.7ミリであった。集中的な地域では荒起こし用に174.6ミリ，代かき用に95.7ミリであった。やや集中的な地域では荒起こし用に180.8ミリ，代かき用に100.9ミリと推定された。荒起こし開始時の湛水深は集中的な地域で55.5ミリ，やや集中的な地域で66.1ミリであり，代かき2日後の湛水深はそれぞれ83.2ミリ，86.6ミリであった。一般的な地域での準備用水量は得なかったが，荒起こし時の湛水深（72.7ミリ），代かき2日後の湛水深（104.0ミリ）および準備用水供給期間（27日間）は，多量の準備用水が供給されたことを示唆した。

かんがい開始から代かき終了までの期間は，実験地域で27日間，一般的な地域で30日間であった。かんがい開始から播種終了までの期間は，やや集中的な地域で27日間，集中的な地域で30日間，一般的な地域で31日間であった。これを作業別に見ると，荒起こし期間は集中的な地域で14日間，やや集中的な地域で21日間，一般的な地域で26日間であった。代かき期間は集中的な地域で11日間，やや集中的な地域で17日間，一般的な地域で25日間であり，直播き期間は，集中的な地域で9日間，やや集中的な地域で12日間，一般的な地域で22日間であった。

調査結果はメクロン地域の乾期稲作において農民が直播きを行い，300ミリから330ミリのかんがい水が適当に分配されるならば，本田準備期間は30日間で十分であることを示した。農民たちは本田準備を30日間以内で終了させるのに十分な農業機械を所有している。

準備用水供給後，104.625日間に集中的な水管理をした地域に800.5ミリ，やや集中的な水

管理をした地域に926.4ミリのかんがい水が供給された。この期間（3月26日～7月8日）の雨量は144.5ミリであった。これを日平均総供給水量で見ると，集中的な地域で9.03ミリ，やや集中的な地域で10.24ミリであった。水田の水位変動から得た推定日減水深は，集中的な地域で平均9.26ミリ（5.31～15.02ミリ），やや集中的な地域で平均11.31ミリ（6.00～19.33ミリ）であった。田越しかんがい（1つの水口が平均約6筆の水田に水を供給）のため，日要水量（減水深）を正確に得ることはできなかった。実験地域への総供給水量と排水量を基に推定した日平均要水量は6.96ミリで，水の圃場効率は集中的な地域で77パーセント，やや集中的な地域で68パーセントであった。

ヘクタール当たりの平均収量は，集中的な水管理をした地域で4,372キロ，やや集中的な水管理をした地域で4,189キロであった。これらの収量レベルは，同作期の実験地域外（パイロットNo.1）の平均収量（ヘクタール当たり4,184キロ）に比較して遜色はなかった。このことは，実験地域に供給された水量は昭和59年乾期作におけるパイロットNo.1地域の平均収量を得るのに十分であったことを示した。

用排水を管理した水田において，5月22日から6月11日にかけて漏水（横浸透）を除いた平均日減水深は6.45ミリであった。これは快晴日（5月22日～29日の平均）で8.43ミリ，雨天日（6月6日～10日の平均，4日間の雨量7.5ミリを含む）で6.13ミリであった。しかしながら快晴日には最高10ミリの日減水深を認めた日もあった。

944ヘクタールの水田地域から日平均約4.91ミリの水が排水された。日平均排水量は3月初旬のほとんど0ミリから5月下旬の8.44ミリの間で振幅した。実験地域からの排水量（集中的な水管理をした地域で日平均2.07ミリ，やや集中的な地域で3.28ミリ）に比較して，広い水田地域ではかんがい水は適正に管理されていなかった。

V　農業普及の効果および今後の課題

メクロン・パイロット・プロジェクトにおける農業普及分野の直接的な貢献は，安定した稲2期作地帯形成への寄与であろう。ヘクタール当たりの平均収量は年1作で2.2トンから年2作で8トンのレベルまで上昇した。増収に結びつけた要因として，末端水路整備により2期作が可能になったこと，土壌が稲栽培に適していたこと，遅れて出発したタイの高収量品種育成も優良な品種を農民に出せるようになったこと，栽培分野での実用実験の結果が蓄積されたこと，等があげられる。こうしたことは稲作の技術普及を容易にした。

普及活動は，王室かんがい局，農業普及局，協同組合促進局と協力して農民組織（特に水利組合）の育成も含めた。パイロット地域で行った水利組合の育成は，パイロット地域外波及している。水利費の徴収も協同組合促進局事務所から群農業協同組合へと移されつつあり，水利組合を基盤とした農業協同組合の強化への動きが出て来ている。

展示農場も対象地域がパイロット地域からメクロンかんがいプロジェクト全域に変わり，パイロット地域での経験をパイロット地域外へ波及させることとなった。また展示農場を水管理訓練のための仮施設として利用する予定となっている。こうした動きは，これまでの展示農場の活動が評価され，今後とも期待されていることを示す。展示農場としては，他の政府機関との連携を強化して，要請に答えて行かなくてはならないだろう。

稲作技術の普及の上で問題として残るのは，直播き方式における水管理（特に播種期）と雑草防除である。これは，農家が直播き栽培に慣れ，播種前の除草剤使用が徹底するならば，近い将来に克服できるだろう。降雨パターンから見て，乾期作に直播きをして雨期作に田植えをするというローテーションも雑草防除に有効である。

MAE KLONG FARMING NEWS

Agricultural Demonstration Center

The Greater Mae Klong Irrigated Agriculture Development Project

No. 1 (January, 1984) - No. 11 (January, 1985)

Motonori Tomitaka

and

Supachai Kaewlamyai

March, 1985

MAE KLONG PILOT PROJECT (Royal Irrigation Department)

IRRIGATED AGRICULTURE DEVELOPMENT PROJECT (Cooperation Project of Ministry of Agriculture and Cooperative, Thailand and Japan International Cooperation Agency)

PREFACE

The Mae Klong Farming News was first published in January 1984 for the purpose of diffusing the appropriate rice cultivation technologies to the farmers inside and outside of the Mae Klong Pilot Project of the Irrigated Agriculture Development Project. About 700 copies of the said farming news in Thai were published every time from the Agricultural Demonstration Center of the Mae Klong Irrigated Agriculture Development Project of the Royal Irrigation Department.

This is the full series of the Mae Klong Farming News (in English) published so far. We are very glad if some of the contents can be the references of the agricultural extension work on rice cultivation and contribute to the upgrading of rice farming technologies of farmers in the Mae Klong area.

Motonori Tomitaka and Supachai Kwaelamyai
Agricultural Demonstration Center
Mae Klong Irrigated Agriculture Development Project

CONTENTS OF MAE KLONG FARMING NEWS

No. 6 (June 1)

1. Yield and yield components.
2. Control blast and insects (by Mr. Avrooth Pisan, Tha Muang Agricultural Extension Office).
3. To : Members of water user groups in sugarcane pilot project, Tambon Tungtong, Amphur Tha Muang (by Mrs. Charunsri Amphansaeng, Mae Klong Cooperative Promotion Department Office).

No. 7 (July 2)

1. Important points of wet season rice cultivation.
2. Herbicide and weed control.

No. 8 (August 1)

1. Ideal rice variety and varieties at present.
2. Spreading period of rice diseases (by Mr. Avrooth Pisan, Tha Muang Agricultural Extension Office).
3. Flag symbol for water supply (by Mrs. Cahrunsri Amphansaeng, Mae Klong Cooperative Promotion Department Office).

No. 9 (September 3)

1. Result of yield survey, 1984 dry season rice.
2. Use fertilizer properly.

No. 10 (October 25)

1. Recommendations on rice farming for Mae Klong area.

No. 11 (January 2, 1985)

1. Important points of dry season rice cultivation.

No. I-1 January 3, 1984.

MAE KLONG FARMING NEWS

Agricultural Demonstration Center
The Greater Mae Klong Irrigated Agriculture Development Project

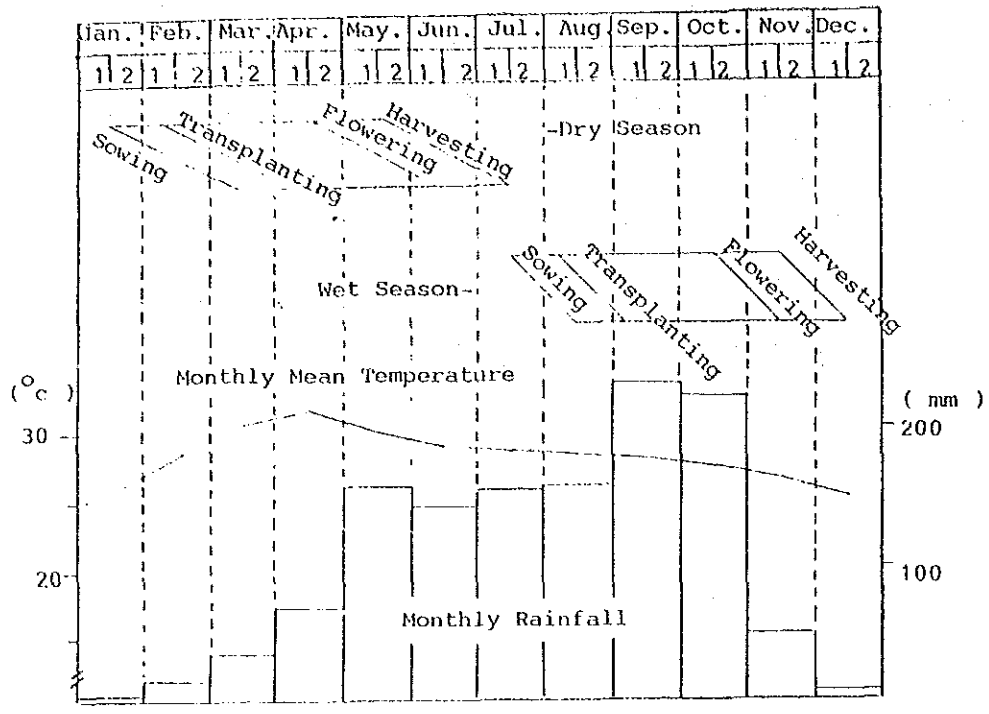
It has been more than six years since Agricultural Demonstration Center (formerly called Trial Farm) commenced in the Greater Mae Klong Irrigated Agriculture Development Project. The demonstration center has tried to find and develope the better rice cultivation technology for farmers in the area of Mae Klong Project. Since this development project aims at stable rice double cropping in a year under controlled water management system, rice cultivation method is different from conventional method.

Not only experiments at the demonstration center but also data collection from farmers' fields have been being conducted for improving lowland rice farming in the area. Agricultural extension services for farmers in the pilot project areas are conducted in cooperation with respective Agricultural Extension Office and Cooperative Promotion Department Office. Because the final goal of the demonstration center is to transfer the knowledge and technology on rice farming to the farmers in Mae Klong area.

It is a pleasure to publish this monthly Mae Klong Farming News. This bulletin will provide technical topics on rice farming and information from respective agencies concerned. This bulletin can be used as guide and text for farmers.

Further, the demonstration center welcomes constructive opinions, suggestions and comments about this farming news for its improvement.

RICE CULTIVATION CALENDAR, 1984.



MATTERS SHOULD BE CONCERNED

1. Variety

   Dry season: RD-23, RD-21, RD-25.

   Wet season: RD-23, RD-21, RD-25.

   Khao Dok Mali 105, Khao Pak Mor 148, Luang Piatew 123.

2. Seed rate

   Transplanting: 6 kg/rai, direct sowing: 15 kg/rai.

3. Nursery size: 20 wa^2/rai (500 m^2/ha)

4. Seedling age at transplanting: 18-25 days.

5. Planting space: 100 hills/wa^2 (25 hills/m^2; about 30 cm x 13 cm or 20 cm x 20 cm)

6. Seedling rate: 3 seedling/hill

7. Root depth at transplanting: as shallow as possible.

8. Basal fertilizer application: 30 kg of Am.Phos/rai for RD varieties.

   Transplanting: apply at paddling time.

   Direct sowing: apply at 2 weeks after sowing (after first irrigation).

9. Top dressing fertilizer application: 20 kg of Am.Sulfate for RD varieties. Apply at young panicle formation stage (about 70 days after sowing or 45-50 days after transplanting)

10. Herbicide application: 5 kg of Saturn G/rai.

Transplanting: 5 days after transplanting

Direct sowing: apply at 2 weeks after sowing

11. Water management

Transplanting: maintain 4-5 cm depth of water or irrigate about 8 cm depth every week until 2 weeks after flowing. However, the paddy field may be dried after maximum tillering stage for 10 days.

Direct sowing: drain out water from 1 day before to about 10 days after sowing.

Before apply fertilizer or herbicide check and close holes in levee. Standing water of at least 3 days is necessary for herbicide, and running water brings out nitrogen fertilizer from the paddy field. Be sure that rice plant requires a lot of water from 10 days before to 10 days after flowering.

12. Special care for direct sowing

Seed bed for gap filling: should be prepared at 1 week before sowing date.

Drainage furrow: should be made every 8-10 m. interval.

13. Rodant and crab control to prevent water loss.

14. Insect and disease control.

RECORD FARMING NOTE

A sheet of paper is attached to this Bulletin. Taking a record of farming activities and cost and returns is important. The record will be the best reference for your farming in the future. Just record what you have done in the field, the amount you have investigated for farming, and the amount you have earned from farming. Don't forget to record the date of each farming activity. You can use the space of others for taking note of what you have observed in the field.

CLEAN FEEDER ROAD, CANAL AND LEVEE

Feeder road and irrigation and drainage canals should be maintained properly. There are some farmers who leave rice straws on or along the feeder road, irrigation canal or drainage canal. They will be the trouble for irrigation and drainage. They obstruct water running, then less water will be available for irrigation and hard to drain excess water. The rice straws attract rats and increase the rat population.

After threshing, all rice straws should be taken out from the road and canal or should be burned by respective farmer. Farmers should clean levee or footpath between rice fields. Cutting grass on levee, closing holes of rats and/or crab are important. Water leaking reduces the effects of fertilizer, herbicide and insecticide. Levee covered with grass attracts rats.

KEEP THIS FARMING NEWS

This farming news will cover all important points on rice farming and water management. Keep this news every month, and you may have a complete text in the future.

FARMING NOTE, 1984

MONTH	FARMING ACTIVITIES	COST AND RETURNS
JAN		
FEB		
MAR		
APR		
MAY		
JUN		
JUL		
AUG		
SEP		
OCT		
NOV		
DEC		

OTHERS:

INFORMATION

MEETING ON RICE PRODUCTION

Meetings on rice production will be held at Pilot Project No.1 and Pilot Project No.2, respectively. Farmers who want to study rice production are welcomed. We use this monthly bulletin as a text for rice production. Other important agenda are, appointment of model farmers for 1984, information from government agencies concerned.

Pilot Project No.1

Time: AM 9.00-12.00, January 10, 1984.
Place: Agricultural Demonstration Center (Trial Farm)

Pilot Project No.2

Time: PM 1.00-4.00, January 12, 1984.
Place: House of Mr.Lhong.

SEED EXCHANGE

About 20 tons RD-23 seeds for dry season planting are now availble at the Agricultural Demonstration Center. Farmers who want to exchange their seeds to RD-23 should report cooperative extension office for recording, and bring dried and clean rice of 5-15% more than what they want to exchange depending on quality. We can exchange seeds only on the below mentioned dates. Be sure to remind the dates and place. The seed exchange will be first come first served bases.

Place: Agricultural Demonstration Center (Trial Farm)
Cooperative member farmers in P/P1 and P/P2 : AM 9.00- PM 4.00 January 23-25, 1984
Farmers not classified as above: AM 9.00- PM 4.00 January 26-27, 1984.

No. I-2 February 1, 1984.

MAE KLONG FARMING NEWS

Agricultural Demonstration Center

The Greater Mae Klong Irrigated Agriculture Development Project

RESULTS OF THE WET SEASON RICE, 1983

The agricultural demonstration center conducted the yield survey of the wet season rice in the pilot project No. 1 and No. 2. We had collected 69 samples of transplanted rice and 15 samples of direct sowing rice from P/P 1, 88 of transplanted rice and 14 of direct sowing rice from P/P 2, respectively. We got rice from 4 m^2 (1 wa^2) at each sampling, then the yield per rai was estimated based on the data at 14 % moisture content.

Table 1. Yield survey results of 1983 wet season.

	Number of samples	Yield (kg/rai) Maximum	Minimum	Average
P/P 1 Transplanting	69	909.92	329.67	581.52 (3,635 kg/ha)
Direct sowing	15	786.68	532.50	639.58 (3,997 kg/ha)
P/P 2 Transplanting	88	881.23	361.32	579.06 (3,619 kg/ha)
Direct sowing	14	848.08	384.86	654.94 (4,093 kg/ha)

In general, direct sowing paddy field produced more rice than transplanting one. However, the direct sowing method faces risk in the wet season. Because, we have heavy rain in the wet season and it makes water control difficult, especially after sowing seeds.

In P/P 1, 3 samples of transplanting produced the equivalent of 800 kg rice per rai or more. In P/P 2, 6 samples of transplanting and 4 samples of direct sowing produced rice more than 800 kg/rai. Out of 13 samples which produced rice more than 800 kg/rai, 11 samples were RD-23, 1 was RD-21, and 1 was Apple Tong.

There was only 1 sample of transplanting in P/P 1, 2 samples of transplanting and 1 sample of direct sowing in P/P 2 that produced rice less than 400 kg/rai. Out of 4 samples, 2 were RD-23, 1 was Luang, and 1 was Khao Luang.

The results indicate that RD-23 and other high yielding varieties produce high yield under good management. Under poor management, however, these varieties can not exhibit their potential.

Table 2. Distribution of plant density of transplanted rice in the wet season, 1983 (No./4 m^2).

	Less than 80	Between 80 to 120	More than 120
P/P 1	7	48	14
P/P 2	3	31	54

Table 2 shows the distribution of plant density of transplanted rice in P/P 1 and P/P 2 in the last wet season. Farmers in P/P 2 have trend to plant rice densely. However, high plant density does not increase the yield. Since the rice plant has tillering ability, about 100 hills per wa^2 (4 m^2) is enough to obtain satisfactory number of effective tillers or number of panicles.

LAND PREPARATION

Timeliness and quality of land preparation may influence the growth of rice. Poor and untimely land preparation may cause serious weed problem and expose the rice plant to harmful substances such as carbon dioxide and methane released by decaying organic matter in the soil.

Objectives of land preparation are:

1. To control weeds effectively. During land preparation, the weeds are destroyed and are initially prevented from competing with seedlings.

2. To mix organic materials with the soil. Weeds and residues of the previous crop are incorporated into the soil and are converted into plant nutrients after they have decayed.

3. To change soil soft for ease in transplanting.

4. To help the formation of hard layer which reduces water and leaching losses during the subsequent flooding stages.

Land should be flooded at least 20 days before transplanting or direct sowing. The purposes of this irrigation are:

1. To control weeds through plowing and puddling in this period.

2. To save the seedlings from the adverse effects of high concentration of harmful substances generated by decomposing organic matter plowed into flooded soils.

3. To allow the rice plant to utilize the ammonium also released during the decomposition of organic matter.

The day of starting irrigation may be the same day of sowing seeds onto the nursery. After 7-10 days of flooding the field, plowing will be done. This period of 7-10 days allows weed seeds to germinate, and they are plowed under the soil. Before and after the plowing, repairing the dikes is essential paticularly in the Mae-Klong area where the irrigation water supply is limitted.

After the plowing, let 7-10 days to pass before puddling. This period allows remaining weed seeds to germinate. The puddling operation breaks the soil clods and incorporate weeds, rice straw and stubble in the mud. The puddling should be done 2-3 days before transplanting or direct sowing. Basal fertilizer application for the field of transplanting rice is to be done before puddling to incorporate the fertilizer into the soil. This minimizes nitrogen loss due to denitrification. For direct sowing rice, however, application of basal fertilizer should be waited until the first irrigation after sowing seeds. Early application of basal fertilizer induces the rapid growth of algae, and it adversely affects seedling establishment.

Leveling of the field will be done at the same day of puddling. Good leveling is the prerequisite for obtaining good yield. It is easier to control weeds and water in good leveled field. In case of direct sowing rice cultivation, success or failure of the crop depends much on the leveling. Leveling at 2-3 days before transplanting or direct sowing is recommendable. Late leveling will cause deep planting in case of transplanting rice. It will cause poor germination in case of direct sowing.

For direct sowing, drainage furrow should be made at every 8-10 meter interval. This drainage furrow helps water management at sowing time, and the seedling establishment will be easier. Poorly drained field will be associate with poor germination and poor seedling establishment, then wide area requires gap-filling later.

SEED SELECTION AND TREATMENT

The rice seed should be pure variety, high germination percentage and free from diseases and weed seeds. Seed selection and treatment require less amount of cost. However, the good seed will contribute to the yield, provided other farm management and climatic conditions are favorable.

1. Selection of Variety

As it is shown recently after the introduction of HYVs (High Yielding Varieties) such as RD varieties, variety itself increases the yield considerably. When we think about rice varieties, we should consider not only characteristics of the variety but also field conditions where the rice variety will be planted, and management techniques of the farmer who will plant the variety. For the Mae-Klong area, generally RD-23 is the best suited variety for both of the dry and wet seasons at present. Some

other varieties are recommended to the dry and wet season, respectively. RD-23 and RD-25 are recommended for both of the seasons, while, Khao Dok Mali 105, Khao Pak Mor 148 and Luang Pratew 123 are only recommended for the wet season because of their photo-sensitive characteristics.

After deciding the variety, the rice seed should be obtained from good sources. The agricultural demonstration center released about 15 tons of RD-23 in last January. The amount of 15 tons is not enough for the Mae-Klong area. When farmers get seeds locally, they should carefully observe the performance of the variety. Yield level, resistance to insect and disease, tolerance to lodging and purity of the variety are some of the important check points.

2. Selection of Seeds

Seeds should be dried properly to prevent the seeds from being checked rice. Avoid rapid drying under strong sunshine, because it will cause the production of checked rice seeds. Seed selection by water is recommendable for obtaining the well matured seed with high germination percentage. Reject floating seeds after sterring seeds in water. They are imperfect or inmature grains.

3. Hastening of Germination

The rice seed can not germinate without oxygen. If the rice seed is sown into the flooded paddy soil, it will rot and die due to lack of oxygen in the soil. For good seedling establishment in nursery or in direct seeded lowland field, hastening of germination is necessary. It will drastically reduce the days from sowing to seedling establishment. Hastening of germination can be done as follows:

1). Contain the selected seeds in the sack and soak in water for 48-72 hours (2-3 days). At least 48 hours of soaking time is necessary

for the seeds to germinate simultaneously.

