CROPPING SYSTEMS DEVELOPMENT AS A COMPONENT OF THE FARMING SYSTEM APPROACH IN THE NORTHEAST RAINFED AGRICULTURAL DEVELOPMENT(NERAD) PROJECT : PROGRESS AND LESSONS LEARNED

Iain A. Craig [1]

Introduction

NERAD is attempting to develop a farming systems research and extension (FSRE) approach appropriate for agricultural development in Northeast Thailand. It is conducting many, diverse activities which are being implemented by 9 line agencies of the Ministry of Agriculture in 9 Tambons in Northeast Thailand (Table 1).

FSRE has many different meanings to different people but as far as the cropping systems component of NERAD is concerned the major elements of such an approach are in line with those described by Panothai (1984) :

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[1] Farming Systems Specialist, University of Kentucky Technical Assistance Team, NERAD Project, Northeast Regional Office of Agriculture, Tha Phra, Khon Kaen, Thailand.

Table 1

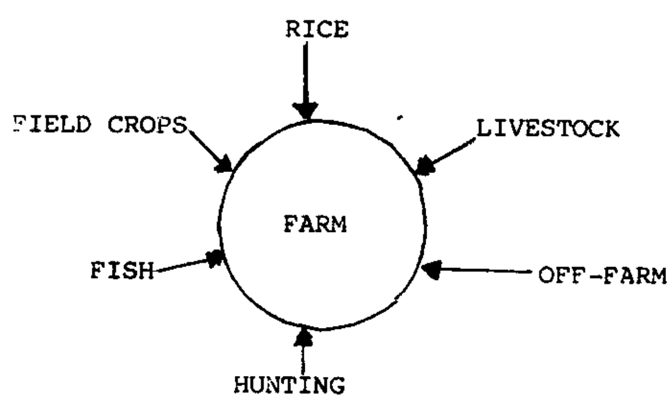
MOAC Department	NERAD Activities
DOA Department of Agiculture	Cropping pattern trials, component technology trials, fruit tree development, sericulture improvement, improved rice variety trials
DOAE Department of Agricultural Extension	Specialist farmer training, Demonstration field days, Technical support and follow up for project activities
OAE Office of Agicultural Economics	Farm record keeping, mini-evaluations, economic analysis of trials
DLD Department of Land Development	Paddy land shaping, Compost demonstrations, Weather data collection, Swamp rehabilitation, Embankment structures, Submerged dams, Weirs, Shallow wells
CPD Cooperative Promotion Department	Market meetings, market price surveys, group procurement
RFD Royal Forestry Department	Village woodlots, pasture improvement, watershed management
DOLD Department of Livestock	Native chicken improvement, Cattle/Buffalo improvement, Pasture improvement
DOF Department of Fisheries	Fish Production improvement, Village aquaculture training, Fish in the paddy

* An FSRE approach is an integrated effort by research and extension personnel who should be jointly involved during all phases of the work.

INTEGRATED:

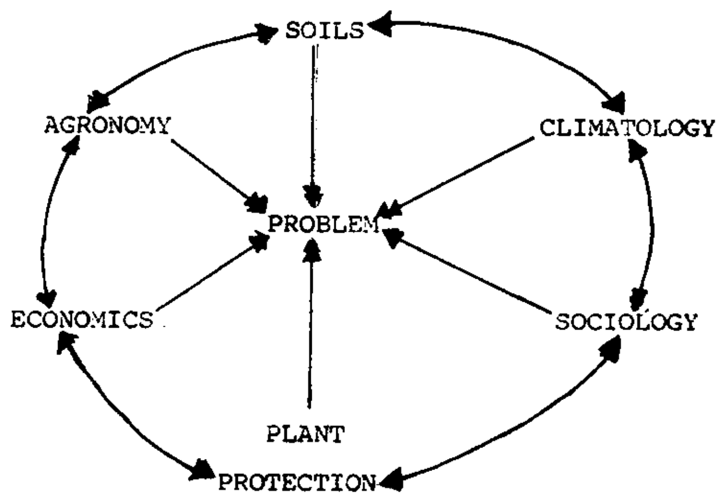
* FSRE is an holistic approach which should consider all important interactions within the farm-family system.

HOLISTIC:



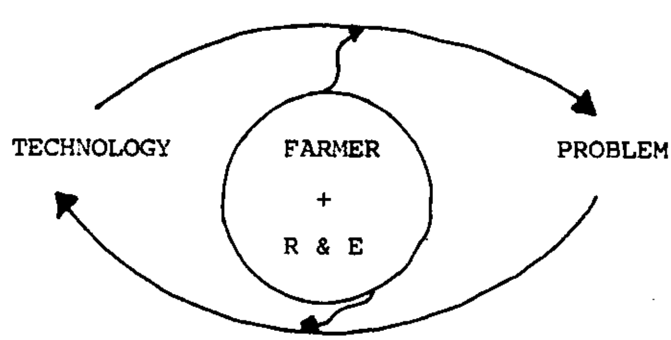
* FSRE work should be conducted in an interdisciplinary manner that custs across departmental and divisional boundaries. It does not replace specific, single discipline research, however, but should complement it especially in the area of assisting in the definition of research priorities.