2). Spread the soaked seeds on a wet flax bag, and cover with wet flax bag for 24-36 hours (1-1.5 days). Thickness of the seeds should be about 15 cm. Turn over the seeds 1 or 2 times to make the seeds germinate at the same time. It also avoids excess heating of the seeds.

3). Start sowing seeds when the seed sprouts 2-3 mm.

SEED RATE FOR TRANSPLANTING

It is interesting to know how the seed rate for transplanting is decided. Based on following information, we will try to calculate seed rate for transplanting 1 rai (0.16 ha).

1. Planting space: 25 hills/m^2 (100 hills/wa^2)
2. Seedling rate: 3 seedlings/hill
3. Germination percentage: 80 %
4. Weight of 1,000 grains of RD-23: 28 g

Calculation:

Number of seedlings per m^2 = 25 hills/m^2 x 3 seedlings/hill

= 75 seedlings/m^2

Since 1 rai is 1,600 m^2,

Number of seedlings per rai = 75 seedlings/m^2 x 1,600 m^2/rai

= 120,000 seedlings/rai

Germination percentage is assumed at 80 %, so

Total number of seeds required for 1 rai = 120,000 seeds/rai x 100/80

= 150,000 seeds/rai

Weight of 1,000 grains of RD-23 is about 28 g, then

Weight of 150,000 seeds = 150,000 seeds x 28 g/1,000 seeds

= 4,200 g

= 4.2 kg

Theoretically, 4.2 kg of rice seeds is necessary to transplant 1 rai of paddy field. However, considering allowances of planting space, seedling rate, seed quality and other errors, 6 kg of rice seeds is recommended to transplant 1 rai of paddy field.

HERBICIDE FOR WEED CONTROL

Nowadays, most farmers favor to use herbicide for weed control. However, it is very difficult to control them especially in case of direct sowing rice. Each chemical kills weeds in different manner, so that the selection and usage of chemical should be considered carefully. There are many kinds of herbicide. Some of their common names and trade names are as follows:

Common name	Trade name
1. Benthiocarb	Saturn G
2. Benpinox	Bo-Down
3. Butachlor	Machete', Chelete'
4. CNP	MO
5. Ioxynil + 2,4-D	Aetil D-S, Aetil D-R
6. Nitrofen	TOX-E-25
7. Oxadiazon	Ronstar
8. Propanil	Propanil C-T, Stamp F 34, Para
9. 2,4-D	Shell D-80, D.M.A.-6, Ester 79, Edsanshor, Twindonal, Twin 2,4-D, Paraester
10. 2,4-D + Oxadiazon	Ronstar 2 D
11. 2,4-D + Prapanil	Same as 8 and 9

From: Technical Document RICE, Agriculture Promotion Department

Table 3 shows kinds of herbicide and their effects of controling different kind of weeds.

Table 3. Kinds of herbicide and their effects

	Benthiocarb	Benzinox	Butachlor	CNP	Ioxynil + 2,4-D	Nitrofen	Oxadiazon	Propanil	2,4-D	2,4-D + Oxadiazon	2,4-D + Propanil
Goose weed	F	G	F	E	E	E	E	N	N	P	E
Mimulus orbicularis	P	G	P	F	E	G	E	N	P	F	G
Sedge	E	E	E	E	E	E	E	F	G	E	E
Tall fringe rush	E	E	E	E	N	E	E	F	E	E	E
Hul sedge	E	E	E	E	E	G	E	F	E	E	E
Rayerass	G	G	G	G	F	G	G	G	N	F	G
Water grass	G	G	F	G	F	E	E	E	P	F	G
Short millet	E	E	G	G	F	E	E	E	N	F	G
Stone wort	G	P	P	P	N	E	G	N	N	F	N
Water clover	P	F	P	P	E	P	G	N	N	G	F
Arrow head	G	G	G	E	E	G	G	P	G	E	E

E: Excellent control
G: Good control
F: Fair control
P: Poor control
N: No control

MEETING ON RICE PRODUCTION

Meeting on rice production will be held at Pilot Project No. 1 and Pilot Project No. 2, respectively. The dates and places are as we decided at last meeting. This farming news will be used as a text.

Pilot Project No. 1

Time: AM 9.00 - 12.00, February 14, 1984.

Place : Agricultural Demonstration Center (Trial Farm)

Pilot Project No. 2

Time: PM 1.00 - 4.00, February 9, 1984.

Place: House of Mr. Lhong

CLEAN CANAL AND LEVEE

Before starting dry season rice cultivation, check paddy field and its adjacent irrigation and drainage facilities. Repair levees especially which face the drainage canal. Leaking water is the main problem of rice production in the dry season. Installation of outlet is recommended to the field which faces the drainage canal. Cleaning of farm ditch is also important. Weeds and mud sediment in the farm ditch will be the trouble for irrigation. There are still some farmers who leave their rice straw along feeder roads, irrigation and drainage canals. Take out or burn the rice straw before starting irrigation for dry season. Since water supply for dry season rice production is limited, every measure of saving water should be adopted to prevent water loss.

No. I-3 March 1, 1984.

MAE KLONG FARMING NEWS

Agricultural Demonstration Center

The Greater Mae Klong Irrigated Agriculture Development Project

Management of nursery bed and transplanting field

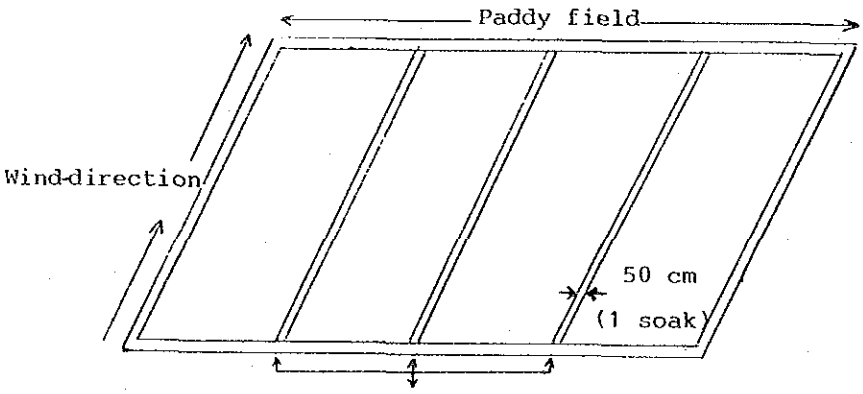
- Nursery bed. Farmers should devide nursery bed into small plots with the width of 1-2 metres and the length is according to the field size. It should be at the least 50 cm from the ditch for protection of insects.

- Transplanting field. Farmers should make furrows with the width of 50 cm. in transplanting field every 8-10 metres for convenience of fertilizer and chemical applications.

- Direct sowing plot. Farmers should practice as same as transplanting field. Make furrows for path by pulling jar every 8-10 metres.

REMARKS:

Making furrow for foot path should follow the wind direction. Even if farmers practice in accordance with the instructions, there may still have insect-diseases in field. Please contact to Agriculture Extension Officer in District or Agriculture Extension Office to get advice and information. When there is insect or disease, Agriculture Extension Office may not help farmers who do not follow the instructions. Because, the extension office will help farmers who follow the instructions.



furrow for foot path : follow wind direction

By: Mr. Vichai Paduongsab.
Agriculture Extension Officer, Tamaka Office.

Punishment for the one who destroys road or ditch in the pilot project

According to the law No. 45 of Act. in Setting Land for Agriculture, "If the land-owner or whoever did anything that made the damage for road, irrigation ditch, or drainage ditch in paddy field, have to be punished by fine not more than 2,000 bahts. The Land-owner or the one who made the damage should return the place to the previous conditions. If someone does not follow the law, he has to be brought at a civil suit.

Mr. Chumpon Parnsira

Administrative Officer, 5

Replacement

Chief of Land Consolidation Office.

MINERAL NUTIRITION AND FERTILIZER OF RICE

For rice, 16 elements are essential - carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, sulfur, calcium, magnesium, zinc,iron,copper, molybdenum, boron, manganese,and chlorine. All essential elements must be present in optimum amounts and in forms usable by rice plants. Nitrogen, phosphorus, and potassium are nutrient elements most commonly applied by rice farmers, because they are usually deficient.

1. Nitrogen

Rice plants require a large amount of nitrogen at the early and mid-tillering stages to maximize the number of panicles. Nitrogen absorbed at the panicle initiation stage may increase spikelet number per panicle. Some nitrogen, however, is also required at the ripening stage.

The functions of nitrogen in rice are:

(1) Gives dark green appearance to plant parts as a component of chlorophyll.

(2) Promotes rapid growth or increased height and tiller number.

(3) Increases size of leaves and grains.

(4) Increases number of spikelets per panicle.

(5) Increases filled spikelets percentage in panicles.

(6) Increases protein content in the grains.

Nitrogen deficiency symptoms are:

(1) Stunted plants with limited number of tillers.

(2) Narrow and short leaves which are erect and become yellowish green as they age (young leaves remain greener)

(3) Old leaves become light straw colored and die.

2. Phosphorus

Phosphorus is involved in the supply and transfer of energy for all the biochemical processes in the rice plant. It:

(1) Stimulates root development.

(2) Encourages more active tillering, which enables rice plants to recover more rapidly and more completely after any adverse situation.

(3) Promotes good grain development and gives higher food value.

Phosphorus deficiency symptoms are:

(1) stunted plants with limited number of tillers.

(2) Narrow and short leaves that are erect and dirty dark green.

(3) Young leaves remain healthier than old leaves, which turn brown and die.

(4) Reddish or purplish color may develop on leaves of varieties.

3. Potassium

Potassium is not a constituent of any organic compound of the plant, but it is a cofactor for enzymes. It:

(1) Favors tillering and increases the size and weight of the grains.

(2) Increases phosphorus response.

(3) Plays an important role in physiological processes in the plant including opening and closing of stomate, and tolerance to unfavorable climatic conditions.

(4) Renders resistance to diseases.

Potassium deficiency symptoms are:

(1) Yellowing at the interveins, on lower leaves, starting from the tip, and eventually drying to a light brown color.

(2) Brown spots sometimes develop on dark green leaves.

(3) Irregular necrotic spots may develop on the panicles.

The response of rice to fertilization when grown in "Lowland" culture depends upon several factors. They are: (1) Varietal type, (2)season, (3) spacing, (4) soil characteristics and fertility level, (5) management factors, (6) timing, (7) water management. Economics or profitability influences the rate of fertilizer application to paddy fields.

Several kinds of fertilizer are available in local market. Table 1 shows names, elements and approximate prices of fertilizer.

Table 1. Fertilizer for rice available in Tha Muang.

Name	Nutrient content (%)			Price (฿ /bag or 50 kg)*
	N	P_2O_5	K_2O	
Am. Sulfate	21	0	0	125-165
Urea	46	0	0	290-310
Am. Phos.	16	20	0	210-220
Am. Phos.	20	20	0	240
Compound	15	15	15	265-310

Note: * depending on brand.

The agriculture demonstration center (trial farm) recommends about 5 kg of N and 6 kg of P_2O_5 per rai as basal fertilizer of RD varieties. For top dressing about 4-6 kg of N per rai is recommended for RD varieties. For local varieties, the amount of fertilizer would be lesser than that of RD varieties. Because they easily lodge with this amount of fertilizer.

About 30 kg of Am. Phos. per rai is equivalent to 5 kg of N and 6 kg of P_2O_5 per rai. This basal fertilizer should be applied at puddling time for transplanting rice, or at 2 weeks after sowing (after the first irrigation) for direct sowing rice.

Asout 20-30 kg of Am. Sulfate or about 8-13 kg of Urea per rai is equivalent to about 4-6 kg of N per rai. This top dressing fertilizer should be applied at the young panicle formation stage. In case of RD-23, it is about 70 days after sowing or 45-50 days after transplanting,

No. I-4 April 2, 1984

MAE KLONG FARMING NEWS

Agricultural Demonstration Center

The Greater Mae Klong Irrigated Agriculture Development Project

DIRECT SOWING: SEED RATE

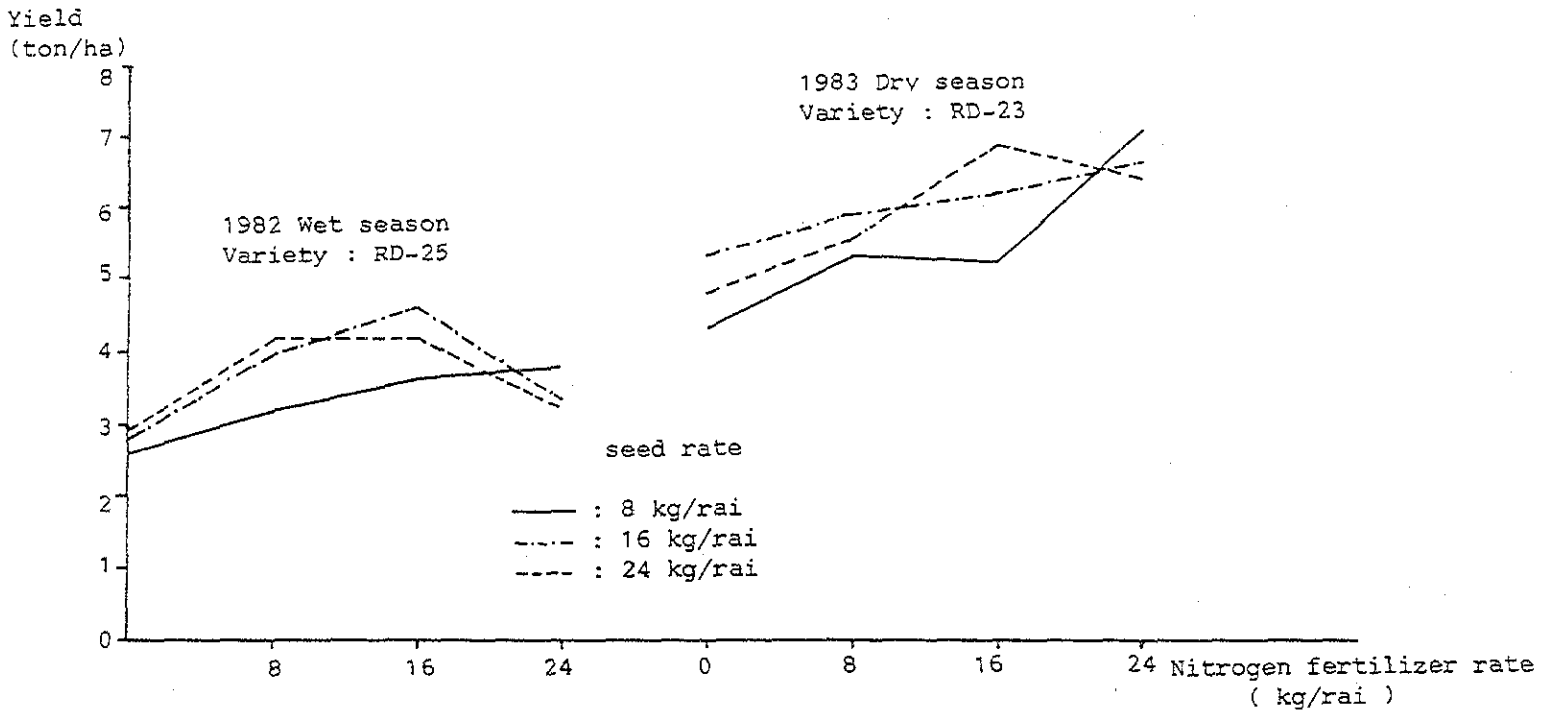
Direct sowing method of rice cultivation becomes popular in Mae Klong area recently. Especially in dry season rice cultivation, majority of farmers practice direct sowing. The agricultural demonstration center conducted several experiments on seed rate of direct sowing rice cultivation.

Fig. 1 shows the rice yields affected by seed rate and nitrogen fertilizer rate in 1982 wet season and 1983 dry season. In the experiments, seed rates were 8, 16 and 24 kg/rai (50, 100 and 150 kg/ha), and nitrogen fertilizer rates were 0, 8, 16 and 24 kg/rai.

In 1982 wet season, using RD-25, seed rate of 16 kg/rai with nitrogen fertilizer of 16 kg/rai produced highest yield. While in 1983 dry season, using RD-23, seed rate of 8 kg/rai with nitrogen fertilizer of 24 kg/rai produced highest yield. Under nitrogen fertilizer rate of 0 or 8 kg/rai, seed rate of 24 kg/rai produced higher yield in 1982 wet season, and seed rate of 16 kg/rai produced higher yield in 1983 dry season. Under nitrogen fertilizer rate of 24 kg/rai, the highest yield was obtained from the seed rate of 8 kg/rai, followed by 16 kg/rai.

The optimum seed rate for direct sowing rice cultivation may be affected by variety, soil fertility and cultural practices. In farmers fields, poor leveling and weeds are problems usually associated with direct sowing rice culture. At the present, seed rate of about 15 kg/rai would be recommendable to ensure good seedling establishment in the field.

Fig. 1 Rice yields affected by seed rate and nitrogen fertilizer rate in direct sowing (Data obtained at agricultural demonstration center).



TRANSPLANTING: SEEDLING AGE AND PLANT SPACING

The best age of seedling for transplanting mostly depends on variety. In general, the earlier the variety matures, the sooner the seedling should be transplanted. Thirty-day or older seedlings recover more slowly than younger seedlings, especially if they suffer from too much stem or root injury during uprooting to transplanting. Such injuries reduce tillering, prolong maturity, and may reduce grain yield.

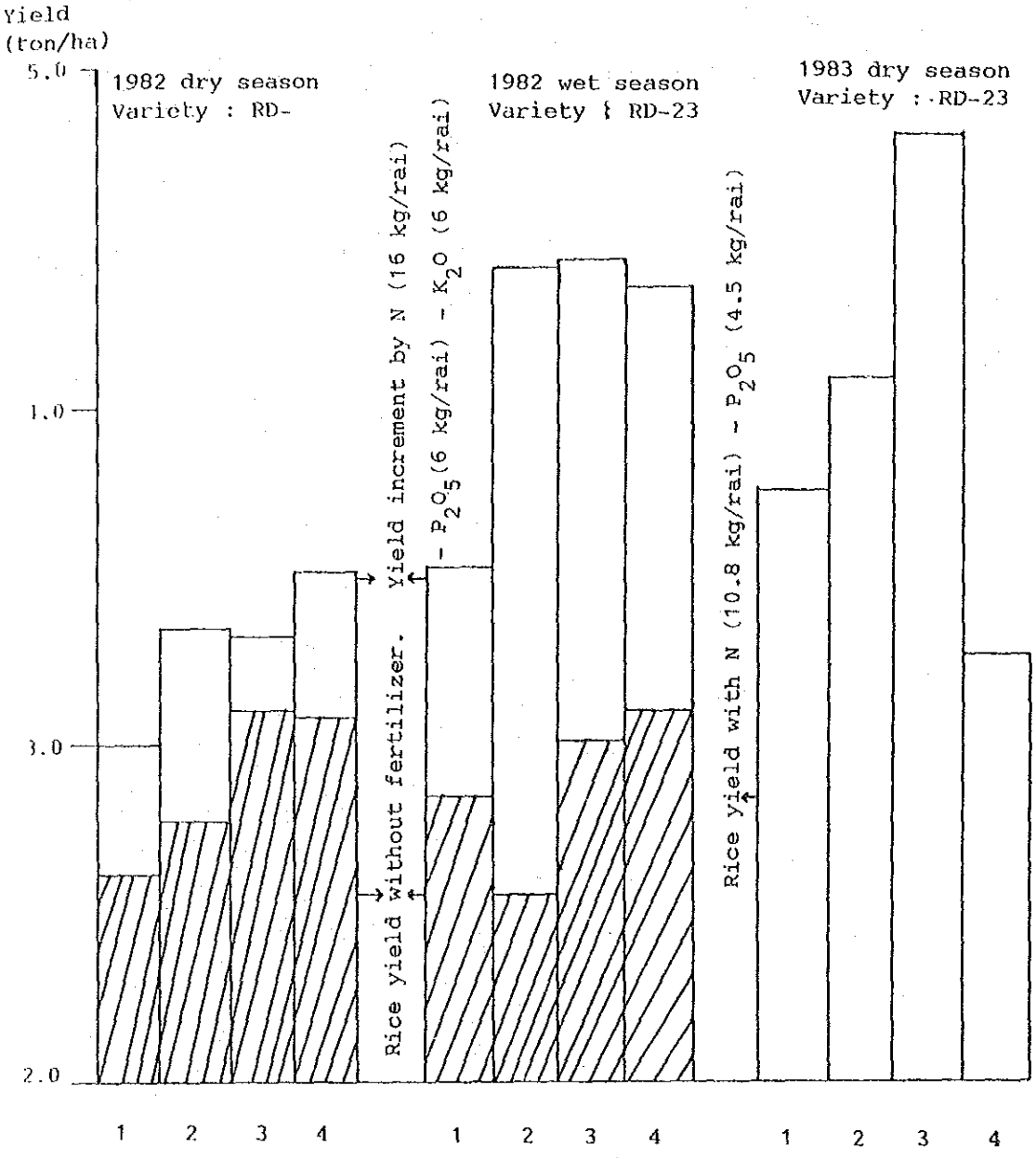
Plant spacing is an important production factor in transplanted rice. Planting rice closer than necessary increases the cost of transplanting and chances of disease and lodging. On the other hand, spacing rice plant wider than necessary may result in low yield because the number of plants in the area may be less than the optimum number needed for grain yield. In case of RD-23 and other high yielding varieties, seedling age of 18-25 days is recommendable for transplanting.

Fig. 2 shows grain yields affected by plant spacing and fertilizer rate at agricultural demonstration center.

In 1982 dry season experiment, RD-7 variety was used. Without fertilizer, plant spacing of 22.2 or 40.0 hills per m^2 produced higher yield. Yield increment by fertilizer application was small.

In 1982 wet season experiment, RD-23 variety was used. Without fertilizer, plant spacing of 22.2 or 40.0 hills per m^2 produced higher yield. Yield increment by fertilizer application was high in 16.0, 22.2 and 40.0 hills per m^2.

Fig. 2 Rice yields affected by plant spacing and fertilizer
(Data obtained at agricultural demonstration center).



Note

1: 11.4 hills/m^2 (35 cm x 25 cm) 2: 16.0 hills/m^2 (25 cm x 25 cm)
3: 22.2 hills/m^2 (30 cm x 15 cm) 4: 40.0 hills/m^2 (25 cm x 10 cm)

In 1982 experiments, fertilizer rate was N (16 kg/rai) - P_2O_5 (6 kg/rai) - K_2O (6 kg/rai). All phosphorus and potassium and 10 kg of nitrogen fertilizer were applied as basal. Then, 4 kg and 2 kg of nitrogen fertilizer was applied as 1st and 2nd top dressing, respectively.

In 1983 dry season, an experiment was conducted to investigate the rice yield of different plant spacings under medium rate of fertilizer application. Fertilizer rate was N (10.8 kg/rai) - P_2O_5 (4.5 kg/rai) - K_2O (4.5 kg/rai). They were 30 kg of Compound fertilizer (15-15-15) for basal, 20 kg of Am. sulfate for 1st top dressing and 10 kg of Am. sulfate for 2nd top dressing. RD-23 variety was used for the experiment. As the result, rice yield from the plant spacing of 22.2 hills per m^2 was highest.

In all the experiments, about 20 day old seedlings were transplanted at the rate of 3 seedlings per hill. Other cultural practices, such as land preparation, weed and pest control, were about the same either with or without fertilizer application at different plant spacings.

The results indicate that 11.4 hills per m^2 (35 cm x 35 cm) is too wide spacing to get high yield either with or without fertilizer. Even without fertilizer, some plots produced about 3 ton/ha of rice. It seems that the yield level of 3 ton/ha is possible under good weed control and water management in Mae Klong area. With fertilizer, plant spacing of 22.2 hills per m^2 was best for RD-23. The agricultural demonstration center recommends plant spacing of 20-30 hills per m^2 (80-120 hills/wa^2) to the farmers in Mae Klong area.

INFORMATION

Farmers Meeting

Farmers meeting on rice production will be held at Pilot Project No. 2. The place and time are as decided in last meeting.

Place: Field house of Mr. Lhong

Time: PM 1:00-4:00, April 12, 1984

The meeting at Pilot Project No. 1 is not held in this month because of delayed farming work.

No. I-5 May 2, 1984

MAE KLONG FARMING NEWS

Agricultural Demonstration Center

The Greater Mae Klong Irrigated Agriculture Development Project

WET SEASON RICE VARIETIES

There may be many characteristics of rice variety which have to be evaluated. Yield potential, grain quality, resistance to deseases, resistance to insects, response to fertilizer, tolerance for lodging, tolerance for drought, tolerance for adverse soils, tolerance for deep water, tolerance for temperature extremes and response to day-length are important characteristics of rice varieties.

Local varieties planted in respective area are the result of farmers' selection. They are adapted to the conditions of planted area. The deep water rice is the typical sample of adaptation to the natural environment.

Most local rice varieties in Thailand are photo-sensitive, and their panicle formation is determined by natural day-length. This is also a kind of adaptation. Because farmers can harvest rice in early dry season. However, the yield level of local varieties is usually low even under good management.

High yielding varieties, such as RD varieties, are the products of plant breeders. They have high yield potential under good management. They are usually non-photo sensitive (excluding RD-27), and their panicle formation is depending on the number of days after sowing.

According to the hearing during yield survey in 1983 wet season, there were 17 varieties planted in Pilot Project No. 1 and 13

varieties planted in Pilot Project No. 2. Table 1 shows distribution of main rice varieties planted in 1983 wet season. Among the varieties, RD-23 was planted most widely in the both areas.

Table 2 shows rice yields of RD and local varieties in direct sowing or transplanting method in Pilot Project area in 1983. In the wet season 46 % and 73 % of the samples was RD varieties in Pilot Project No. 1 and No. 2, respectively. The average yields in wet season were 632 kg per rai for RD varieties and 557 kg per rai for local varieties in Pilot Project No. 1, then 615 kg per rai for RD and 511 kg per rai for local varieties in Pilot Project No. 2. The yield difference between RD and local varieties was 75 kg and 97 kg per rai in Pilot Project No. 1 and No. 2, respectively.

Although RD-varieties are recommended for both wet and dry seasons, there are farmers who plant local varieties in wet season. Average yield of local varieties is low, but it is safety to plant local varieties if farm imputs (fertilizer and chemicals) are limited.

Fig. 1 shows the life cycle of 120-day and 150-day varieties. The 120-day variety is the example of high yielding varieties, and the 150-day variety is the example of local varieties. The biggest difference between the 120-day and 150-day varieties is the difference of vegetative phase (seeding to panicle initiation). The 150-day variety has lag vegetative growth, which only prolongs the growing period (from seeding to maturity) but not increases the rice yield even under good management. The rice plant requires more nutrients and water, when its growing period is prolonged, and the chances of insects and/or diseases also increase.

Table 1. Distribution of main varieties in Pilot Project area in 1983 wet season.

Pilot Project No. 1		Pilot Project No. 2	
RD-23	37 %	RD-23	58 %
Luang Pratiu	31 %	RD-5	12 %
Khao Pak Mo	5 %	Luang Pratiu	10 %
Luang Phra	4 %	Khao Tondiao	6 %
Others (13 varieties)	23 %	Others (9 varieties)	14 %
Total samples	84	Total samples	102

Table 2. Rice yields of different varieties and planting methods in Pilot Project area in 1983 (kg/rai).

	Pilot Project No. 1	Pilot Project No. 2
Dry season	840	718
Direct sowing	871 (40 %)	637 (33 %)
Transplanting	816 (60 %)	757 (67 %)
Total samples	91 (100 %)	100 (100 %)
Wet season	592	589
RD-varieties	632 (46 %)	615 (73 %)
Direct sowing	640 (18 %)	709 (10 %)
Transplanting	624 (29 %)	599 (63 %)
Local varieties	557 (54 %)	511 (27 %)
Direct sowing	- -	455 (3 %)
Transplanting	557 (54 %)	518 (24 %)
Total samples	84	102

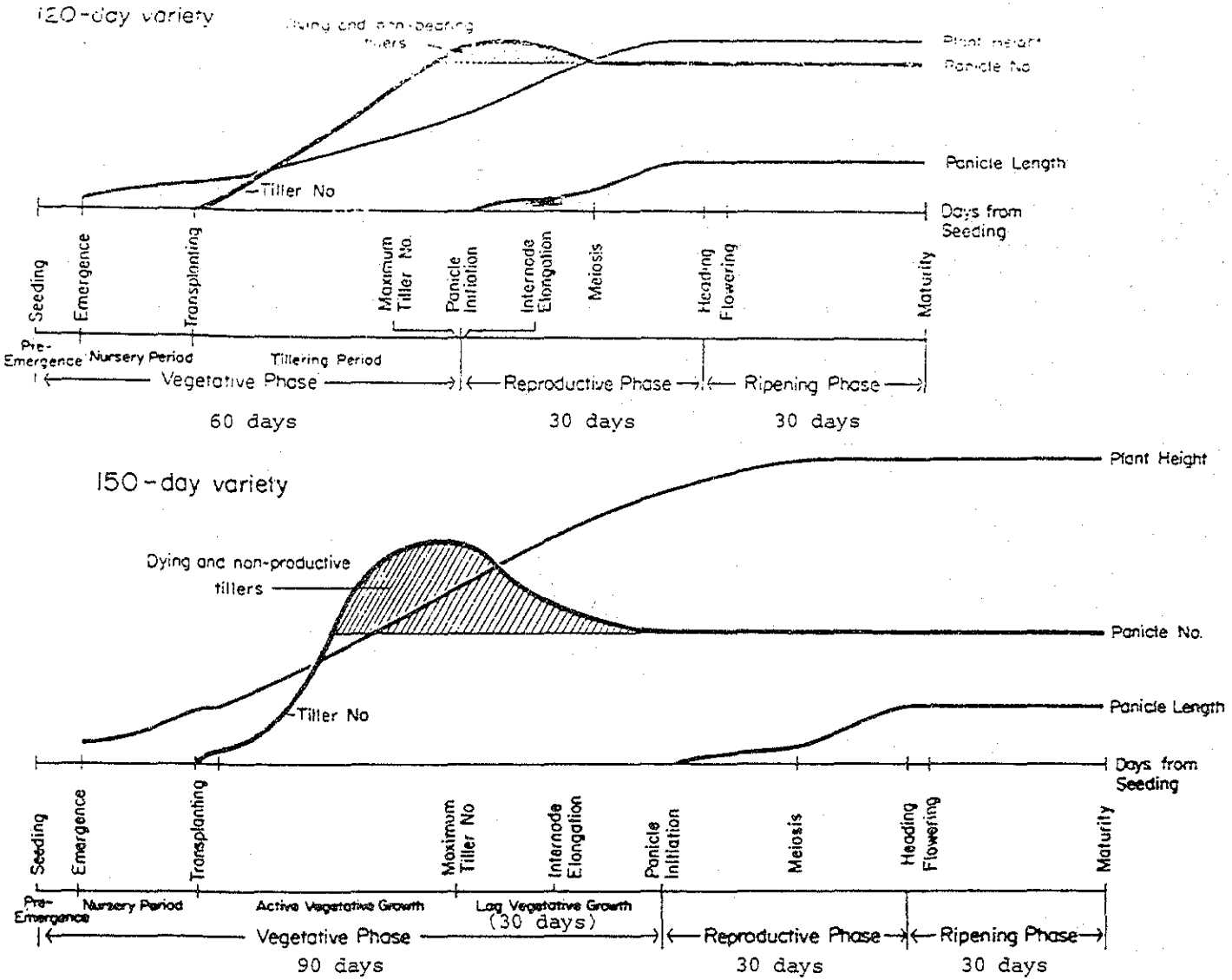


Fig. 1 Growth stages and developmental phases of rice varieties in the tropics.

Table 3 shows the approximate dates of flowering of local varieties and recommendable cultivation practices. The growing period of 130-140 days is adopted. This growing period is enough for local varieties in Mae Klong area, where irrigation water is easily controlled and soil is fertile.

There are some farmers who plant local varieties too early and the growing periods are more than 170 days. Since panicle initiation of photo-sensitive varieties is controlled by the natural day-length, earlier planting is not recommendable for these local varieties and RD-27.

Table 3. Approximate dates of flowering of photo-sensitive varieties and recommendable cultivation practices.

Varieties	Sowing	Trans-Planting	Panicle initiation	Flowering	Harvesting
Khao Dok Mali 105	Jul. 4-Jul. 14	Jul. 24-Aug. 3	Sep. 22	Oct. 22	Nov. 21
Nang Mor S-4	Jul. 9-Jul. 19	Jul. 19-Aug. 8	Sep. 27	Oct. 27	Nov. 26
Khao Pak Mo 148	Jul.16-Jul. 26	Jul. 26-Aug. 5	Oct. 4	Nov. 3	Dec. 3
RD-27	Jul.28-Aug. 7	Aug. 17-Aug. 27	Oct. 16	Nov. 15	Dec. 15
Luang Pratiu 123	Aug. 1-Aug. 11	Aug. 21-Aug. 31	Oct. 20	Nov. 19	Dec. 19
RD-23 (non photo-sensitive)	Jul. 1-Aug. 20	Jul. 21-Sep. 10	Aug. 30-Oct. 19	Sep. 29-Nov. 18	Oct. 29-Dec. 18

Note:

1. Growth duration: 130-140 days (120 days for RD-23)
2. Nursery period: 20 days
3. Panicle initiation to flowering: 30 days
4. Flowering to harvesting: 30 days

Introduction of Cooperative

Mr. Sawhan Plymas

Cooperative Officer of Tha-Muang

I. What is Cooperative

Cooperative is operated by members. Cooperative Promotion Department, Ministry of Agriculture and Cooperative has duties to promote and assist cooperatives and members within the limit of law, rule and order.

Cooperative is the first institute in Thailand that raises capitals and provides loans to farmers for increasing production and income. The first cooperative was registered on the 26th February 1916, as "Wat jan cooperative unlimited for liability" in Pitsanuloak province, and this day is called "cooperative day".

Cooperative is the organization setting up by people of same occupation to protect their interests and increase income. Agricultural cooperative is the cooperative of farmers and gardeners. Purposes of setting agricultural cooperative are to solve the problems in farming and to up-grade the living standard of farmers.

II. Rights of Member

Rights of cooperative member are the power of the member or assistances he can get from the cooperative. They are:

1. Have a right to attend meetings to express opinions and cast vote.

   1). Express opinions or give advice for the improvement of cooperative.

   2). Select or dismiss the committee members.

   3). Observe working of officers in cooperative.

   4). Revise or add rules and regultions of cooperative if necessary for adjusting current conditions.

2. Have a right to be chosen for committee member, chairman or secretary.

3. Have a right of inquiring or checking regulations, reports, balance sheet and any other documents between cooperative and the member.

4. Have a right to get assistances from other members, committee and officers of cooperative.

5. Have a right to use business of cooperative, such as

1). Get loans and/or deposit money.

2). Order and buy necessary goods for farming and living.

3). Sell products to cooperative.

III. Duties of Member

Cooperative members have to practice following member's duties.

1. Duties of individual member.

1). Follow the rules and regulations of cooperative.

2). Have to attend the meeting everytime.

3). Have business and support cooperative always.

4). Persuade other members to be well behaved members.

5). Have a harmony within members and sacrifice for public interests.

6). Control cooperative firmly.

7). Help other members, committee members and officers of cooperative with justice.

8). Make oneself understand rules and regulations of cooperative.

9). Widen mind to accept new ideas and opinions that help the growth of cooperative.

10). Maintain business with cooperative honestly.

11). Introduce others about cooperative work.

12). Not to seek privilege from cooperative.

2. Duties at the Meeting

1). Decide or revise the rules and regulations of cooperative.

2). Check cooperative management.

3). Elect or dismiss committee members or cooperative members.

4). Give approval on cooperative operation.

5). Set the loan amounts of cooperative.

6). Check annual profit of cooperative.

IV. Loan

The member can get loans from the cooperative in 2 kinds.

1. Short period loan for farming expenses.

1). Loan for seeds, fertilizer, chemicals and wages for farming.

2). Loan for the preparation of selling farm products.

3). Loan for tax and other necessities in farming.

Have to return the loan in 12 months or after selling farm products.

2. Medium period loan for investment in agricultural assets.

1). Improve land or buy land for farming.

2). Construct or improve canal, water gate, ditch and other land improvement.

3). Loan for machine, pump, transportation and others necessary for farming.

4). Investment for animal.

5). Payment of old debt in farming.

Have to return the loan in 3 years.

V. Deposit

Cooperative accepts deposits and savings of the members with the interests of 11 % per year for deposit and 8 % per year for saving.

VI. Guarantees

The member has to offer one of the following guarantees to get loan from the cooperative.

1. Registration papers of own land.

2. Use 2 persons for guarantees; one of them should be the land owner. One person can not guarantee more than 3 persons. The loan of short period should be not more than 10,000 ¥.

3. Guarantees in group for short period loan of same production. If the member can not use guarantees mentioned as 1 and 2, all members of the group should guarantee and response for the debt together.

VII. Payment for Debt

1. Before the due date of paying debt or when the member has sold products, they should pay debt to cooperative. If they pay debt earlier, the interests will be less because the cooperative charges them per day. The member can pay the debt everyday, and should not wait until the due date of payment of debt under contract.

2. Have to return the principal and interests in time.

3. Have to pay by one-self at the cooperative office, and keep the receipt signed by collector and manager. Have to bring the account book everytime.

VIII. Meeting

The district cooperative or the cooperative promotion officer usually set meetings at least 2 times. Every member has to attend the meeting. Topics in the meeting are as follows:

1. Application for the member of cooperative.

2. Acknowledge the new members and the members who want to dismiss from the cooperative.

3. Elect or dismiss the chairman and secretary of the group.

4. Choose the representative of members who joins the upper scale meeting.

5. Inspection of using loan-money.

6. Survey about the demands of farmers.

7. Give education on cooperative and conduct training which would be useful for the members.

8. Have to bring the account book every time.

IX. Kinds of Cooperative

There are 6 kinds of cooperative. They are:

1. Agricultural cooperative

2. Store cooperative

3. Saving cooperative

4. Fishery cooperative

5. Service cooperative

6. Settlement cooperative

X. Principles of Cooperative

1. Open membership.

2. Control by democracy systems.

3. Limited dividend following the share.

4. Give education and training.

5. Cooperate with other cooperative.

INFOMATION

Farmers Meeting

Farmers meeting on rice production would be held at Pilot Project No. 1 and No. 2, respectively. Farmers who are interested in rice production are welcomed.

Pilot Project No. 1.

Place: Agricultural Demonstration Center

Time: AM 9:00 - 12:00, May 16, 1984

Pilot Project No. 2.

Place: Field house of Mr. Lhong

Time: PM 1:00 - 4:00, May 15, 1984

No. I-6 June 1, 1984

MAE KLONG FARMING NEWS

Agricultural Demonstration Center

The Greater Mae Klong Irrigated Agriculture Development Project

YIELD AND YIELD COMPONENTS

Grain production in rice is usually examine in two ways. One of the common methods of examining the rice yield is to obtain the ratio of the grain dry weight to the total above-ground dry weight (biomass) at maturity or harvest. It is called "harvest index" and expressed as follows:

$$\text{Harvest index} = \frac{\text{grain dry weight}}{\text{total above-ground dry weight}}$$

The total above-ground dry weight is the total dry weight of stems, leaves, grains and other plant parts of rice plant at maturity.

The total dry weight of good rice crop is around 1,600 - 3,200 kg per rai (10-20 ton/ha), depending on variety, management, and environment. The harvest index is about 0.3 for traditional tall varieties and about 0.5 for improved short varieties.

Traditional varieties usually produce lot of total dry matter, but they do not efficiently produce rice grains due to lower value of harvest index. On the other hand, improved varieties produce rice grains more efficiently because of higher value of harvest index.

Another method of examining the rice yield is to investigate the grain yield based on yield components. The grain yield can be expressed as follows:

Grain yield (kg/rai) = panicle number/m^2 x grain number/panicle x filled grain rate x 1,000-grain weight x 1.6 x 10^{-3}

or

Grain yield (ton/ha) = panicle number/m^2 x grain number/panicle x filled grain rate x 1,000-grain weight x 10^{-5}

Table 1 shows rice yield and yield components of RD-23 at different plant spacing at the agricultural demonstration center in 1983 dry season. As number of hills per m^2 increased, number of panicles per hill decreased. However, number of panicles per m^2 increased as increasing number of hills per m^2. One thousand grain weight was almost constant regardless the differences in plant spacing. Low rice yield of sparse plant spacing (35 cm x 25 cm) was due to less number of grains per m^2. Low rice yield of dense plant spacing (25 cm x 10 cm) was due to less number of grains per m^2 and low percent of filled grains. The data show that the rice yield is greatly influenced by number of grains per m^2 and percent of filled grains.

The number of grains per m^2 can be increased by increasing number of panicles per m^2 and increasing number of grains per panicle. The two yield components, however, usually negatively correlate. If number of panicles per m^2 increased, number of grains per panicle decreases, or vice verse. To get the optimum number of grains per unit area, good variety and management are necessary in addition to favorable environment.

Percent of filled grains is also an important factor. It appears to be determined by (a) ability of leaves to produce carbohydrates, (b) ability of grains to accept carbohydrates, and

Table 1. Yield and yield components at different plant spacing (RD-23, 1983 dry season)

	Plant spacing (hills/m^2)				
	11.4 (35 cm x 25 cm)	16.0 (25 x 25)	22.2 (30 x 15)	40.0 (25 x 10)	Target
Panicles/hill	17.50	16.31	12.29	8.39	15
Panicles/m^2	199.50	261.00	272.78	335.50	300
Grains/panicle	87.00	89.69	83.01	60.81	100
Grains/m^2	17,356.50	23,409.09	22,648.92	20,401.76	30,000
Filled Grains/panicle	65.30	68.64	64.36	39.86	75
Un-filled grains/panicle	21.70	21.05	18.65	20.95	25
% filled grains	75.05	76.53	77.53	65.55	75
1,000-grain weight (g)	24.66	25.69	25.54	25.99	28
Yield estimated (kg/rai)	514.01	736.38	717.41	556.10	1,008
Actual yield (kg/rai)	598.05	650.65	750.29	519.95	-

Note:

Fertilizer rate (kg/rai) = N (10.8 kg) - P_2O_5(4.5 kg) - K_2O(4.5 kg)

Data at Agricultural Demonstration Center.

(c) efficiency of assimilate translocation from leaves to grains. Although many factors affect the percent of filled grains, drought during panicle formation and flowering, lodging before flowering or early grain filling stages, low amount of solar radiation before and after flowering, and low temperature at panicle formation or high temperature at flowering decrease the percent of filled grains.

Improved varieties (RD varieties in Thailand) are generally panicle-number types and short in plant height. In this type, number of panicles per m^2 is high, but number of grains per panicle is less. On the other hand, most of traditional varieties are panicle-weight types and tall in plant height. In this type, number of panicles per m^2 is less, but number of grains per panicle is high. In direct sowing rice, number of panicles per m^2 is usually more than that of transplanting. In most cases it ranges from 400 to 600 panicles per m^2. However, panicle size (number of grains per panicle) becomes smaller under dense plant spacing.

As it is mentioned earlier, rice yield can be increased through increasing number of grains per m^2 and increasing percent of filled grains. To increase the number of grains per m^2, young seedlings (18-25 day old seedlings) should be transplanting at proper plant spacing (20-30 hills/m^2). In case of direct sowing, seed rate of 15 kg per rai is recommendable, and the seeds should be germinated prior to sowing.

For RD varieties, application of basal fertilizer (30 kg/rai of ammonium phosphate) at the last puddling in transplanting or at the first irrigation after direct sowing increases the number of effective tillers (panicles). Application of top dressing fertilizer (20-30 kg/rai of ammonium sulfate or 10-15 kg/rai of area) at panicle formation stage increases the number of grains per panicle.

Weed and water controls are other important cultural practices to obtain enough number of grains per m^2 and high percent of filled grains. Weeds compete with rice plant in nutrients, water and solar radiation. Water stress in early stages prevents tillering of rice plant and increases weed population. On the other hand, water stress during from panicle formation to early grain filling stages decreases number of grains per panicle and percent of filled grains.

In case of traditional varieties, lodging is the problem for rice production. The lodging increases mutual shading of leaves and decreases carbohydrate production in the leaf. It also prevent translocation of assimilates from leaves to grains. Early planting of photo-sensitive traditional varieties in wet season usually associate with excessive vegetative growth, which prolongs the length of internode and the rice plant lodges easily. Since the flowering time of photo-sensitive varieties is controlled by day length, they should be sown about 100 to 110 days before expected flowering date of respective variety.

Rice yield is the sum of variety, management and environment. To obtain satisfactory rice yield, farmers should be familia with the characteristics of rice plant and try to improve farming techniques.

CONTROL BLAST AND INSECTS

Mr. Arvooth Pisan

Tha-muang Agricultural Extension Office

Blast

Cause: Fungus

Symptom: The fungi disperse in the air and fall down to rice leaves. When the moisture is high, the fungi develop fibers to destroy the rice plant. Some sears will be shown or the rice leave. The shape of sears is round or eclipse like human eye. It is gray in color, but the edge of sears is brown. When the rice plant is damaged virulently, the leave becomes dry. The disease can damage the rice plant at any stage of growth.