INTERDISCIPLINARY :



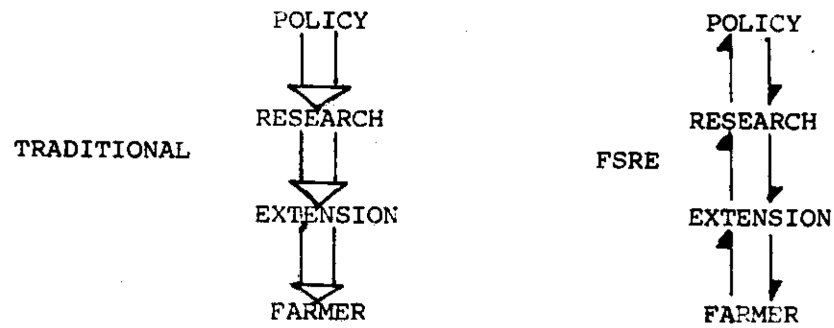
* It focuses at the farm level and should include 'on-farm' trials and research, where relevant, to gain a better understanding of real problems and of the performance of new technologies under actual farm conditions. The farmer should be considered a partner in this phase of the research and should be actively involved throughout.

ON-FARM:

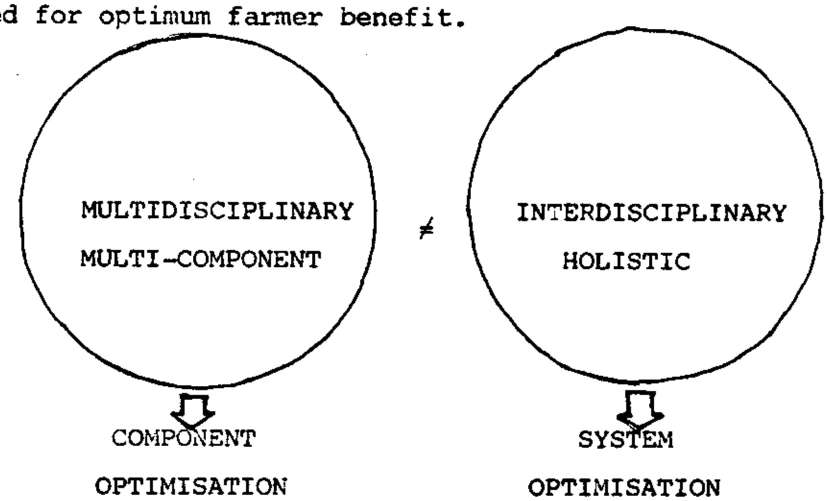


*It has stronger 'bottom-up' orientation than the traditional technology based approach to development and thus requires a greater delegation of responsibility to junior scientists and technicians.

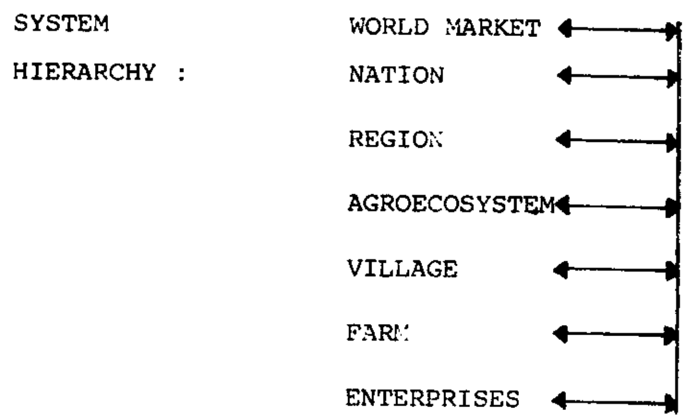
BOTTOM-UP:



There are also 2 characteristics of NERAD that are sometimes mistakenly interpreted as being part of the FSRE approach. First, NERAD is often viewed as an fSRE project merely because it contains a large number of diverse activities being implemented by personnel from many disciplines. However, unless the different disciplines are interacting and working in an integrated manner in order to ensure that different activities complement and support each other, then the 'systemic properties' cannot be manipulated for optimum farmer benefit.



Secondly, over-emphasis of the farm system by some FSRE proponents can either preclude some potential development opportunities or reduce or even negate the benefit of some on farm activities by failing to consider off-farm interactions. The farm household system is undoubtedly much larger than merely the land area for which title is held. The northeastern farmer views surrounding forest or common land, roadside verges, water sources and off-farm employment opportunities as potential resources within his system.



There are a number of key agro-ecological characteristics of Northeast Thailand that have important implications for FSRE programs in the region. Some consideration of how these implications are translated into strategic and tactical responses within NERAD's cropping systems component will be made here.