Control:

1. Use resistant varieties: RD 7.
2. Seed treatment with chemical: Dithane M. 45
3. Plant spacing should not be too dense but should divide into subplots for drainage.
4. Nitrogen fertilizer should be applied at moderate rate.
5. Use chemicals, when the symptom is found on the rice plant: Benlate, Kazumin at the rate of 2 table sppoons mixed with 20 liters of water.

RD 23, the most widely planted rice variety at the present, is only moderately resistance to blast. In this crop season, blast has spreaded out in the area of Suphanburi province. So farmers should often patrol and take care the rice field. If farmers delay to control the disease, it will spread rapidly and the neck rot will be seen at the flowering stage.

Rice Stem Borers

Four kinds of stem borers are important in rice production. They are:

1. White stem borer: Broun stripe along its body and the head of larva is brownish.
2. Purple striped stem borer: Brown and purple stripe along its body and the head of larva is black.
3. Striped stem borer: Color of body is either creamy, white yellow or gray.
4. Pink stem borer: Color of body is pink and yellowish, and the insect is bigger than others.

Characteristics: Stem borers are kind of night-time moth. They fly around the light. Farmers call Chi-pa-khao.

Damage: Stem borers damage the rice plant from seedling stage to harvesting stage. The adult lays the cluster of eggs along the rice leaf or leaf sheath. Larbae of stem borers feed within the stem and cause dead heart or white head (empty grains).

Control:

1. Apply Furadan 3G at the rate of 3 kg per rai at 5, 30, and 60 days after transplanting, respectively.
2. Spray Azodrin at the rate of 40 cc mixed with 20 liters of water every 10-15 days.

Rice Swarming Caterpillar

Characteristics: This caterpillar is a kind of night-time moth which is gray or brownish. The adult lays eggs on the leaf of rice seedling. After 2-8 days, eggs hatch abd become caterpillars. The caterpillar has yellow stripe along its body and the black spot on every segment.

Damage: First stage of caterpillar bites surface of the leaf. When it grows up, they eat all parts of the leaf and remain only petiole.

Damaging season: May-September.

Control:

1. Spray Azodrin at the rate of 40 cc mixed with 20 liters of water.
2. Irrigate paddy fields until the water level comes up to the top of the rice plant.

Rice Leaf Roller

Characteristics: Larva or caterpillar is green. Adult has brown wings and two brown stripes cross against on the front wings.

Damage: The larvae bite and eat surface of leaves. White tissue is seen on the surface and the larvae roll the leaves and live inside them.

Damaging season: All the season.

Control: Spray Azodrin at the rate of 30-40 cc mixed with 20 liters of water when the incects are found and dispersing.

Notice

Farmers should often patrol and observe their fields. If any pest is found dispersing, contact to the extension workers, zone man or chairman or secretary of water user group, and request to subsidize some chemicals from the government.

To: Members of Water User Groups in Pilot Project No. 2,
Tambon Takramen and Tambon Donchaaim, Amphur Thamaka

1. Payment of water fees for maintenance of irrigation system.

According to the committee meeting of Agricultural Cooperative in Thamaka Land Consolidation in March 9, 1984, chairman of water user group collects water fee from the members of each water user group. Based on the area of irrigated field, the member has to pay the fee to the chairman or the secretary, and asks the receipt.

2. Members of water user groups are requested to practice the followings.

1) Observe the irrigation system, roads and other facilities after land consolidation, and keep them in good conditions.

a) Don't do any things that damage the facilities.

b) Don't bring domestic animals to the irrigation system, because they damage the facilities.

c) Don't destroy or change the form of irrigation and drainage ditchs.

d) Don't leave anything in irrigation and drainage canals, because it increases the cost of cleaning. If it costs more than the maintenance fee deposited, additional collection of water fee is necessary.

2) Have to use the varieties suitable for irrigation schedule.

3) Prevent excess water leaking from paddy fields, through repairing dikes and closing holes.

4) Develop mutual understanding among members of the group and respect the right of other farmers on irrigation water.

5) Cooperate with the officers who work along water user groups.

The committee, consists of Mr. Somkiat Yodmanee (Zone man, Royal Irrigation Department), Mr. Virod Inkriang (Agricultural Extension Officer, Tambon Takramen), Mr. Pratep Maneedit (Agricultural Extension Officer, Tambon Donchaaim) and Miss. Charoonsri Amphansaeng (Cooperative Promotion Department Officer), holds the meeting at the field house of Mr. Lhong A.M. 9:00 to P.M. 4:30 every Friday. The member, whoever has problems or wants advice, can meet them. If the member has any problem or transaction, he can contacts any of them attending the meeting.

To: Members of Water User Groups in Sugarcane Pilot Project,
Tambon Tungtong, Amphur Tha-muang

Whoever member of water user group did not pay water fee for 1983, should pay at Tha-muang Agricultural Cooperative Office, or asks zone man to inform the officer to collect the payment.

Miss. Charoonsri Amphansaeng
Officer of Cooperative Promotion Dept.

INFORMATION

Farmers Meeting

Farmers meeting is held at Pilot Project No. 1 and No. 2, respectively. Times and places are as follows:

P/P 1: A.M. 9:00-12:00, June 13, 1984
Agricultural Demonstration Center

P/P 2: P.M. 1:00-4:00, June 12, 1984
Field house of Mr. Lhong

No. 1-7 July 2, 1984

MAE KLONG FARMING NEWS

Agricultural Implementation Center

The Greater Mae Klong Irrigated Agriculture Development Project

IMPORTANT POINTS OF WET SEASON RICE CULTIVATION

There are several important points of rice cultivation in wet season. Before starting wet season rice cultivation, farmers should know irrigation schedule, rainfall and temperature patterns, and characteristics of varieties which they plant.

Number of rice varieties planted in wet season is more than that of planted in dry season. Almost all of rice varieties planted in dry season are RD varieties. On the other hand, traditional varieties and RD varieties are planted in wet season depending on management, soil and water conditions. It means that wet season rice cultivation is more diversified than dry season one.

In wet season rice, farmers should plant rice at appropriate time and harvest within the year. If the rice plant does not mature within the year, it will face drought during flowering and grain filling period in Mae Klong area where the irrigation water supply usually stops at the end of November. Low temperature in early dry season (end of November to December) sometimes cause the cold injury of rice plant, because the rice plant is weak against cold temperature, especially when it is panicle initiation to flowering.

Harvesting date of photo sensitive varieties is naturally fixed depending on the variety. They are November 21 for Khao Dok Mali 105, November 26 for Nang Mon S-4, December 3 for Khao Pak Mo 148, December 15 for RD-27, and December 19 for Luang Pratiu 123. If these varieties

are planted too early, they only prolong the vegetative period but not increase the rice yield. In case of non-photo sensitive varieties, if they are planted too early, they mature before ending wet season, then it will be the trouble for farmers during harvesting time.

Considering the above mentioned circumstances, farmers should plant any of rice varieties at appropriate time that ensure flowering before November 20. All of the above mentioned photo sensitive varieties flower before November 20. In case of these photo sensitive varieties, farmers should sow seeds (sowing to the nursery or direct sowing to the field) about 130 to 140 days before harvesting date. In case of non-photo sensitive varieties (such as RD-23), farmers should sow seeds in the period from July 20 to August 20.

Leveling work is one of the most important farming practices in rice cultivation. Poor leveling will cause weed problem in either transplanted or direct seeded field. It also the main cause of poor germination and not uniform growth of direct seeded rice. Poorly leveled field require lot of working in later for gap-filling and weeding.

Another important point is seedling age for transplanting. Try to transplant about 18 to 25 day seedlings. Old seedlings take time to recover after transplanting and produce less tillers. Old seedlings also prolong the growth period (days from sowing to harvesting) in non-photo sensitive varieties.

Weed control becomes important recently in Mae Klong area, as more farmers adopt direct sowing method of rice cultivation. Direct sowing rice cultivation faces a risk in wet season, because of high possibility of flooding after sowing. However, advantages of labor saving in this method attracts some farmers even for wet season rice.

Based on the observation at agricultural demonstration center and farmers' fields, application of Saturn G (Benthiocarb) is the most successful weed control method at present. Saturn G is pre-emergence herbicide and granular type. It should be applied at the rate of 5 kg per rai at 3 to 5 days after transplanting or 3 to 5 days before direct sowing. The paddy field should be flooded before appling Saturn G, then should have standing water at least for 3 days. In case of direct sowing field, farmers should level the field properly, then irrigate the field for 7 to 10 cm. Close crab holes to prevent water leakage from the field, then apply Saturn G. Wait for 3 to 5 days, then drain out excess water. Make drainage furrows in the field every 6 or 8 m interval, then sow germinating seeds. Be sure that Saturn G is not effective if the soil is moved after application, so that it is not control the weeds of drainage furrows. It is also not effective if the surface soil is not under water or the surface soil is moved by strong rain. For later stage weed control (just after maximum tillering stage), there are many kind of herbicides including 2.4-D and its derivatives. However, most of these harbicides adversely affect rice plant when they are applied to young seedlings.

When farmers use herbicides, they should pay more caution about how to use them. There observed lot of miss-use-cases of herbicide in 1984 dry season. An overdose in application will not only kill weeds but also damage the rice plant.

In this wet season rice, farmers (especially in Pilot Project No. 1) should pay attention to dormancy period of rice seeds. If farmers sow rice seeds before their domancy period expired, percent of germination is quite low. Domancy periods from maturity date are 7 days for RD-7, 35 days for RD-9, 28 days for RD-11, 24 days for RD-21, 32 days for RD-23, 28 days for RD-25.

HERBICIDES AND WEED CONTROL

Nowadays, most farmers favor to use herbicides for weed control. However, it is very difficult to control them especially in case of direct sowing rice. Each herbicide kills weeds in different manner, so that farmers should carefully decide the kind of herbicide and follows the instruction of usage. There are many kind of herbicides. Some of their common names and trade names are as follows:

Common name	Trade name
1. Benthiocarb	Saturn
2. Bifenox	Modown
3. Butachlor	Machete, Chelete
4. CNP	Mo
5. Ioxynil + 2,4-D	Actril DS, Actril DR
6. Nitrofen	Tok-E 25
7. Oxadiazon	Ronstar
8. Propanil	Propanil C.T., Stam F. 34, Bara F 100
9. 2,4-D	Shell-D 80, D-M-A-6, Ester 79, Edsanchor, Twindronal, Twin 2,4-D, Bara-ester
10. 2,4-D + Oxadiazon	Ronstar 2 D
11. 2,4-D + Propanil	Same as 8 and 9

Table 1 shows kind of herbicides and their effects of controling different kind of weeds.

Table 1. Kind of herbicides and their effects

	Benthiocarb	Bifenox	Butachlor	CNP	Ioxynil + 2,4-D	Nitrofen	Oxadiazon	Propanil	2,4-D	2,4-D + Oxadiazon	2,4-D + Propanil
Goose weed	F	G	F	E	E	E	E	N	N	P	E
Mimulus orbicularis	P	G	P	F	E	G	E	N	P	F	G
Sedge	E	E	E	E	E	E	E	F	G	E	E
Tall-fringe-rush hoorah grass	E	E	E	E	N	E	E	F	E	E	E
Nut sedge	E	E	E	E	E	G	E	F	E	E	E
Raygrass	G	G	G	G	F	G	G	G	N	F	G
Barnyardgrass	G	G	F	G	F	E	E	E	P	F	G
Jungle-rice	E	E	G	G	F	E	E	E	N	F	G
Stone wort	G	P	P	P	N	E	G	N	N	F	N
Water clover	P	F	P	P	E	P	G	N	N	G	F
Monochoria	G	G	G	E	E	G	G	P	G	E	E

E: Excellent control

G: Good control

F: Fair control

P: Poor control

N: No control

From: Technical Document RICE, Agriculture Promotion Department.

Note: This article is same as published in February.

No. I-8 August 1, 1984.

MAE KLONG FARMING NEWS

Agricultural Demonstration Center

The Greater Mae Klong Irrigated Agriculture Development Project

IDEAL RICE VARIETY AND VARIETIES AT PRESENT

Rice varieties planted in Mae Klong area are diversified from traditional to RD varieties especially in wet season. Farmers want the rice variety that can produce high grain yield without any troubles. However, any rice variety planted at present has some defects. After introduction and experience of several RD varieties, RD-23 became the most popular viriety in dry and wet seasons in Mae Klong Pilot Project areas. In 1984 dry season, RD-23 was damaged by blast in some areas. Not only farmers but also agricultural extension officers are anxious about the weakness of this variety to blast.

Table 1 shows the characteristics of recommended varieties for Mae Klong area. There is no variety which has enough resistance to all kind of diseases and insects. The table indicates that the yield levels of RD varieties are higher than those of traditional varieties (at agricultural demonstration center). Moreover, the RD varieties have stronger resistance to diseases and insects than traditional varieties.

Rice breeders have been working to find the ideal rice variety. The ideal variety should have at least high yield potential, good grain quality, adaptability to the environment (soil, water and weather conditions), resistance to diseases and insects, and tolerance to lodging. However the speed of varietal improvement is quite slow. RD-21, 23, 25 and 27 were released in 1981, since then new RD varieties have not been released yet. It means that finding better varieties than present RD varieties is very difficult task.

At the present situations, farmers should not fully depend on the rice variety. They have to practice good management according to the characteristics of respective variety.

Table 1. Characteristics of recommended varieties for Mae Klong area.

I. None photo sensitive varieties (can be planted in dry and wet seasons)

Variety	Disease resistance					Insect resistance				Dormancy period (days)	Plant height (cm)	Cooking quality	Fertilizer response	Growth duration (days)	Yield (kg/rai)
	BL	BLB	GSV	YOLV	RSV	GLH	BLH	SB	GM						
RD-7	MS	R	S	R	S	S	S	S	S	7	115	Soft	High	125	672
RD-9	S	S	S	MS	S	R	R	R	R	35	115	Hard	High	120	657
RD-11	MR	S	MR	S	S	MR	S	S	S	28	115	Hard	High	135	730
RD-21	MR	R	S	S	R	S	R	S	S	24	110	Soft	High	125	666
RD-23	MR	R	S	S	R	S	R	S	S	32	115	Soft	High	120	715
RD-25	MR	MR	S	S	R	S	MR	MR	S	28	100	Hard	High	100	538

II. Photo sensitive varieties(can be planted in wet season only).

														Harvest date	
KDM	S	S	S	S	S	S	S	S	S	56	138	Soft	Low	Nov. 21	363
NM	S	MR	S	S	S	-	S	S	-	35	160	Soft	Low	Nov. 26	436
KPM	MR	S	S	S	S	-	S	S	-	42	140	Soft	Low	Dec. 3	415
LP	R	S	S	S	S	S	S	S	S	42	150	Soft	Low	Dec. 19	414
RD-27	S	S	S	S	MR	S	S	S	S	35	160	Soft	Low	Dec. 15	517

Varieties: KDM-Khao Dok Mali 105, NM-Nang Mon S-4, KPM-Khao Pak Mo 148, LP-Luang Pratiu 123.

Diseases: BL-Blast, BLB-Bacterial leaf blight, GSV-Grassy stunt virus, YOLV-Yellow orange leaf virus, RSV-Ragged stunt virus.

Insects: GLH-Green leaf hopper, BLH-Brown plant hopper, SB-Stem borer, GM-Gall midge.

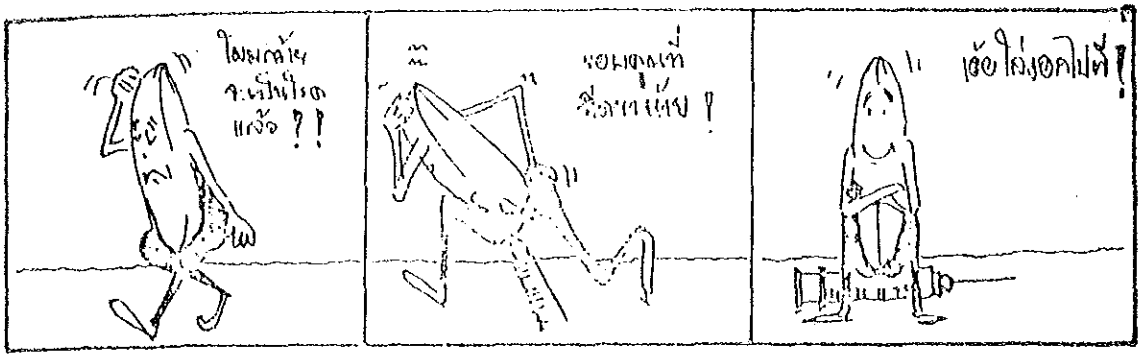
Resistances: R-Resistant, MR-Moderately resistant, MS-Moderately susceptible, S-Susceptible.

SPREADING PERIOD OF RICE DISEASES

I feel bad because of diseases

I recover after injection

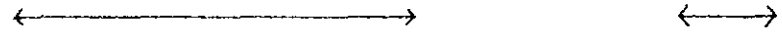
Now, I feel fine



Rice disease is a very important enemy which affects rice yield. Its virulence depends on kind of disease, environment, rice variety and others. Moreover, if some kind of disease spread out at different growth stages, its virulence will be different. It means that if farmers can control the disease precisely at appropriate time, it will contribute to the increment of rice yield.

1. Blast

Seedling stage — Maximum tillering — Booting stage



1) Spreading period: Throughout the season. But the virulent period is from seedling stage to maximum tillering stage and booting stage.

2) Control: Reduce amount of N fertilizer. Nursery should be made against the wind direction, and the width of each nursery bed should be not more than 1 m. Use resistant varieties (i.e. RD-1, 9, 11 and 21). Seed treatment (i.e. Triophonate at the rate of 0.5 % of seed weight will prevents the seedling from blast for about 3 weeks). Spray Tricyclazole 75%WP or Bavistin 50%WP.

2. Brown spot and Narrow brown spot

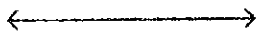
Seedling stage Maximum tillering Booting stage

1) Spreading period: Same as blast.

2) Control: Apply muriate of potash (KCl) at the rate of 5-10 kg/rai. Use resistant varieties (i.e. RD-7 and 11). Seed treatment with Mancozeb.

3. Dirty panicle and Sheath rot

Nursery period Booting stage Milky stage

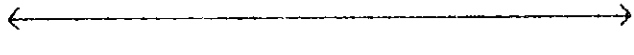


1) Spreading period: Booting stage to milky stage is very virulent stage.

2) Control: Use resistant variety to dirty panicle (i.e. RD-7). Use chemicals (i.e. Polyoxine-Z, Delzene 80%WP).

4. Sheath blight

Nursery Transplanting Maximum tillering Flowering



1) Spreading period: From transplanting to flowering stage.

2) Control: Use resistant varieties (i.e. RD-13 and tall local varieties). Use chemicals (i.e. Validomycin 3%EC, Hinosan 30-50%EC, or Derosal 60%WP).

5. Bacterial leaf blight and Bacterial leaf streak

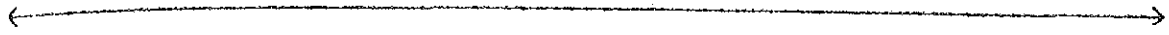
Nursery Maximum tillering Booting Milky

1) Spreading period: Nursery period to milky stage. Nursery period to maximum tillering and booting to milky stage are very virulent.

2) Control: Use resistant varieties (i.e. RD-7, 19, 21, 23 and 25 for bacterial leaf blight, and RD-5 for bacterial leaf streak). Use Phenazin 10%WP.

6. Yellow orange leaf virus, Ragged stunt virus, Gall dwarf virus

Nursery Transplanting Maximum tillering Booting Flowering



1) Spreading period: Throughout the season, but should be careful from seedling stage up to when the rice plant is 60 days old. The dispersion depends on vector (insects). Lots of insects are found in early March in dry season and early July in wet season.

2) Control: Use resistant varieties (i.e. Kamphai, RD-11 for yellow orange leaf virus, RD-9, 21 and 23 for ragged stunt virus, and Khao Dok Mali, Khao Niao, Luang Kra Riang, Khao Luang, Sichampa, Nang Mon Bao and Khao Lamyai for gall dwarf virus. Eradicate the vector (insects) by using Furadan 3%G before seeding and before transplanting at the rate of 5 kg/rai, then spray MIPC 50%WP at the rate of 10 gm/20 liter of water every 7-10 days.

Mr. Arvooth Pisan

Tha-muang Agricultural Extension Office

FLAG SYMBOL FOR WATER SUPPLY

For: Members of water user groups in pilot project No. 2

Amphoe Tha Maka, Kanchanaburi province.

Mr. Somkiat Yotmani, zone man of Kamphaengsaen project, proposed to the officers concerned in P/P 2 and members of water user groups about how to operate irrigation water conveniently and quickly. Everybody agreed that to riase the flag at the paddy field when you have some problems.

1. When your paddy field does not have water and need water, raise the red flag at your paddy field. After having water in the field, have to take out the flag.

2. When rice diseases occur in your paddy field, raise the yellow flag.

These are conveniences for you, because you need not to notify the president of water user group or officer concerned. You have sometimes lost your time, because you could not see the president or officers. If you show the flags at your fields, concerned personals will help to solve the problems.

Remarks: Please show the flag when you face the problem. After solving the problem, please take out the flag from the field. If some farmers show the flag without problems, they will be fined 50 Baht per time by their president. The farmers can get the receipt about the fine. Money collected from the farmers will be added to the account of maintenance fee of respective group.

Please understand and follow the advice. Thank you.

Mrs. Charunsri Amphansaeng

Cooperative Promotion Department

No. I-9 September 3, 1894.

MAE KLONG FARMING NEWS

Agricultural Demonstration Center

The Greater Mae Klong Irrigated Agriculture Development Project

RESULT OF YIELD SURVEY, 1984 DRY SEASON RICE

Yield survey of 1984 dry season rice was conducted in pilot project areas. Number of samples collected were 130 from pilot project No. 1 and 115 from pilot project No. 2. Each sample was collected from 4 m^2 of paddy field. The agricultural demonstration center is thankful to the farmers who cooperated the yield survey.

Table 1 shows the yield data. Average rice yield of pilot project No. 1 was 669 kg per rai (4,184 kg/ha) and that of pilot project No. 2 was 728 kg per rai (4,551 kg/ha). Average yield of direct sowing was lower in pilot project No. 1, but higher in pilot project No. 2 comparing with that of transplanting.

The highest yield was 1,124 kg per rai (7,026 kg/ha) and 976 kg per rai (6,099 kg/ha); the lowest yield was 229 kg per rai (1,432 kg/ha) and 303 kg per rai (1,894 kg/ha) in pilot project No. 1 and No. 2, respectively. The data show that the direct sowing method of rice cultivation is not inferior if the paddy field is properly managed. However, transplanting method of rice cultivation showed more stable yield. The lowest yields of transplanting fields were 631 kg per rai (3,945 kg/ha) in pilot project No. 1 and 502 kg per rai (3,137 kg/ha) in pilot project No. 2.

In 1984 dry season, because of improvement work of irrigation system, irrigation water supply to pilot project No. 1 was delayed. Farmers were hurry to finish land preparation and sowing. As the result, most area (about 90 %) received direct sowing in pilot project No. 1, then lots of the fields faced weed problems. These circumstances were probably the reasons of lower yield in pilot project No. 1.

Table 1 Yield data of 1984 dry season rice.

1. Average of total samples.

Pilot project No. 1 (130 samples): 669 kg/rai (4,184 kg/ha)

Pilot project No. 2 (115 samples): 728 kg/rai (4,551 kg/ha)

2. RD-varieties in different cultivations.

	Pilot project No. 1		Pilot project No. 2	
Direct sowing	(116 samples)		(52 samples)	
Highest	1,124 kg/rai	(7,026 kg/ha)	976 kg/rai	(6,099 kg/ha)
Lowest	229	(1,431)	303	(1,893)
Average	656	(4,099)	719	(4,493)
Transplanting	(12 samples)		(55 samples)	
Highest	952 kg/rai	(5,950 kg/ha)	928 kg/rai	(5,798 kg/ha)
Lowest	631	(3,945)	502	(3,137)
Average	769	(4,805)	687	(4,296)

Table 2 Distribution of varieties in 1984 dry season

	Pilot project No. 1		Pilot project No. 2	
RD-23	124 samples	(95 %)	105 samples	(91 %)
RD-7	3	(2)	2	(2)
RD-11	1	(1)	-	
Apple Tong	1	(1)	-	
Unidentified varieties	1	(1)	8	(7)
Total	130	(100)	115	(100)

Table 2 show the distribution of rice varieties in pilot project areas in 1984 dry season. RD-23 was the most widely planted variety. 124 out of 130 samples in pilot project No. 1 and 105 out of 115 samples in pilot project No. 2 were RD-23. The data indicate that recommendation from agricultural extension office and agricultural demonstration center about the variety is widely adopted by farmers in the area.

During the yield survey, there observed some unidentified varieties. They might be derivatives of RD varieties, but farmers said different names. To avoid problems arised from miss-named varieties, farmers and other personals who involved in seed distribution should not give any special names to seeds.

USE FERTILIZER PROPERLY

The agricultural demonstration center is conducting the farm survey inside and outside pilot project areas. Through the survey, there observed that some farmers miss-used fertilizer. Some farmers in Tambon Donchaem, Amphur Tha Maka used 16-20-0 for both basal and top dressing. Some farmers in Tambon Tha Takror, Amphur Tha Muang used 21-0-0 for basal and 16-20-0 for top dressing. There may be miss-understandings among farmers about fertilizer use.

Phosphorus is necessary at early growth stages than at later stages because phosphorus is needed for tillering and because the total phosphorus requirement is small relative to nitrogen. Furthermore, if sufficient phosphorus is absorbed at early growth stages, it can be easily redistributed to growing organs. It means that phosphorus fertilizer should be applied when the rice plant is young.

The price of 16-20-0 fertilizer is about 230 Baht per bag and that of 21-0-0 is about 130 Baht per bag. If farmers mis-use 16-20-0 fertilizer, it is more costly than using 21-0-0 fertilizer.

The agricultural demonstration center recommends 16-20-0 for basal fertilizer at the rate of 30 kg per rai, and 21-0-0 for top dressing fertilizer at the rate of 20 kg per rai if farmers plant RD-varieties under irrigated conditions. Fertilizer recommendation to traditional varieties depends on soil and water conditions, growth duration and other farming practices. However, about 10 kg per rai of 21-0-0 for top dressing would be recommendable in most cases.

No. I-10 October 25, 1984

MAE KLONG FARMING NEWS

Agricultural Demonstration Center
The Greater Mae Klong Irrigated Agriculture Development Project

RECOMMENDATIONS ON RICE FARMING FOR MAE KLONG AREA

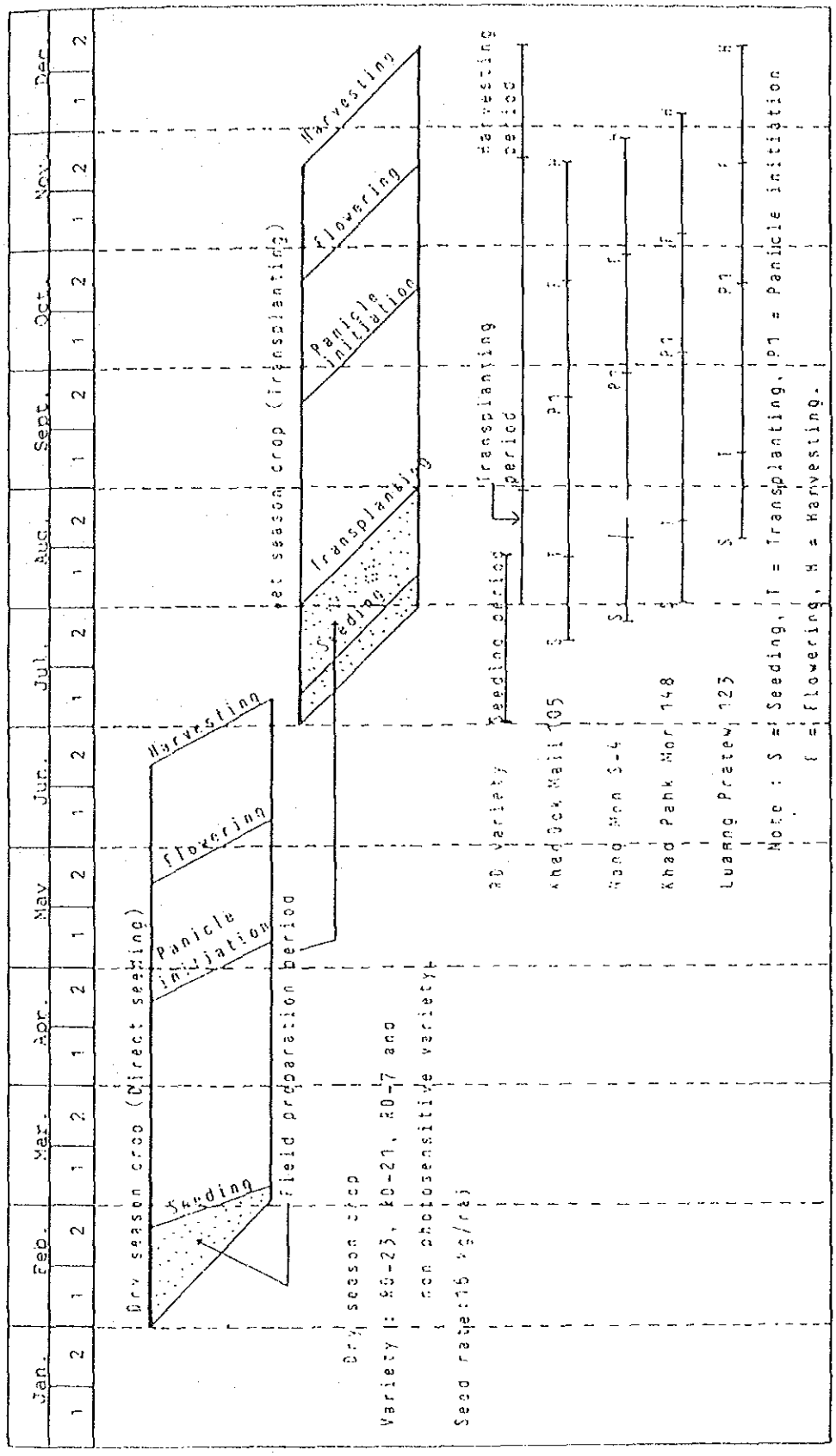
Since 1979 wet season, the agricultural demonstration center has tried to find out what are the appropriate rice farming technologies in Mae Klong area. Lot of experiments and field observations have been conducted in last 5 years regarding rice varieties, seed rates for transplanting and direct sowing, seedling age, fertilizer rate and its application times, weed control, insect control, and varietal tolerance against insects and diseases.

Appropriate rice farming practices obtained in the past have been introduced to the farmers in pilot project area through farmers meetings, assisting model farmers, and this farming news. Tha Muang Agricultural Extension Office, Tha Maka Agricultural Extension Office and Cooperative Promotion Department Mae Klong Office are main agencies work together for organizing farmers and conducting meetings.

Rice production in pilot project area increased rapidly after completion of land consolidation work. It was due to introduction of rice double croppings in a year and increased average yield. Yield level of 700 kg per rai (4,375 kg/ha) or more is reported by many farmers. Distribution of good seeds and information on rice farming contributed to the yield increase, in addition to farmers efforts on increasing rice yield.

On October 25, the evaluation team on Irrigated Agriculture Development Project visit Mae Klong Pilot Project. In this occation, this revised "Recommendations on rice farming for Mae Klong area" is distributed to the farmers as the reference of stable rice double cropping practices in the area.

1. Rice cultivation calendar in Mae Klong area.



2. Recommendations of rice farming practices for Mae Klong area.

		Dry season	Wet season
1	Yield target	800 kg/rai (5,000 kg/ha)	700 kg/rai (4,375 kg/ha)
2	Cultivation method	Direct sowing	Transplanting
3	Variety	RD-23 (70 %) Other non photo-sensitive varities (30 %)	RD-varieties (70 %) Local varieties (30 %) Khao Dok Mali 105 Nang Mon S-4 Khao Pak Mor 148 Luaeng Pratew 123
4	Nursery size	Small area for gap-filling	20 wa^2/rai (500 m^2/ha)
5	Seed rate	16 kg/rai (100 kg/ha)	6 kg/rai (37.5 kg/ha)
6	Seedling age at transplanting	-	18-25 days
7	Plant spacing	-	100 hills/wa^2 (25 hills/m^2) about 30 cm x 13 cm or 20 cm x 20 cm
8	Root depth at transplanting	-	As shallow as possible
9	Basal fertilizer	Ammonium phosphate 30-40 kg/rai	RD varieties Ammonium phosphate 30-40 kg/rai Local varieties Ammonium phosphate 20 kg/rai
	Application time	2 weeks after sowing	Puddling time or 1 week after transplanting

10	Top dressing	Ammonium sulphate 20-40 kg/rai	RD-varieties Ammonium sulphate 20-30 kg/rai Local varieties Ammonium sulphate 10-20 kg/rai
	Application time	At panicle initiation stage (about 70 days after sowing)	About 45-50 days after transplanting
11	Herbicide	Saturn G: 5 kg/rai	Saturn G: 5 kg/rai
	Application time	4-5 days before sowing	4-5 days after transplanting
12	Water management Transplanting: Maintain 4-5 cm depth of water or irrigate about 8 cm depth every week until 2 weeks after flowering. However, the paddy field may be dried after maximum tillering stage for 10 days. Direct sowing: Drain out water from 1 day before to about 10 days after sowing. Before apply fertilizer or herbicide, check and close holes in levee. Standing water of at least 3 days is necessary for herbicide, and running water bring out nitrogen fertilizer from the paddy field. Be sure that the rice plant requires a lot of water from 10 days before to 10 days after flowering.		
13	Special care for direct sowing Seed bed for gap-filling: Should be prepared at 1 week before sowing date. Drainage furrow: Should be made every 8-10 m interval.		
14	Rodent and crab control to prevent water loss.		
15	Insect and disease control.		

No. 1-11 January 2, 1985

MAE KLONG FARMING NEWS

Agricultural Demonstration Center

The Greater Mae Klong Irrigated Agriculture Development Project

IMPORTANT POINTS OF DRY SEASON RICE CULTIVATION

Dry season rice planted area has been expanding year after year in Mae Klong area following the expansion of land consolidated area. The agricultural demonstration center recommends the direct sowing of pre-germinated seeds for dry season rice cultivation. The rice yield of direct sowing is not inferior to that of transplanting, if the paddy field is properly managed. Before starting dry season rice cultivation, check and remaind the following points.

1. Variety.

   Plant non photo-sensitive RD varieties. RD-23 is the most recommendable variety at present.

2. Seed selection.

   Select seeds by water and use only well matured seeds.

3. Seed rate.

   1) Direct sowing: 10-16 kg per rai (62.5-100 kg/ha).

   2) Transplanting: 6 kg per rai (37.5 kg/ha). It becomes 60 kg of seeds for 0.5 rai of nursery and to be transplanted for 10 rai of main field.

4. Hastening of germination.

   1) Soak seeds in water for 48-72 hours (2-3 days).

   2) Keep seeds about 15 cm in thickness on and covered by wet flax bags under shade. It takes 24-36 hours (1-1.5 days) for the seeds to be ready for sowing (about 1-2 mm of root rength).

   3) Turn over the seeds 1 or 2 times in the germinating period.

5. Land preparation.

Good land preparation is the prerequisite for good yield. Leveling work is especially important in direct sowing rice cultivation, because poor leveling adversely affect the seedling establishment and weed control.

6. Herbicide application to direct sowing field.

1) During and after land preparation period, check and close holes in diches and ditches to prevent water leadage.
2) Irrigate water to the depth of 10-15 cm after leveling.
3) Wait 1-2 days for soil colloid to sink.
4) Apply Saturn G (Bentiocarb) at the rate of 5 kg per rai.
5) Wait 4-5 days to drain out water, then start direct sowing work.

7. Direct sowing.

1) Make furrows every 6-8 m interval to drain out water at lower portion of the field.
2) Sow seeds at a uniform rate. However, sow seeds densely to a small portion as nursery of gap-filling.
3) Do not irrigate the paddy field until the establishment of seedlings (about 10-14 days).

8. Fertilizer application to direct seeded field.

1) Apply ammonium phosphate (16-20-0) at the rate of 30-40 kg per rai (187.5-250 kg/ha) about 2 weeks after sowing (after re-irrigation).
2) Apply ammonium sulphate (21-0-0) at the rate of 20-40 kg per rai (125-250 kg/ha) at the panicle initiation stage (about 70 days after sowing

9. Transplanting.

1) Plant young seedlings (18-25 days old). Old seedlings require more time to recover and produce less number of effective tillers.

2) Plant 3-4 seedlings per hill at the spacing of about 100 hills per wa^2 (25 hills/m^2). It is about 30 cm x 13 cm or 20 cm x 20 cm.

3) Under low fertilizer rate and/or transplanting old seedlings, the plant spacing should be denser (about 12o hills/wa^2).

10. Herbicide application to transplanted field.

Apply Saturn G (Benthiocarb) at the rate of 5 kg per rai 4-5 days after transplanting.

11. Fertilizer application to transplanted field.

1) Apply ammonium phosphate (16-20-0) at the rate of 30-40 kg per rai at the last puddling time or 1 week after transplanting.

2) Apply ammonium sulphate (21-0-0) at the rate of 20-40 kg per rai at the panicle initiation stage (about 45-50 datys after transplanting).

12. Some other points.

1) When apply fertilizer or herbicide, the paddy field should have enough standing water (7-10 cm) and leakage should be prevented.

2) Read carefully the instruction of chemicals and follow the instruction.

3) Finish direct sowing before March 7 or finish sowing to the nursery before February 15.

4) Ammonium phosphate (16-20-0) should be used only for basal fertilizer. On the other hand, ammonium sulphate (21-0-0) can be used both for basal and top dressing.

5) About 350 and 400 panicles per m^2 are necessary respectively for direct seeded and transplanted paddy to produce 800 kg per rai (5 ton/ha) of rice.

HISTORICAL CHANGE AND PRESENT SITUATIONS OF RICE FARMING

IN

SOME OF MAE KLONG AREA

Motonori Tomitaka

MARCH 1985

MAE KLONG PILOT PROJECT (Royal Irrigation Department)

IRRIGATED AGRICULTURE DEVELOPMENT PROJECT (Cooperation Project of Ministry of Agriculture and Cooperative, Thailand and Japan International Cooperation Agency)

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INTRODUCTION

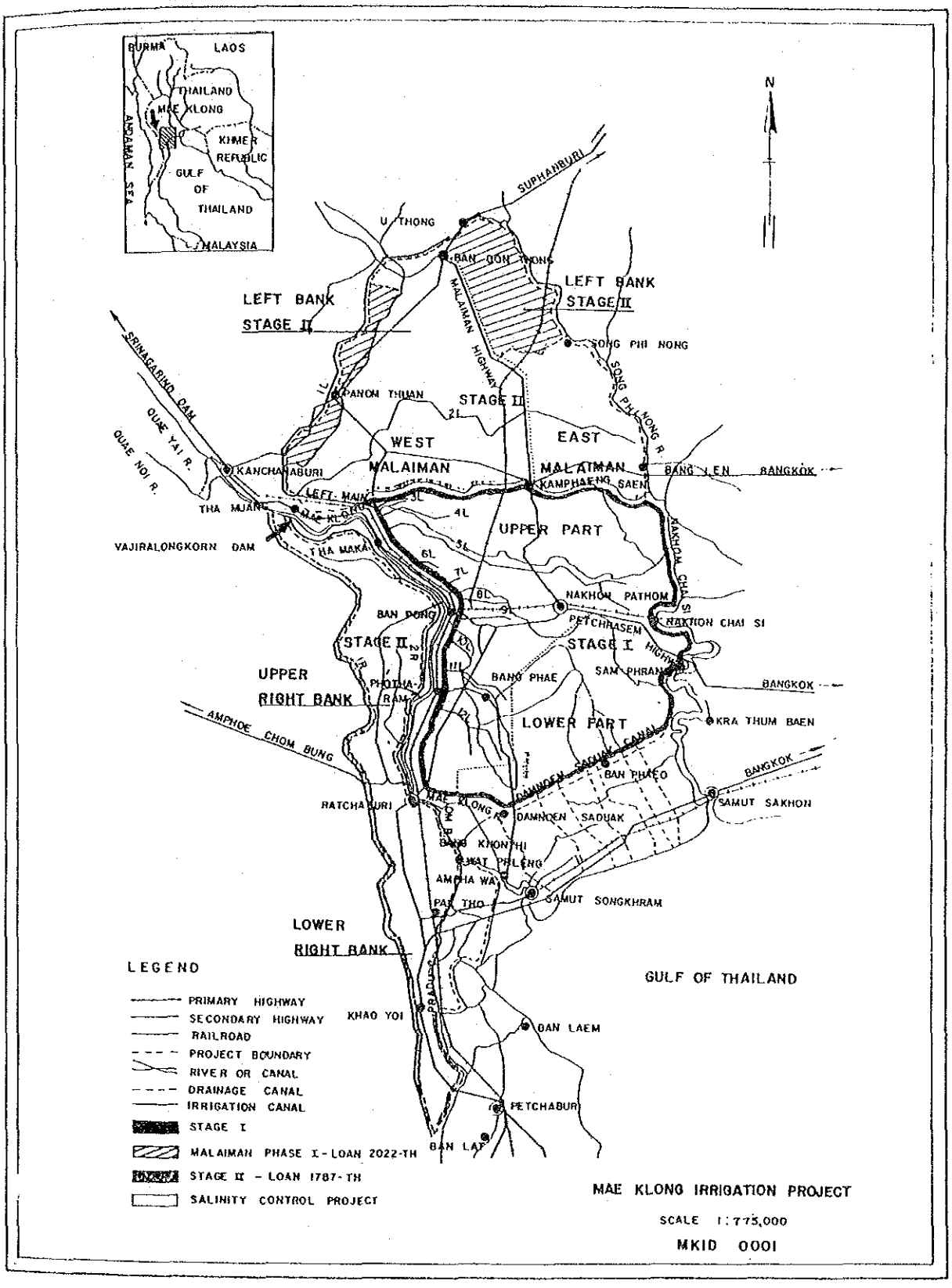
The Greater Mae Klong Irrigation Project is located in the south-western portion of the Central Plain of Thailand (Fig. 1). The Project covers an area of approximately 3,170,700 rai (507,312 ha). Soils in the area are in general suitable for growing crop, and the main crops are sugarcane and rice. Water source to the area is that of Mae Klong river, which has two main tributaries of Khwae Yai river and Khwae Noi river.

Although there were some infrastructure development projects as early as 1903 in the area, formulation of the whole Mae Klong River Basin Development Plan and its implementation (started in 1964) has greatly contributed to the development of agriculture in the area. Out of many kinds of development works, construction of the Vajiralongkorn Diversion Dam (completed in 1972) is probably the biggest event on the agricultural development in the area. During and after the construction of the diversion dam, irrigation and drainage net works have been also constructed by the Royal Irrigation Department (RID). In addition to the above, construction of the Srinagarind Dam on Khwae Yai river (completed in 1979) and the Khao Laem Dam on Khwae Noi river (started storing water in 1984 and to be completed in 1985) makes it possible to control water of Mae Klong river.

In 1977, the Government of Thailand and the Government of Japan exchanged the Record of Discussion on the Technical Cooperation of Irrigated Agriculture Development Project (IADP). The IADP has consisted of the Center (in Central Land Consolidation Office), Suphan Buri Experiment and Training Center (in Department of Agriculture), Chao Phya Pilot Project (in Agricultural Land Reform Office), and Mae Klong Pilot Project (in RID).

THe Mae Klong Pilot Project has aimed at promoting on-farm development work that enables to increase rice production through increasing yield per

Fig. 1 Location of Mae Klong Irrigation Project.



unit acerage and expansion of the area for rice double cropping, and contributing the improvement and diffusion of appropriate rice farming techniques together with strengthening farmers' organizations. The Pilot Project has 2 Pilot Areas and Agricultural Demonstration Center.

Two kind of land consolidation works were demonstrated in the pilot areas. For Pilot No. 1 (total area of 403.6 ha including 9.9 ha for the Agricultural Demonstration Center), an intensive type of land consolidation was performed during the years of 1979 to 1981. The intensive type included the on-farm irrigation and drainage canals, farm roads, land leveling, and reallotment of fields. Standard size of the terminal irrigation unit is 19.2 ha, length of the farm ditch is 600 m, farm road is constructed along the farm ditch, and the drainage ditch is constructed between the irrigation unit. The terminal irrigation unit consits of 12 pieces of paddy fields respectively right and left side of the farm ditch, and the size of each paddy field is 50 m x 160 m (although it is divided into 3-4 fields at present).

For Pilot No. 2 (total area of 550.5 ha), an extensive type of land consolidation was performed in the years of 1981 to 1982. The extensive type included the on-farm irrigation and drainage canals and farm roads. The on-farm irrigation facilities were constructed along the border of land owners. There is no standerd size of irrigation unit, but about 30 ha of the size in average.

Agricultural Demonstration Center was constructed in Pilot No. 1 in 1979. It has played an important role to the improvement of rice farming in Mae Klong area, especially for the pilot areas, through conducting applied research, demonstration, seed multiplication and diffusing modern rice farming techniques to the farmers.

To observe the effects of the Cooperation Project, a farm survey of 168 farmers was initially conducted in 1982. The farmers were some of those

in the pilot areas (42 farmers each) and 3 areas of outside the Pilot Project. The 3 areas were selected with the consideration of, the one close to Pilot No. 1 and land consolidation work would take place within few years (21 farmers), another one remote from the pilot areas and land consolidation work would not take place within few years (21 farmers), and the other one close to Pilot No. 2 and land consolidation work took place simultaneously with that of Pilot No. 2. Results of the survey were reported in "Extension-Research Program Report" (IADP, 1983).

Although it is too early to conduct the succeeding farm survey just merely 2 years after the initial survey, due to the termination of the Cooperation Project in March 1985, the farm survey was conducted in 1984. The survey forcused on rice farming because of the purpose of the Cooperation Project.

ACKNOWLEDGEMENT

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METHODOLOGY

Five areas were selected for this study. They were Pilot No. 1, Pilot No. 2, and their comparative 3 areas. The 5 areas were same as those in the previous (initial) survey done in 1982. The survey covered a total number of 168 farmers. The number of farmers interviewed were also same as that in the previous survey. Since the main task of IADP has been to improve rice farming, every farmer in this farm survey was selected those who practiced rice cultivation.

Some of the farmers surveyed in the previous time were replaced by other farmers in this survey. There were some of them, who quitted farming (one in Pilot No. 1), moved to other areas (one in Pilot No. 1), did not have farming area in the pilot area (one in Pilot No. 1), and initially two households jointed into one (one in Pilot No. 2). In addition to the above, since names and addresses of the farmers in the previous survey were not completely recorded, there might be some more farmers who replaced the initial ones in this survey.

The farm survey was conducted through interviewing the farmers. Five female interviewers were recruited for the survey. They were graduates of high school (1), agricultural college (1), commercial college (2), and teachers college (1). In addition to the interviewers, one secretary and one agronomist (both university graduates and efficient in English) were accompanied during the farm survey. Three more assistants (2 agricultural college graduates and 1 university graduate) joined the survey, when more number of farmers were interviewed at the same time.

All the interviewers, secretary and assistants were trained for 5 days prior to conducting the farm survey. Some farmers in Pilot No. 1 were requested to cooperate the training in the later part.

The questionnaire was first prepared in English and translated into Thai. The questionnaire covered 1983 wet season rice, 1984 dry season rice, other crops harvested, livestock and poultry sold, other incomes in 1983, change of farming methods, and other situations of living.

The farm survey was conducted in August 1984. Depending on the convenience of farmers, the interview was done either at the house of hamlet chief (Phuyai ban), meeting place, farmer house or Agricultural Demonstration Center. Information on the farm survey was given to the respective hamlet chief prior to conducting the hearing, and names and address of the farmers were chedked by the resident record. Upon the finishing interview of each farmer, the answers were checked, and additional questions were given to the farmer to confirm the relevance of information whenever necessary. Most of data were tabulated, and missing data and distrustful information were further collected or checked through visiting the farmers.

Because the farm survey was administered by the IADP, it was conducted not only in the Mae Klong Pilot Project but also in the Cha Phya Pilot Project. Part of the data collected in the 2 Pilot Projdcts were processed at the Center of IADP. Data of the previous survey were also further processed according to the manner of this survey. However, due to the limited time left until the termination of the Cooperaion Project (to be terminate on March 31,1985), results of the survey would be separately reported.

LOCATIONS OF THE AREAS

Locations of the 5 study areas are shown in Fig. 2. Although they are located scatteredly (as much as about 60 km from Pilot No. 1 to Nongplamor on road), all of them are located in rather upper area (or near to the Vajiralongkorn Diversion Dam) in the Mae Klong Irrigation Project. Table 1

Fig. 2 Location of the study areas.

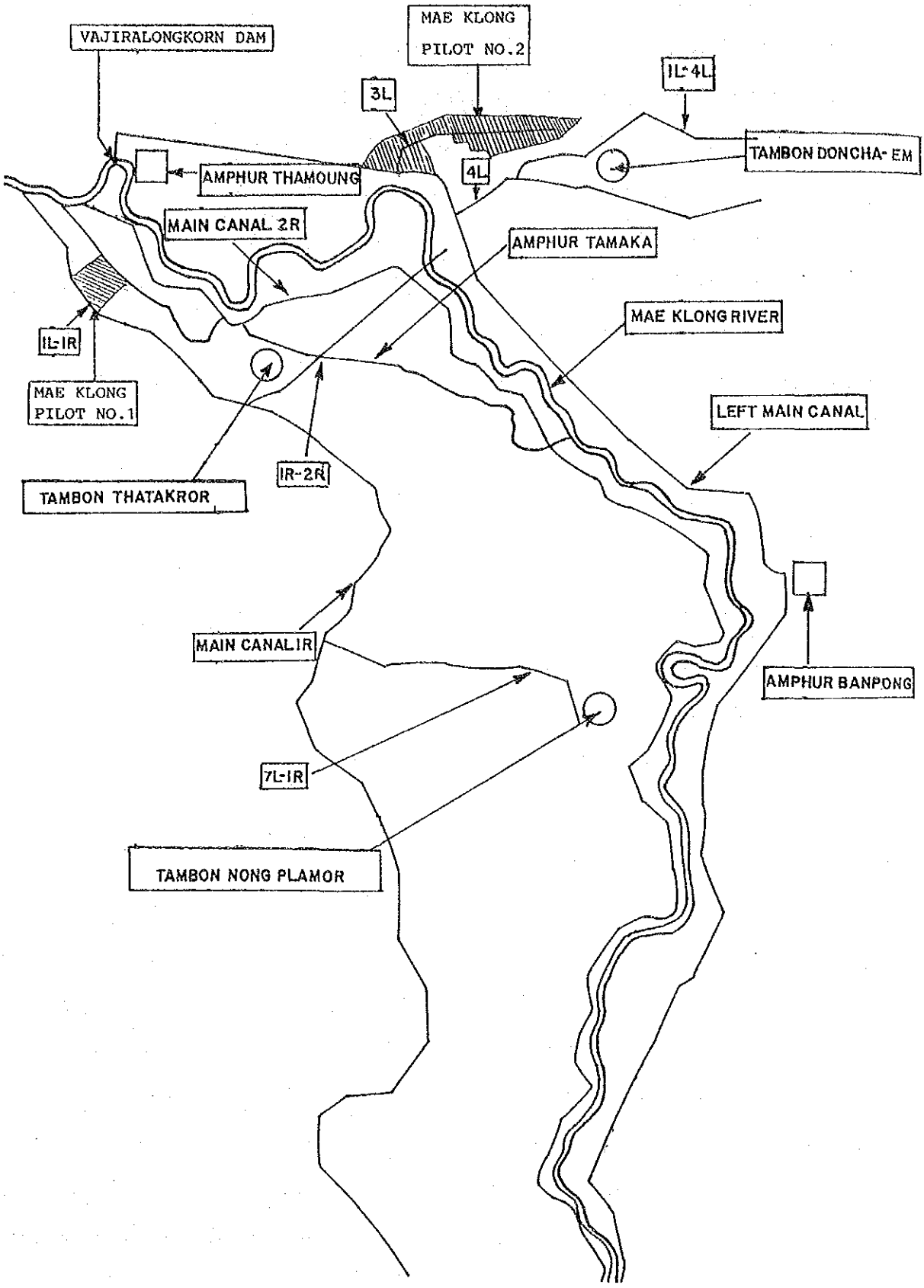


Table 1 General features of the study areas.

	Pilot No. 1	Thatakor	Nongplamor	Pilot No. 2	Doncha-em
Total area (rai)	2,522.5	15,625	18,426	3,440.6	12,642
Arable area	2,298.6(100)	10,710(100)	16,570(100)	3,273.1(100)	10,588(100)
Paddy field area	2,248.8(98)	4,908(46)	15,937(96)	2,839.4(87)	2,097(20)
Sugarcane field area	23.8(1)	4,489(42)	300(2)[a]	305.6(9)	7,964(75)[b]
Number of farm households	149[c]	479	785	313[c]	622
Land consolidation type	Intensive	Extensive	Extensive	Extensive	Extensive
Land consolidation year	1979-81	1983-84	To be 1985	1981-82	1981-82
Dry season rice	Planting	Planting	Not planting	Planting	Planting
Name of irrigation canal	1L-1R	1R-2R	7L-1R	Left Main & 3L	4L
Means of irrigation	Pump up	Gravity	Gravity	Gravity	Gravity
Number of farmers interviewed	42	21	21	42	42

Notes: Information on Thatakor, Nongplamor, and Doncha-em is obtained at Thamuang, Banpong, and Thamaka Agricultural Extension Office, respectively.

[a] Upland crop area (sugarcane is included).

[b] Include upland crop area.

[c] Number of households having agricultural land in the area.

shows the general features of the study areas. Rice is planted in all the areas, and sugarcane is also extensively planted except in Nongplamor. At present, dry season rice is not planted in Nongplamor, but planted in other 4 areas. Irrigation water is coming from the Vajiralongkorn Dam, but different canals supply water to the different areas.

I. Pilot No. 1

Pilot No. 1 is located just near the Vajiralongkorn Dam, and it is part of Banmai and Muangchum villages in Thamuang district, Kanchanaburi province. It covers an area of 2,522.5 rai (including 62 rai of Agricultural Demonstration Center), and total number of households holding land in Pilot No. 1 are 149.

It received the intensive type of land consolidation between the years of 1979 to 1981, and further improvement of irrigation systems in early 1984. Farmers started dry season rice cultivation from the following year of land consolidation. Irrigation water is supplied through the 1L-1R canal, which is the first left lateral canal of the first right bank main canal. Due to higher elevation of the area comparing to the water level of the 1R canal, irrigation water is pumped up to the 1L-1R canal. The type of land consolidation and the means of irrigation water supply are quite different from the other 4 areas.

Although most of the agricultural land in Pilot No. 1 is used for rice cultivation, since the area is located around the border of 3 villages (Khaonoi is also facing to the pilot area), many farmers also have fields outside of the pilot area. As the result, sugarcane and other upland crop productions are also important in the area.

II. Thatakor

Thatakor village is located in Thamuang district, Kanchanaburi province, and just the down side of Pilot No. 1. Main crops in the area are rice and sugarcane, which covers 46 percent and 42 percent of the arable area, respectively.

Some limited number of farmers started dry season rice cultivation as early as 1980. But it was 1984 that many farmers started dry season rice cultivation after the construction of on-farm irrigation facilities (extensive type) in 1983 to 1984. Irrigation water supply to the area is through the 1R-2R canal, and by gravity.

Following the previous survey, some 6 farmers outside of Thatakor village were also included in this survey. However, they at least have fields in the area supplied water by the 1R-2R canal.

III. Nongplamor

Nongplamor village is located in Banpong district, Rachaburi province. Rice is the main crop in the area, which covers 96 percent of the arable area. Banboo craft is practiced by many farmers in the area for the additional income.

Dry season rice is not planted at present, because the land consolidation work is not yet taken place in the area. Irrigation water supply is through the 7L-1R canal, and by the gravity. The canal was first constructed in 1977 as earth made, and concrete lining of the canal was done in 1983 to 1984. It is expected to have land consolidation (extensive type) in 1985.

IV. Pilot No. 2

Pilot No. 2 is located in Thamaka districe, Kanchanaburi province. It covers an area of 3,440.6 rai in Takram-en village, and total number of households holding land in Pilot No. 2 are 313.

Pilot No. 2 received the extensive type of land consolidation in 1981 to 1982, and further minor improvement work in 1983. Some limited number of farmers started dry season rice cultivation as early as 1878, but most of them from the year of land consolidation. Irrigation water is supplied through either the Left Main canal or the 3L (third left) canal depending on the location of the field, and it is supplied by gravity.

Although 87 percent of the arable area is used for paddy field in Pilot No. 2, sugarcane is more widely planted in the whole arable area of Takram-em (68 % of the arable area of 20,034 rai). Many farmers in Pilot No. 2 have sugarcane fields especially outside of the pilot area.

V. Doncha-em

Doncha-em village is located in Thamaka district, Kanchanaburi province, and just down side of Pilot No. 2. Sugarcane is the main crop in the area, and covers 75 percent of the arable area. Rice is the second crop, and covers 20 percent of the arable area. There are many sugarcane factories in and around Thamaka, and Kanchanaburi province is noted as sugarcane producing area in Thailand.

Land consolidation work (extensive type) was taken place in the same years of that of Pilot No. 2. Irrigation water is supplied mostly through the 4L canal, and by gravity.

HISTORICAL CHANGE OF RICE FARMING

I. Expansion of Rice Double Cropping Area

Cropping index is one of the useful methods in evaluating the intensity of land use. The index is that the number of crops grown per annum on a given area of land and usually expressed by percent.

Table 2 shows the change of cropping index on paddy field in last 2 or 3 years. Great increases of cropping index can be observed for Pilot No. 1 (103 % to 175 %) and Pilot No. 2 (131 % to 178 %). The data indicate that the dry season rice planted area has rapidly expanded after the completion of land consolidation work in the areas.

Table 2 Change of cropping index on paddy field (%).

		Wet season	Dry season	Total
Pilot No. 1	1981	87.9	15.5(38.1)	103.4
	1983/84[a]	99.4	75.3(95.2)	174.7
Thatakor	1981	100.0	5.1(28.6)	105.1
	1983/84	98.8	28.2(90.5)	127.0
Nongplamor	1981	94.8	0.0	94.8
	1983/84	92.1	0.0	92.1
Pilot No. 2	1981/82[b]	95.5	35.3(69.0)	130.8
	1983/84	97.1	80.7(100.0)	177.8
Doncha-em	1981/82	100.0	45.1(76.2)	145.1
	1983/84	96.2	64.9(97.6)	161.0

Notes: [a] Taken 1983 wet season and 1984 dry season.
[b] Taken 1981 wet season and 1982 dry season.
Figures in brankets are percent of farmers planted dry season rice.

In the pilot areas and Doncha-em, where the land consolidation work was finished by 1982 (1981 for Pilot No. 1), dry season rice was planted in the area of about 65 to 80 percent of the paddy field in 1984. In case of Thatakor, where the terminal irrigation facilities were constructed in 1983 to 1984, dry season rice was planted onto the 28 percent of the paddy field in 1984. Many farmers reported that they were not ready for the dry season rice cultivation, because they did not expect water coming to the area in the

season, then planted onto small areas as trial. The cropping index for Nongplamor is still less than 100 percent because of not planting dry season rice. The data also show the expansion of rice planted area in wet season in Pilot No. 1 by more than 10 percent.

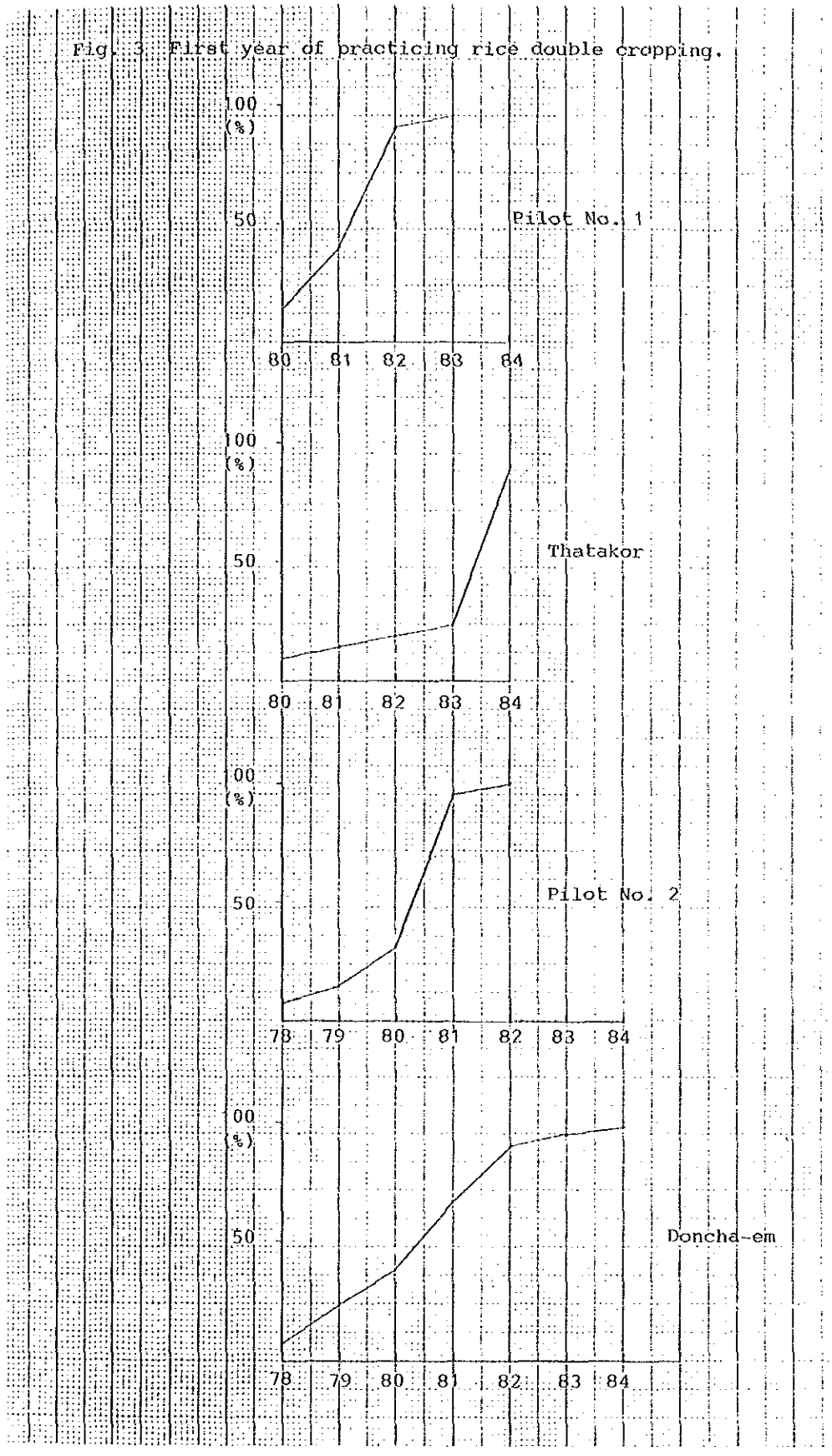
The cropping index in this report is based on the total rice farming area and rice planted area of the farmers interviewed. Some farmers have increased or decreased the farming size even within a year. There are some farmers who have leased in paddy fields only in wet season, or leased in smaller paddy fields in dry season. There are also some other farmers who have leased out some or all of the paddy fields in dry season. These situations affect the value of cropping index obtained. The actually planted area of dry season rice is apparently more than the values in the table. It is probably safe to state the cropping index of at least 180 percent for the pilot areas and Doncha-em.

The table also shows that the percent of farmers planting dry season rice has increased in all the 4 land consolidated areas of Pilot No. 1 (38 % to 95 %), Thatakor (29 % to 91 %), Pilot No. 2 (69 % to 100 %), and Doncha-em (76% to 98 %). It indicates that the farmers have rapidly adopted the dry season rice cultivation in the last years.

Fig. 3 shows the increase of the percent of farmers planting dry season rice in the 4 areas. Some farmers in Pilot No. 2 and Doncha-em planted dry season rice frist time in 1978, while those in Pilot No. 1 and Thetakor in 1980. The rapid increase can be observed from 1980 to 1982 for Pilot No. 1, 1984 for Thatakor, 1980 to 1981 for Pilot No. 2, and rather gradual increase from 1978 to 1982 for Doncha-em.

The expansion of rice double cropping area is probably the biggest change occured or occuring in the agricultural sector in Mae Klong area. And the expansion is not only itself important but also it has involved the

Fig. 3 First year of practicing rice double cropping.



change of other farming practices such as introduction of high yielding varieties (HYVs), changing of planting method, and so on.

II. Change of Rice Varieties

Table 3 shows the percent of the area planted with HYVs in wet season. Since all the planted area in dry season is covered by the HYVs, although some farmers have given some other names to the RD varieties or their derivatives, only that of wet season is taken.

Table 3 HYVs planted area in wet season (%).

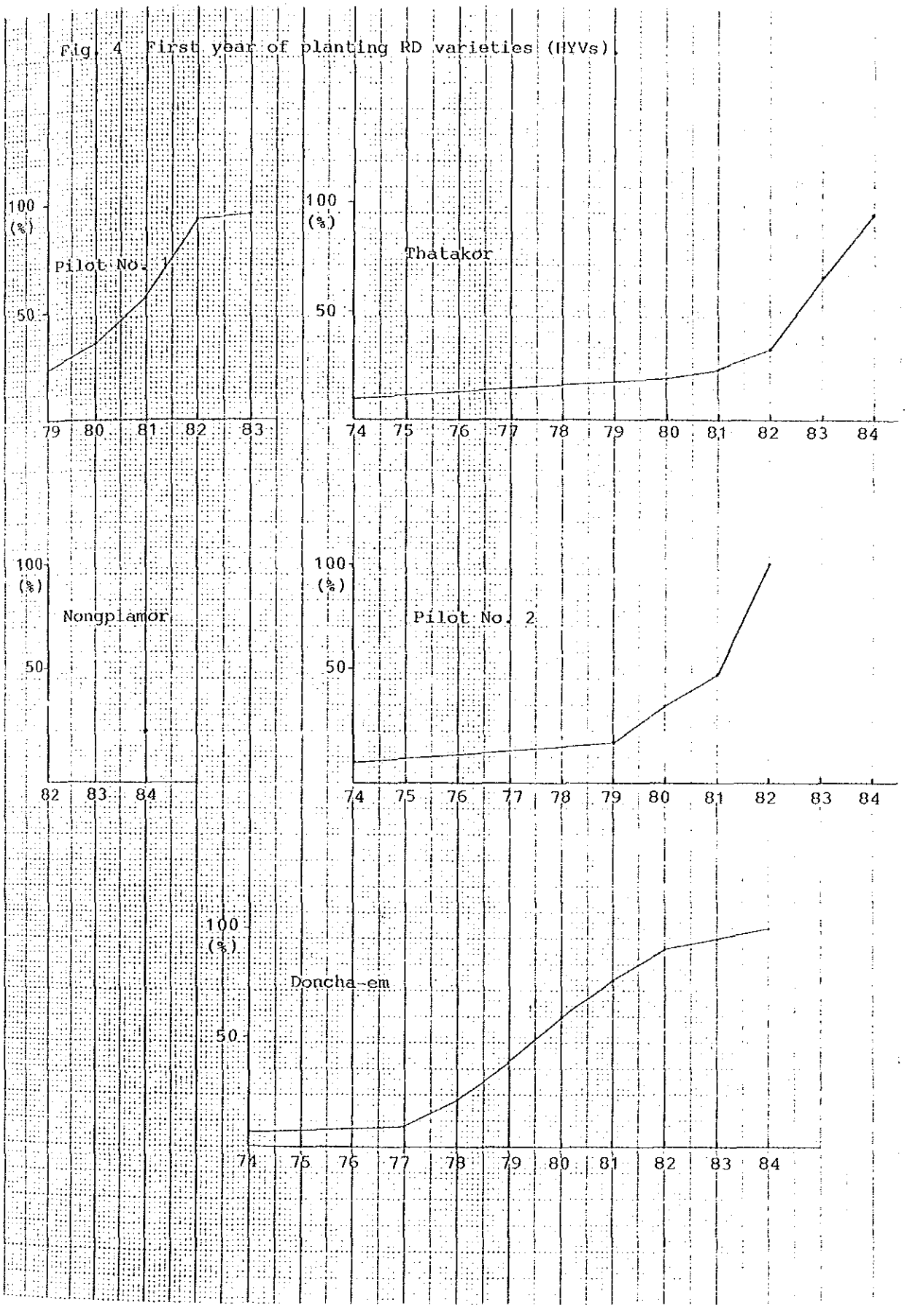
	Pilot No. 1	Thatakor	Nongplamor	Pilot No. 2	Doncha-em
1981	23.3(38.1)	2.4(4.8)	0.0	27.6(52.4)	15.7(19.0)
1983	46.6(66.7)	6.7(14.3)	0.0	62.4(76.2)	12.4(21.4)

Note: Figures in brankets are percent of farmers reporting.

Covering area of the HYVs had expanded in the 2 years in Pilot No. 1 (23 % in 1981 to 47 % in 1983), Thatakor (2 % to 7 %), and Pilot No. 2 (28 % to 62 %), but slightly reduced in Doncha-em (16 % to 12 %), and not planted yet in Nongplamor in 1983. Further, percent of the farmers planting the HYVs has increased in the 4 areas of Pilot No. 1 (38 % to 67 %), Thatakor (5 % to 14 %), Pilot No. 2 (52 % to 76 %), and Doncha-em (19 % to 21 %).

Fig. 4 shows the percent of farmers adopted HYVs at different years. Some farmers in Thatakor, Pilot No. 2, and Doncha-em introduced HYVs in 1974, Pilot No. 1 in 1979, and Nongplamor in 1984 (wet season). The HYVs were rapidly adopted by the farmers in the pilot areas between 1979 to 1982, Thatakor between 1982 to 1984, and Doncha-em between 1977 to 1982. In Nongplamor, however, some farmers have just started the planting of HYVs in 1984. So far, those who have experiences of planting the HYVs are all of the

Fig. 4 First year of planting RD varieties (HYVs)



farmers in Pilot No. 2 and Doncha-em, 95 percent of Pilot No. 1 and Thatakor, and 24 percent of Nongplamor.

Since traditional varieties are not suitable for dry season rice cultivation, this rapid change is due to the experiences of planting HYVs in dry season. It means that the expansion of dry season rice planting area has also affected the rice varieties in wet season.

III. Change of Rice Planting Method

Table 4 shows the percent of farmers who have adopted transplanting, direct sowing, or partly transplanting (adopted both of transplanting and direct sowing). For the wet season rice cultivation, all the farmers in Nongplamor have adopted the transplanting method. In Thatakor, all of the farmers practiced the transplanting method in 1981, and only one farmer partly direct seeded in 1983. Farmers adopting solely the transplanting method have been reduced in the pilot areas, from 90 percent to 62 percent for Pilot No. 1, and from 100 percent to 79 percent for Pilot No. 2. Consequently, number of farmers practicing the direct sowing or the partly direct sowing have increased in the areas. In Doncha-em, contrastingly, the percent of farmers adopting the solely transplanting method has increased from 79 percent to 86 percent.

For the dry season rice cultivation, the planting method has been drastically changed in some of the areas, with more percent of the farmers adopting the direct sowing method. In 1984 dry season, 90 percent of the farmers in Pilot No. 1 have adopted only the direct sowing method, and only one farmer (2.5 %) practiced the solely transplanting method. The rapid change of planting method is apparent, because two third of the farmers practiced the solely transplanting method in the area in 1981 dry season. In Thatakor, all farmers practiced only the transplanting method in 1981 dry

Table 4 Adoption of planting methods (%).

		Wet season			Dry season		
		Transplanting	Direct sowing	Both methods	Transplanting	Direct sowing	Both methods
Pilot No. 1	1981	90.0 (38)	0.0	9.5 (4)	66.7 (12)	16.7 (3)	16.7 (3)
	1983/84	61.9 (26)	14.3 (6)	23.8 (10)	2.5 (1)	90.0 (36)	7.5 (3)
Thatakor	1981	100.0 (21)	0.0	0.0	100.0 (6)	0.0	0.0
	1983/84	95.2 (20)	0.0	4.8 (1)	36.8 (7)	15.8 (3)	47.4 (9)
Nongplamor	1981	100.0 (21)	0.0	0.0	-	-	-
	1983/84	100.0 (21)	0.0	0.0	-	-	-
Pilot No. 2	1981/82	100.0 (42)	0.0	0.0	65.5 (19)	10.3 (3)	24.1 (7)
	1983/84	78.6 (33)	4.8 (2)	16.7 (7)	45.2 (19)	28.6 (12)	26.2 (11)
Doncha-em	1981/82	78.6 (33)	16.7 (7)	4.8 (2)	84.4 (27)	9.4 (3)	6.3 (2)
	1983/84	85.7 (36)	4.8 (2)	9.5 (4)	68.3 (28)	19.5 (8)	12.2 (5)

Note: Figures in brankets are number of farmers reporting.

season, but many farmers have adopted the direct sowing (16 %) or partly direct sowing (47 %) in 1983 dry season. Although the trend of changing planting method is similar, in Pilot No. 2 and Doncha-em, it has not so rapidly changed as that of Pilot No. 1 and Thatakor.

Table 5 shows the percent of direct seeded area in the pilot areas. The values are based on the field observation just after the finishing of transplanting and direct sowing works. Differently planted areas were falled down on the maps, and the percent of direct seeded area was estimated. The table clearly shows that the direct seeded area has expanded in the last years. Further, the percent of direct seeded area is higher in dry season.

Table 5 Percent of direct seeded area[a].

	Pilot No. 1		Pilot No. 2	
	Dry season	Wet season	Dry season	Wet seasom
1981	5	10	2	5
1982	10	15	4	10
1983	45	30	30	20
1984	90	55	60	45

Note: [a] Obtained by the Agricultural Demonstration Center.

Favorable weather is probably the main reason of more rapidly expanding the direct seeded area in dry season. There is almost no rainfall during the direct sowing and seedling establishment period in this area in dry season. More rapid expansion of direct seeded area in Pilot No. 1 is apparently due to its type of land consolidation. Since Pilot No. 1 received the intensive type of land consolidation, it is easier to drain out excess water before or after the sowing. Proper distribution of irrigation and drainage ditches in the area is more suitable for direct sowing rice culture

than other areas, where received or receiving the extensive type of land consolidation.

IV. Use of Fertilizer and Chemical

Fertilizer and chemical applications are usually associated with the modern farming technologies or yield increase if other factors are favorable to the crop production. Fig. 5 shows the first year of using fertilizer. Some farmers in Doncha-em first used fertilizer in 1958, followed some in Thatakor in 1966, Pilot No. 1 in 1969, Nongplamor in 1972, and Pilot No. 2 in 1974. So far, except one farmer in Pilot No. 1, all farmers in the areas have experiences of fertilizer application to crops. The curve of the increment of those having experiences of fertilizer application is steaper for the pilot areas.

All of the farmers in Nongplamor have mentioned that rice was the crop to which they applied fertilizer at the first time. However, many farmers in other areas mentioned that sugacane was the crop to which they first applied fertilizer, or some farmers applied fertilizer to rice and sugarcane first time in the same year. Percent of the farmers applied fertilizer first to sugarcane were more in Thatakor (81 %) and Doncha-em (67 %).

Table 6 shows the practice of fertilizer application to the rice plant in the 2 surveys. Percent of the farmers applied fertilizer had increased (or same 100 %) in most of the cases except that of wet season in Nongplamor. In wet season, lower percent of the farmers had applied fertilizer in Thatakor (38 % to 52 %) and Doncha-em (60 % to 69 %), comparing with Pilot No. 1 (76 % to 91 %), Nongplamor (100 % to 95 %), and Pilot No. 2 (71 % to 98 %). All farmers planting dry season rice had applied fertilizer in 1984, and some slight increase of the percentage was observed in Pilot No. 2 and Doncha-em (97 % to 100 %).

Fig. 5 First year of fertilizer application.

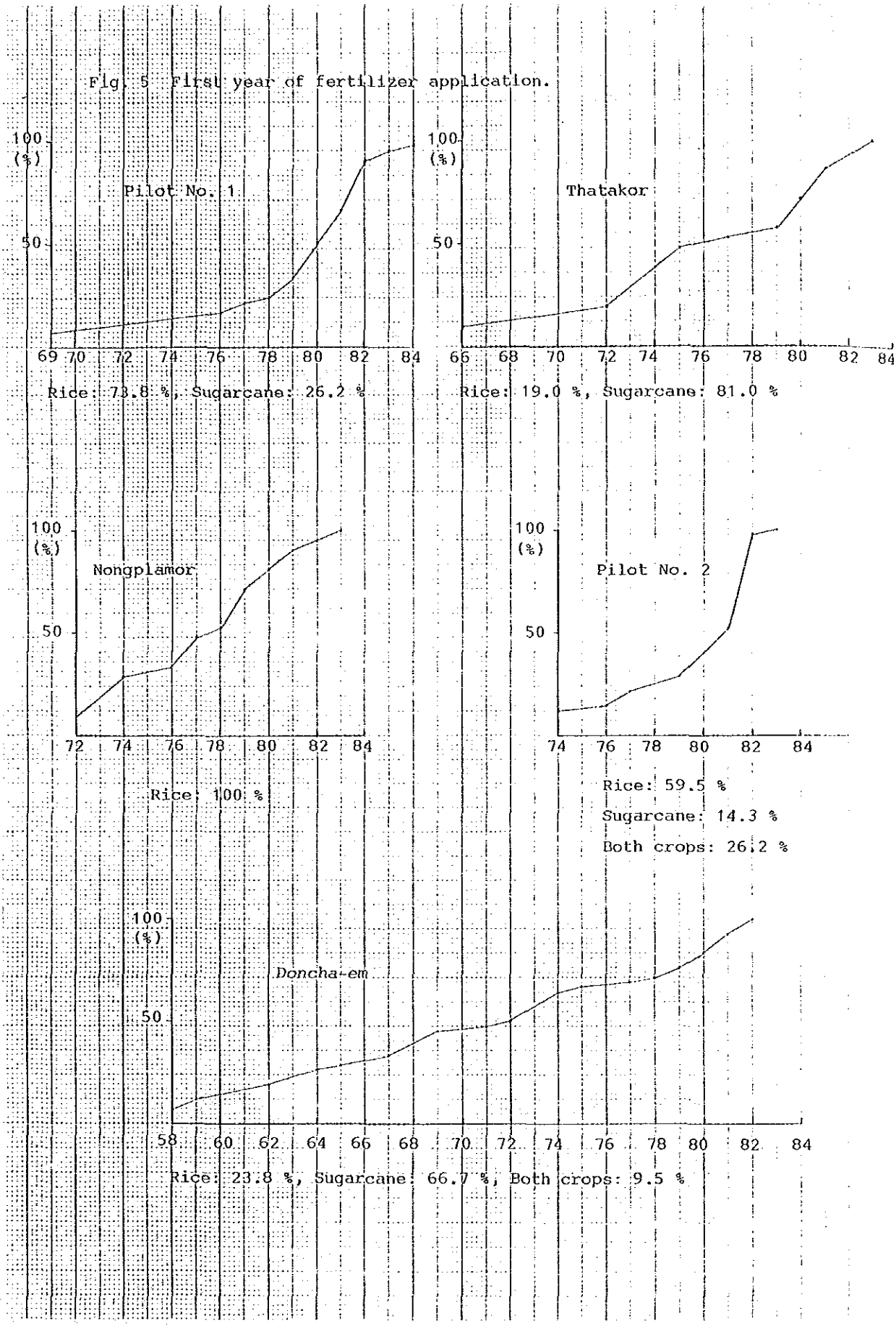


Table 6 Change of fertilizer use.

		Wet season		Dry season	
		% used	Cost (Baht/rai)	% used	Cost (Baht/rai)
Pilot No. 1	1981	76.2	87.8(32)	100.0	146.7(16)
	1983/84	90.5	77.5(38)	100.0	112.8(40)
Thatakor	1981	38.1	43.9(8)	100.0	149.3(6)
	1983/84	52.4	78.5(11)	100.0	161.4(19)
Nongplamor	1981	100.0	78.2(21)	-	-
	1983/84	95.2	80.3(20)	-	-
Pilot No. 2	1981/82	71.4	84.0(30)	96.6	103.0(28)
	1983/84	97.6	136.3(41)	100.0	140.8(42)
Doncha-em	1981/82	59.5	99.9(25)	96.9	137.7(31)
	1983/84	69.0	126.6(29)	100.0	147.0(41)

Note: Figures in brankets are number of farmers reporting.

The average cost of fertilizer (Baht/rai) was more in dry season in all the areas and in the both survey years. The average cost increased except that of Pilot No. 1 (decreased both wet and dry seasons). At present, farmers spend about 80 Baht of fertilizer to 1 rai of paddy field in Pilot No. 1, Thatakor, and Nongplamor, 135 Baht in Pilot No.2, and 125 Baht in Doncha-em in wet season. For dry season rice, it is about 120 Baht for Pilot No. 1, 160 Baht for Thatakor, 140 Baht for Pilot No. 1, and 150 Baht for Doncha-em.

Fig. 6 shows the first year of using chemical in farming. Some farmers in Doncha-em first used chemicals in 1958, followed by some in Pilot No. 2 in 1963, Thatakor in 1964, Pilot No. 1 in 1969, and Nongplamor in 1974. Although kind of crop was not asked during the interview, the contrasting data of Nongplamor indicate that more farmers first used chemicals to the sugarcane plant in other areas. So far, those who have experiences of using

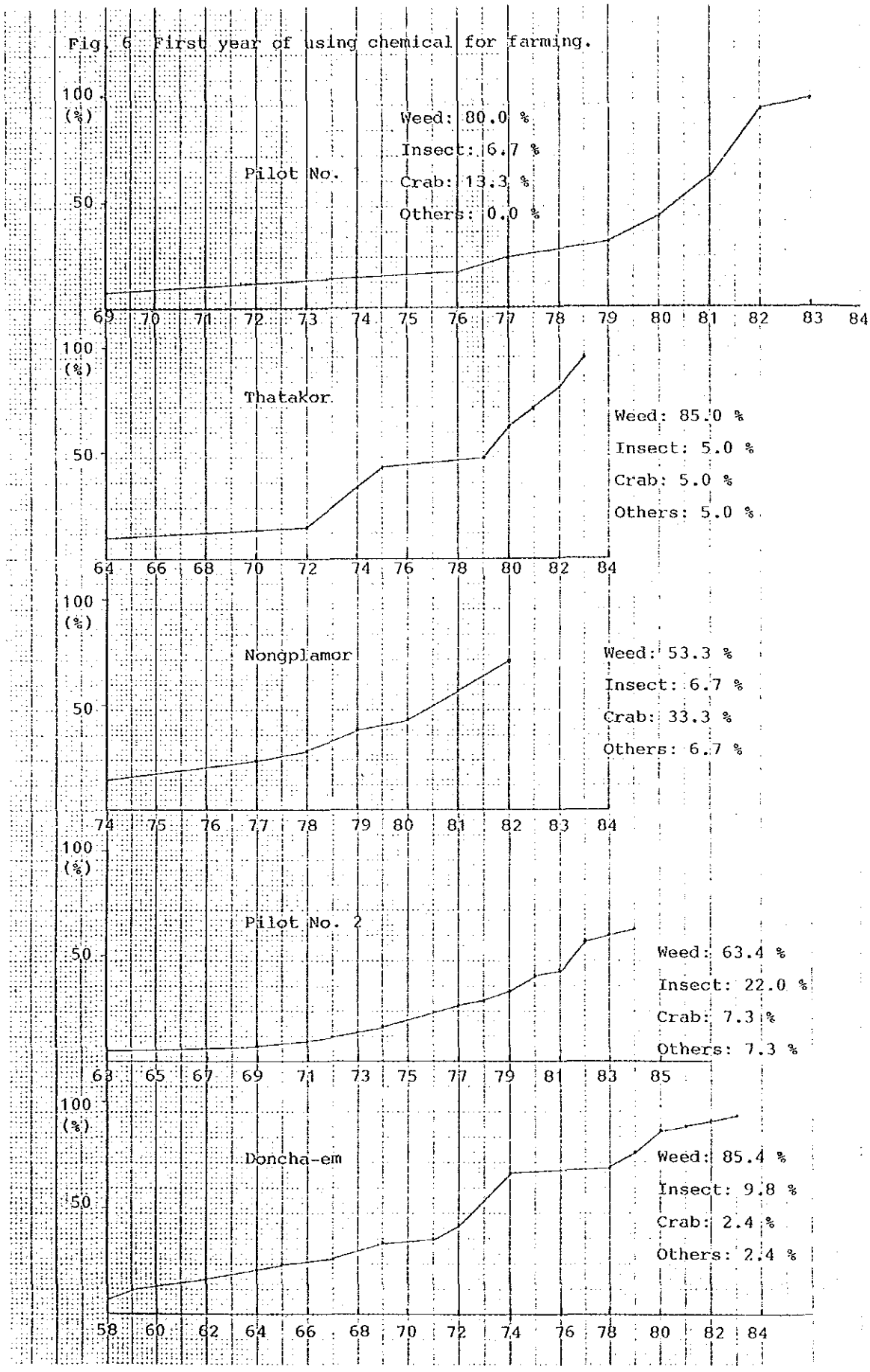


Fig. 6 First year of using chemical for farming.
100 (%)
50
Pilot No.
Weed: 80.0 %
Insect: 6.7 %
Crab: 13.3 %
Others: 0.0 %
69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84
100 (%)
50
Thatakor
Weed: 85.0 %
Insect: 5.0 %
Crab: 5.0 %
Others: 5.0 %
64 66 68 70 72 74 76 78 80 82 84
100 (%)
50
Nongplamor
Weed: 53.3 %
Insect: 6.7 %
Crab: 33.3 %
Others: 6.7 %
74 75 76 77 78 79 80 81 82 83 84
100 (%)
50
Pilot No. 2
Weed: 63.4 %
Insect: 22.0 %
Crab: 7.3 %
Others: 7.3 %
63 65 67 69 71 73 75 77 79 81 83 85
100 (%)
50
Doncha-em
Weed: 85.4 %
Insect: 9.8 %
Crab: 2.4 %
Others: 2.4 %
58 60 62 64 66 68 70 72 74 76 78 80 82 84

chemicals are 98 percent of the farmers in Pilot No. 1, 95 percent of them in Thatakor, 71 percent in Nongplamor, 86 percent in Pilot No. 2, and 93 percent in Doncha-em.

The main purpose of initial chemical use was weed control in all the areas, followed by insect or crab control. Only one farmers in Doncha-em mentioned that he first used the chemical for rat control (included in others).

Table 7 shows the practice of chemical use in the 2 surveys. Percent of the farmers using chemicals decreased in all the areas excep in Pilot No. 1, where more than 90 percent of the farmers used chemicals in the both crop seasons of 1983/84 (increased from 86 % to 91 % in wet and 88 % to 93 % in dry). For the 1983/84 rice cultivations, rather low percent of the farmers used chemicals in other 4 areas of Thatakor (decreased from 86 % to 52 % in wet and 83 % to 74 % in dry season), Pilot No. 2 (95 % to 64 % and 83 % to 71 %), Doncha-em (76 % to 67 % and 66 % to 51 %), and Nongplamor (86 % to 62 % in wet).

Table 7 Change of chemical use.

		Wet season		Dry season	
		% used	Cost (Baht/rai)	% used	Cost (Baht/rai)
Pilot No. 1	1981	85.7	13.1(36)	85.7	17.0(14)
	1983/84	90.5	22.3(38)	92.5	21.5(37)
Thatakor	1981	85.7	13.4(18)	83.3	65.5(5)
	1983/84	52.4	29.8(11)	73.7	56.7(14)
Nongplamor	1981	85.7	9.0(18)	-	-
	1983/84	61.9	12.6(13)	-	-
Pilot No. 2	1981/82	95.2	12.4(40)	82.8	18.5(24)
	1983/84	64.3	20.6(27)	71.4	21.0(30)
Doncha-em	1981/82	76.2	20.3(32)	65.6	23.4(21)
	1983/84	66.7	17.1(28)	51.2	28.6(21)

Note: Figures in brankets are number of farmers reporting.

For wet season rice, the average cost of chemicals (Baht/rai) increased for Pilot No. 1 (13 Baht/rai to 22 Baht/rai), Thatakor (13 Baht to 30 Baht), Nongplamor (9 Baht to 13 Baht), and Pilot No. 2 (12 Baht to 21 Baht), but decreased for Doncha-em (20 Baht to 17 Baht). That of dry season rice was rather high for Thatakor, although it reduced some in the 3 years (66 Baht to 57 Baht). For the dry season rice, the cost increased in other areas of Pilot No. 1 (17 Baht to 22 Baht), Pilot No. 2 (19 Baht to 21 Baht), and Doncha-em (23 Baht to 29 Baht).

V. Use of Agricultural Machineries

Fig. 7 shows the percent of farmers done land preparation by either own machines or in contract. Some farmers in Doncha-em first used machines in 1964, followed by some of them in Thatakor in 1969, in Pilot No. 1 in 1972, Pilot No. 2 in 1974, then Nongplamor in 1977. Although kind of crop was not asked, the introduction of machines for land preparation was apparently earlier to sugarcane fields than to paddy fields. Those who volunteerly specified the crop always mentioned that it was earlier to the sugarcane field.

By the year of 1983, all the farmers had used machines for the land preparation. However, there were 2 farmers (one each in Thatakor and Nongplamor) who had used water baffalos for the land preparation of part of the paddy fields in 1983/84 crop seasons. Those who have power tillers are 50 percent of Pilot No. 1, 57 percent of Thatakor, 43 percent of Nongplamor, 50 percent of Pilot No. 2, and 54 percent of Doncha-em at present. In addition to the power tillers, there are 2 percent in Pilot No. 1 and 17 percent in Doncha-em who have tractors. Those who ask land preparation in contract usually pay around 200 Baht per rai including ploughing and puddling.

Fig. 8 shows the first year of threshing rice by machines (mostly

Fig. 7 First year of land preparation by farm machine.

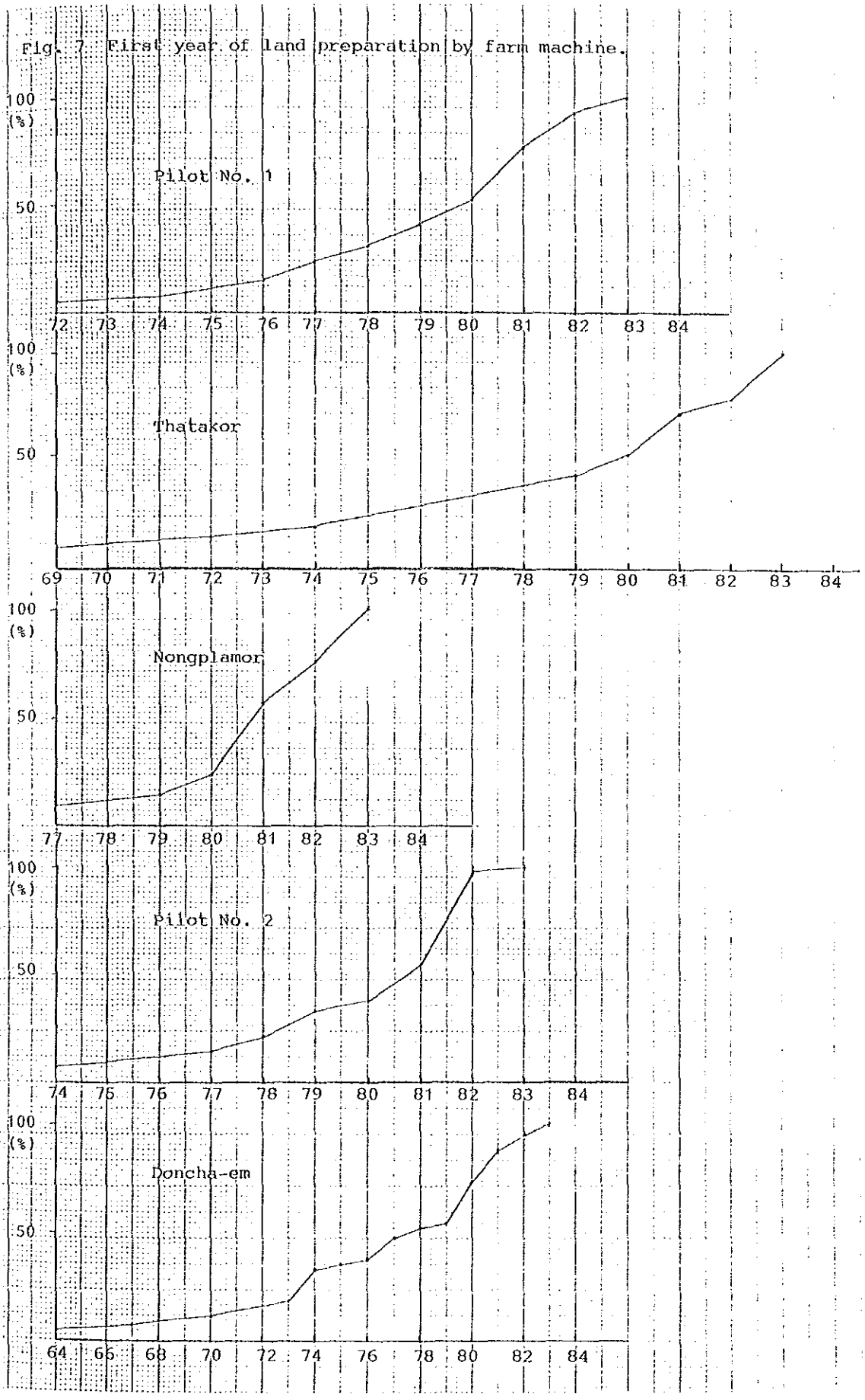
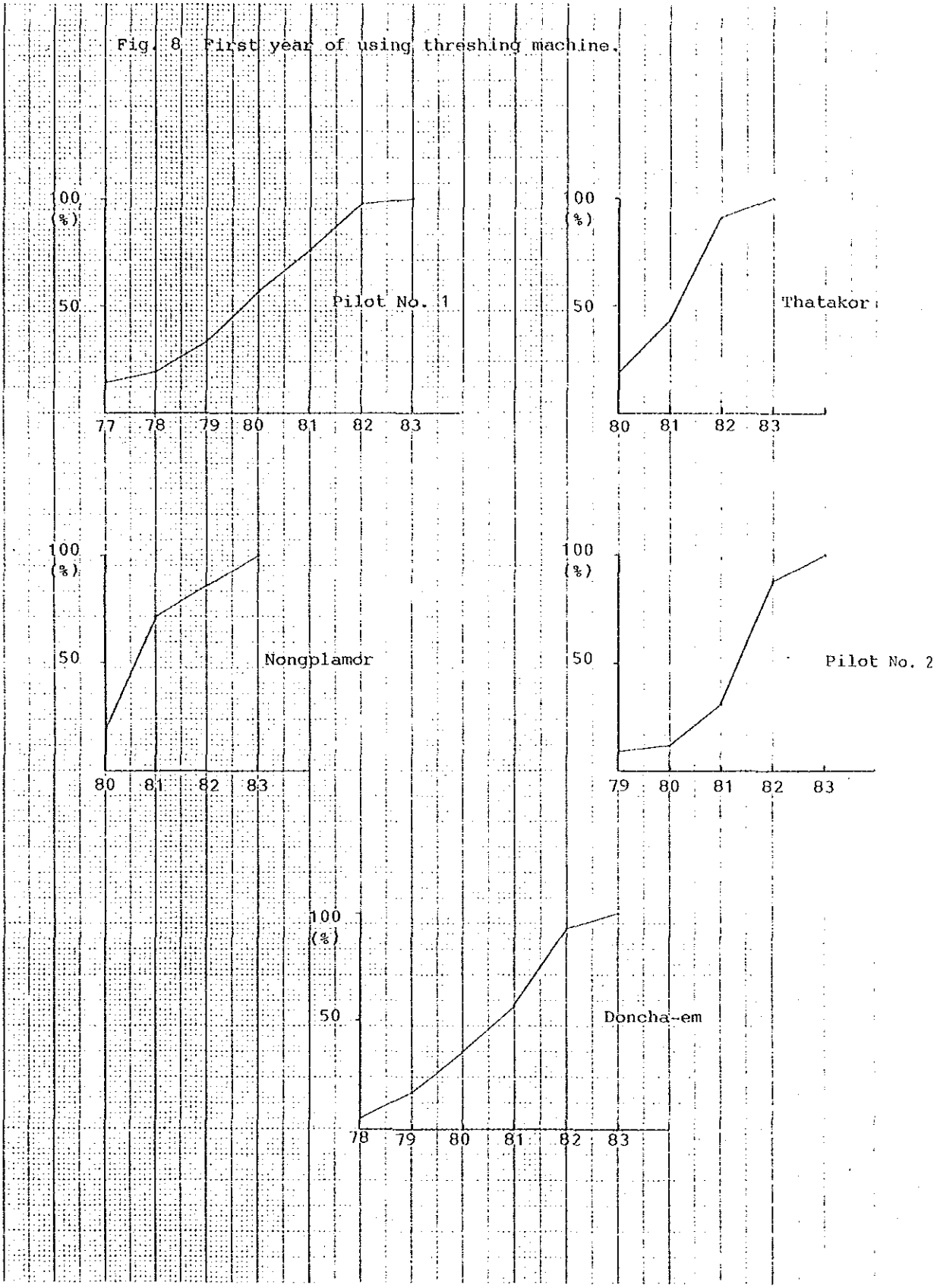


Fig. 8 First year of using threshing machine.



done in contract). Some farmers in Pilot No. 1 first used the thresher in 1977, followed by some in Doncha-em in 1978, in Pilot No. 2 in 1979, and in Thatakor and Nongplamor in 1980. Major type of the thresher in the area is that of developed at IRRI (International Rice Research Institute), and it is usually loaded on the vehicles. Same as that of land preparation, all the farmers in the areas had used threshing machines by 1983. Among the 168 farmers interviewed in this survey, a farmer in Pilot No. 2 and 4 farmers in Doncha-em have threshing machines. Other farmers ask threshing in contract at the condition of 30 kg or 40 kg per ton of threshed rice.

VI. Change of Average Rice Yield

Rice yield is influenced by many factors such as climate, soil, water, seed, management, and so on. Much attention should be paid when comparing the yields of different years or different places.

Table 8 presents the average yields of the 5 areas in the 2 surveys. Increased average yields were observed in all the areas except that of wet season in Doncha-em (decreased by 6 kg/rai) and dry season in Thatakor (decreased by 29 kg/rai). The highest yield increment in wet season rice was that of Pilot No. 2 (64 kg/rai), followed by Thatakor (36 kg/rai). The yield increment in dry season was highest for Doncha-em (168 kg/rai), followed by Pilot No. 2 (110 kg/rai). There was not much difference in the average yield between the years in other areas.

For the wet season rice, the average yield was lowest for Nongplamor in the both surveys (451 kg/rai in 1981 and 465 kg/rai in 1983), and highest for Pilot No. 2 (508 kg/rai in 1981 and 571 kg/rai in 1983). For the dry season rice, the lowest average were for Doncha-em in 1981 (505 kg/rai) and for Pilot No. 1 in 1983 (576 kg/rai), and the highest was for Thatakor (747 kg/rai in 1981 and 718 kg/rai in 1984). Standard deviations of the average

yields show that the yields in Nongplamor, Pilot No. 2 and Doncha-em ranged more widely in 1983/84. It became smaller for Pilot No. 1 (in both crop seasons) and the dry season of Thatakor.

Table 8 Average rice yields (kg/rai).

		Wet season	Dry season
Pilot No. 1	1981	480.3(107.7)	567.0(156.0)
	1983/84	499.7(95.2)	576.1(110.6)
Thatakor	1981	461.4(79.8)	747.2(172.1)
	1983/84	497.4(105.0)	718.4(137.9)
Nongplamor	1981	451.0(63.0)	-
	1983/84	465.2 (101.1)	-
Pilot No. 2	1981/82	507.5(88.9)	578.9(148.9)
	1983/84	571.3(148.1)	688.6(155.5)
Doncha-em	1981/82	494.4(98.4)	505.2(123.9)
	1983/84	488.6(154.4)	672.7(178.1)

Note: Figures in brankets are standard deviations.

Table 9 shows the rice yields of the pilot areas after the completion of land consolidation. The yield level was estimated by about 100 samples from each of the pilot areas in each crop season. One sample area was 4 m^2 in the circle. It shows that the average yield of Pilot No. 2 had more steadly increased. The yield of Pilot No. 1 was more fractuating especially in dry season.

Land consolidation work of the upper and lower streams of Pilot No. 1 has influenced the irrigation schedule , then the planting season is usually delayed in the area. The delayed planting season has apparently affected the yield level of Pilot No. 1. Furthermore, since irrigation water of Pilot No.

Table 9 Average rice yields in different crop seasons (kg/ha)[a].

1. Pilot area No. 1

	Dry season			Wet season		
	Highest	Lowest	Average	Highest	Lowest	Average
1980	6,100	1,325	4,125	4,625	1,625	3,134
1981	6,250	1,750	3,862 (3,544)	4,825	2,165	3,294 (3,002)
1982	6,042	1,258	3,639	5,728	1,409	3,432
1983	7,703	3,003	5,253	5,675	2,060	3,699 (3,123)
1984	7,026	1,431	4,184 (3,601)	7,388	1,648	3,680

2. Pilot area No. 2

	Dry season			Wet season		
	Highest	Lowest	Average	Highest	Lowest	Average
1981				4,943	2,270	3,556 (3,172)
1982	5,750	2,062	3,558 (3,618)	5,550	1,289	3,738
1983	6,751	2,078	4,485	5,508	2,101	3,684 (3,571)
1984	6,099	1,894	4,551 (4,304)	6,228	2,673	4,373

Notes: [a] Obtained by the Agricultural Demonstration Center.

Figures in brankets are those from the farm surveys.

1 is supplied through pumping up water from the main canal to the lateral canal, then troubles of the pump also influence the water supply. These external factors have apparently affected the yield of Pilot No. 1. Although it is difficult to rationalize these external factors, rather low yield of Pilot No. 1 is not due to the poor farming practice.

VII. Change of Cost and Return in Rice Farming

Average cost of wet and dry season rice cultivation (Baht/rai) is given in Table 10 and Table 11, respectively. The cost includes that of hired labour, machine rental, fuel and lubricant, repair and maintenance, seed, and chemical, but not includes that of land rent and irrigation water.

The average cost of wet season rice was decreased for Pilot No. 1 (429 Baht to 379 Baht), Thatakor (383 Baht to 292 Baht), and Nongplamor (478 Baht to 351 Baht), but increased for Pilot No. 2 (390 Baht to 440 Baht) and Doncha-em (445 Baht to 517 Baht). The average cost of dry season rice shows the similar trend. The cost was decreased for Pilot No. 1 (506 Baht to 406 Baht) and Thatakor (504 Baht to 417 Baht), but increased for Pilot No. 2 (429 Baht to 434 Baht) and Doncha-em (490 Baht to 525 Baht).

Among the cost mentioned above, the hired labour cost was decreased in all the area regardless the seasons. Rather high cost of rice cultivation and the increase of average cost in Doncha-em were partly due to the increased cost of repair and maintenance for wet season and the increased percent of farmers spending the maintenance cost in dry season. Increased average cost in Pilot No. 2 was partly due to the increased fertilizer cost (103 Baht to 141 Baht for wet season and 84 Baht to 136 Baht for dry season rice).

Table 12 and Table 13 shows the cost and return of wet and dry season rice, respectively. For the wet season rice, the gross income per rai was about 1,500 Baht, and it did not change widely for Pilot No. 1 (1,552 Baht to

Table 10 Average cost of wet season rice cultivation (Baht/rai)[a].

		Hired labour	Machine rental	Fuel & lubricant	Repair & maintenance	Seed	Fertilizer	Chemical	Total
Pilot No. 1	1981	148.0(27)	187.4 (40)	55.6(19)	88.0(9)	32.7(42)	87.8(32)	13.1(36)	428.5(42)
	1983	97.9(22)	172.5(42)	39.5(26)	22.4(7)	36.9(42)	77.5(38)	22.3(38)	378.8(42)
Thatakor	1981	194.2(15)	96.5(19)	61.4(18)	89.9(9)	37.6(21)	43.9(8)	13.4(18)	383.0(21)
	1983	43.6(15)	124.6(21)	44.7(13)	39.3(9)	35.1(21)	78.5(11)	29.8(11)	292.1(21)
Nongplamor	1981	204.4(17)	144.4(21)	61.6(17)	26.8(9)	20.8(21)	78.2(21)	9.0(18)	477.9(21)
	1983	107.4(16)	135.5(20)	38.7(14)	20.0(8)	22.3(21)	80.3(20)	12.6(13)	350.9(21)
Pilot No. 2	1981	180.5(32)	160.3(30)	52.5(18)	57.5(8)	32.3(42)	84.0(30)	12.4(40)	389.6(42)
	1983	94.3(27)	141.2(42)	45.6(25)	65.9(17)	38.1(42)	136.3(41)	20.6(27)	440.0(42)
Doncha-em	1981	173.4(32)	148.6(34)	61.7(24)	102.9(19)	36.2(42)	99.9(25)	20.3(32)	445.3(42)
	1983	165.8(26)	135.2(38)	57.2(27)	256.0(19)	40.3(42)	126.6(29)	17.1(28)	516.7(42)

Notes: [a] Exclude land rent fee and irrigation water fee.

Figures in brankets are number of farmers reporting.

Table 11 Average cost of dry season rice cultivation (Baht/rai)[a].

		Hired labour	Machine rental	Fuel & lubricant	Repair & maintenance	Seed	Fertilizer	Chemical	Total
Pilot No. 1	1981	136.2(9)	213.6(16)	50.5(6)	33.3(1)	33.5(16)	146.7(16)	17.0(14)	506.3(16)
	1984	50.6(20)	177.5(40)	37.8(22)	49.9(4)	44.7(40)	112.8(40)	21.5(37)	406.0(40)
Thatakor	1981	152.5(4)	91.2(5)	93.5(5)	0.0	55.4(6)	149.3(6)	65.5(4)	504.0(6)
	1984	64.8(7)	140.8(19)	44.8(12)	82.6(4)	40.2(19)	161.4(19)	56.7(14)	416.7(19)
Nongplamor	1981	-	-	-	-	-	-	-	-
	1984	-	-	-	-	-	-	-	-
Pilot No. 2	1982	185.2(19)	118.0(28)	55.4(18)	108.4(3)	33.7(29)	103.0(28)	18.5(24)	429.3(29)
	1984	86.4(23)	150.4(42)	42.6(25)	49.1(10)	44.0(42)	140.8(42)	21.0(30)	434.6(42)
Doncha-em	1982	163.2(22)	141.4929)	61.1(18)	240.4(4)	36.9(32)	137.7(31)	23.4(21)	490.4(32)
	1984	145.3(22)	151.2(38)	52.3(27)	197.6(14)	42.9(41)	147.0(41)	28.6(21)	524.6(41)

Notes: [a] Exclude land rent fee and irrigation water fee.

Figures in brankets are number of farmers reporting.

Table 12 Cost and return of wet season rice.

		Average yield (kg/rai)	Planted area (rai/farm)	Unit price (Baht/ton)	Gross income (Baht/rai)	Total cost (Baht/rai)[a]	Net income (Baht)	
							Per rai	Per farm
Pilot No. 1	1981	480.3	16.22	3,232.1	1,552.4	428.5 (27.6)[b]	1,123.9	18,299.7 (42)[c]
	1983	499.7	19.34	3,066.0	1,532.1	378.8 (24.7)	1,153.3	22,304.8 (42)
Thatakor	1981	461.4	26.24	3,300.0	1,522.6	383.0 (25.2)	1,139.6	29,903.1 (21)
	1983	497.4	23.00	3,071.4	1,527.7	292.1 (19.1)	1,235.6	28,418.8 (21)
Nongplamor	1981	451.0	26.19	3,219.1	1,451.8	477.9 (32.9)	973.9	25,506.4 (21)
	1983	465.2	27.24	3,316.7	1,542.9	350.9 (22.7)	1,192.0	32,470.1 (21)
Pilot No. 2	1981	507.5	14.79	3,150.0	1,598.6	389.6 (24.4)	1,209.0	17,881.1 (42)
	1983	571.3	14.88	3,026.4	1,729.0	440.0 (25.4)	1,289.0	19,180.3 (42)
Doncha-em	1981	494.4	14.46	3,259.1	1,611.3	445.3 (27.6)	1,166.0	16,860.4 (42)
	1983	488.6	16.64	3,069.1	1,499.6	516.7 (34.5)	982.9	16,355.5 (42)

Notes: [a] Include the cost of hired labour, machine rental, fuel and lubricant, repair and maintenance, seed, fertilizer, and chemical, but not include that of land rent and irrigation water.

[b] Percent of the cost to the gross income.

[c] Number of farmers reporting.

Table 13 Cost and return of dry season rice.

		Average yield (kg/rai)	Planted area (rai/farm)	Unit price (Baht/ton)	Gross income (Baht/rai)	Total cost (Baht/rai)[a]	Net income (Baht)	
							Per rai	Per farm
Pilot No. 1	1981	567.0	7.53	3,381.3	1,917.2	506.3 (26.4)[b]	1,410.9	10,624.1 (16)[c]
	1984	576.1	15.38	3,138.2	1,808.5	406.0 (22.4)	1,402.5	21,570.5 (40)
Thatakor	1981	747.2	4.67	3,108.3	2,322.5	504.0 (21.7)	1,818.5	8,492.4 (6)
	1984	718.4	7.26	3,021.1	2,170.4	416.7 (19.2)	1,753.7	12,731.9 (19)
Nongplamor	1981	-	-	-	-	-	-	-
	1984	-	-	-	-	-	-	-
Pilot No. 2	1982	578.9	7.93	2.293.1	1,327.5	429.3 (32.3)	898.2	7,122.7 (29)
	1984	688.6	12.37	3,064.3	2,110.1	434.6 (20.6)	1,675.5	20,725.9 (42)
Doncha-em	1982	505.2	8.56	2,439.1	1,232.2	490.4 (39.8)	741.8	6,350.0 (32)
	1984	672.7	11.51	3,234.2	2,175.6	524.6 (24.1)	1,651.0	19,003.0 (41)

Notes: [a] Include the cost of hired labour, machine rental, fuel and lubricant, repair and maintenance, seed, fertilizer, and chemical, but not include that of land rent and irrigation water.

[b] Percent of the cost to the gross income.

[c] Number of farmers reporting.

1,532 Baht) and Thatakor (1,523 Baht to 1,528 Baht). However, it was increased to some extentent for Nongplamor (1,452 Baht to 1,543 Baht) and Pilot No. 2 (1,543 Baht to 1,729 Baht), but decreased for Doncha-em (1,611 Baht to 1,500 Baht). For the dry season rice, the gross income was rather decreased for Pilot No. 1 (1,917 Baht to 1,809 Baht) and Thatakor (2,323 Baht to 2,170 Baht), but greatly increased for Pilot No. 2 (1,328 Baht to 2,110 Baht) and Doncha-em (1,232 Baht to 2,176 Baht).

Although the average yield affected the change of gross income to some extent, the main reason of the change was due to the difference of the unit price of rice between the survey years. The unit price of 1981 dry season rice (Pilot No. 1 and Thatakor) was rather high (3,381 Baht/ton and 3,108 Baht/ton, respectively), but the proce of 1982 dry season rice (Pilot No. 2 and Doncha-em) was quite low (2,293 Baht/ton and 2,439 Baht/ton, respectively) comparing to that of 1984 dry season (ranged 3,021 Baht/ton for Thatakor to 3,234 Baht/ton for Doncha-em).

Percent of the cost to the gross income of wet season rice was decreased for Pilot No. 1 (28 % to 25 %), Thatakor (25 % to 19 %), and Nongplamor (33 % to 23 %), but increased for Pilot No. 2 (24 % to 25 %) and Doncha-em (28 % to 35 %). On the other hand, that of dry season was decreased in all the areas of Pilot No. 1 (26 % to 22 %), Thatakor (22 % to 19 %), Pilot No. 2 (32 % to 21 %), and Doncha-em (40 % to 24 %).

For the wet season rice, the net income per rai did not change much for Pilot No. 1 (1,124 Baht to 1,153 Baht), rather increased for Pilot No. 2 (1,209 Baht to 1,289 Baht) and Thatakor (1,140 Baht to 1,236 Baht), and more increased for Nongplamor (974 Baht to 1,192 Baht), but decreased for Doncha-em (1,166 Baht to 983 Baht). The net income of dry season rice had been almost the same for Pilot No. 1 (1,411 Baht to 1,403 Baht), slightly decreased for Thatakor (1,819 Baht to 1,754 Baht), but it was greatly increased for