First, the subsistence rice crop is undoubtedly the key to cropping systems development in the Northeast. If improvements can be made to the rice crop, then constraints will be removed enabling farmers to diversify their cropping activities. Conversely, any cropping system technology which interferes with the subsistence rice crop is unlikely to be successful (Craig and Pisone, 1985). Most of the major advances in rice-based cropping systems development throughout the world have come through the introduction of new rice varieties. In most cases these have been short duration, non-photoperiod-sensitive varieties enabling planting of rice to be adjusted for timely planting of pre or post-rice crops (Dalrymple, 1971; Carangal, 1977). However, in rainfed environments such as the Northeast, the flexibility of photoperiod sensitive rice is essential to ensure a crop and thus this type of breakthrough is unlikely. NERAD's focus has been moving more towards component technology work on rice itself and exploring the potential for stabilizing and increasing rice yields by selective pre and post rice crops.

Secondly, it would appear that northeastern farmers are highly skilled and their traditional practices are already well tuned to local agro-ecological conditions (KKU, 1982, a). The implication here is that rapid, revolutionary breakthroughs in cropping systems development are unlikely. NERAD's approach has been more of attempting to make small improvements to the farmers traditional practices in each locality based on the farmers' problems and taking account of the constraints facing them.

Many papers have stressed the extreme variability of agro-ecological and economic conditions overboth time and space in the Northeast (KKU, 1982, b). It is therefore unlikely that cropping systems can be developed which will give optimal returns every year or will be suitable for the entire region. Rather, the approach should attempt to identify for each specific location a series of low-risk, '<u>robust</u>' technologies which give at least adequate returns all years. These technologies will have to be low-cost and purchased-input levels should be adjusted towards risk minimization rather than yield maximization.

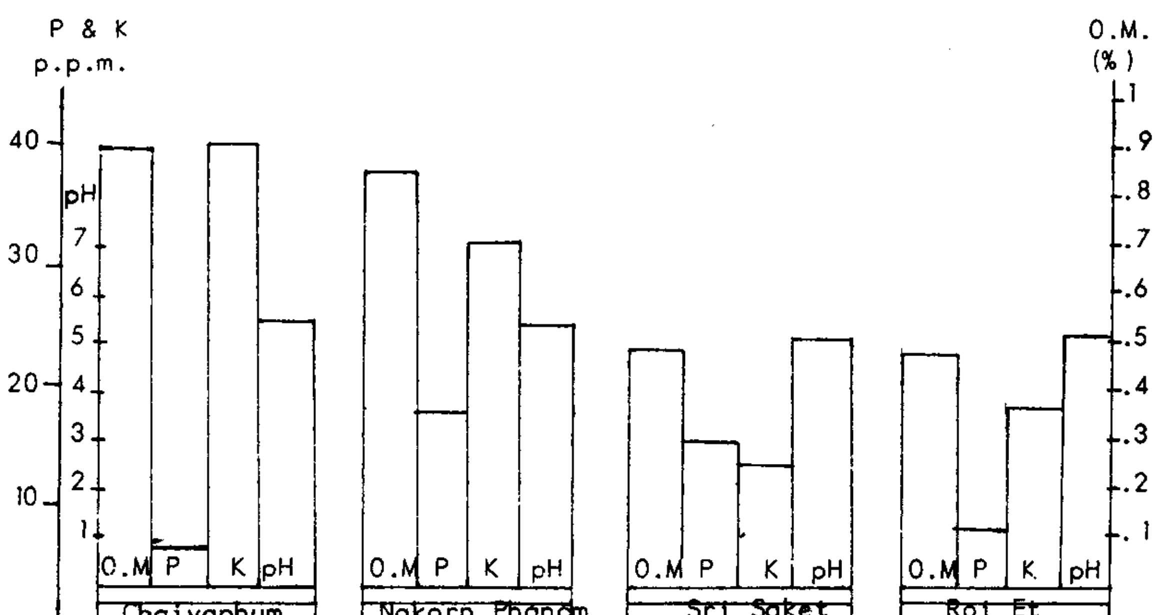
Finally, most of the cropping systems development work in the world to date has been in irrigated areas and has been synonymous with increasing cropping intensity (Andrews and Kassam, 1976; Anon., 1975; Dalrymple, 1971). There is always the danger, however, of over-emphasising cropping intensification as the major objective of this work especially in rainfed areas where the potential for more than one crop per year is often extremely limited. Previous papers have clearly shown that although there is a potential for multiple cropping in some situations in the Northeast, many of the current problems facing the traditional monocrop systems are extremely serious and warrant higher research priority than cropping intensification. It is anticipated that NERAD's cropping systems work in the future will focus more towards tackling these problems than attempting to increase cropping intensity per se.

Farmer Strategies

It would appear that the majority of the traditional cropping systems in the Northeast are 'exploitive' in nature and the farmers' strategy is essentially one of mining the natural soil fertility built up when the land was under forest-cover (Ragland, et aL, 1983). Purchased fertilizer in the rice crop is zero or minimal and the predominant upland systems of kenaf or cassava also generally reseive no fertilizer. A review of the soil fertility levels for 4 NERAD principal villages shown in Figure 1 gives some idea of how long this exploitation process has been going on in each Province.

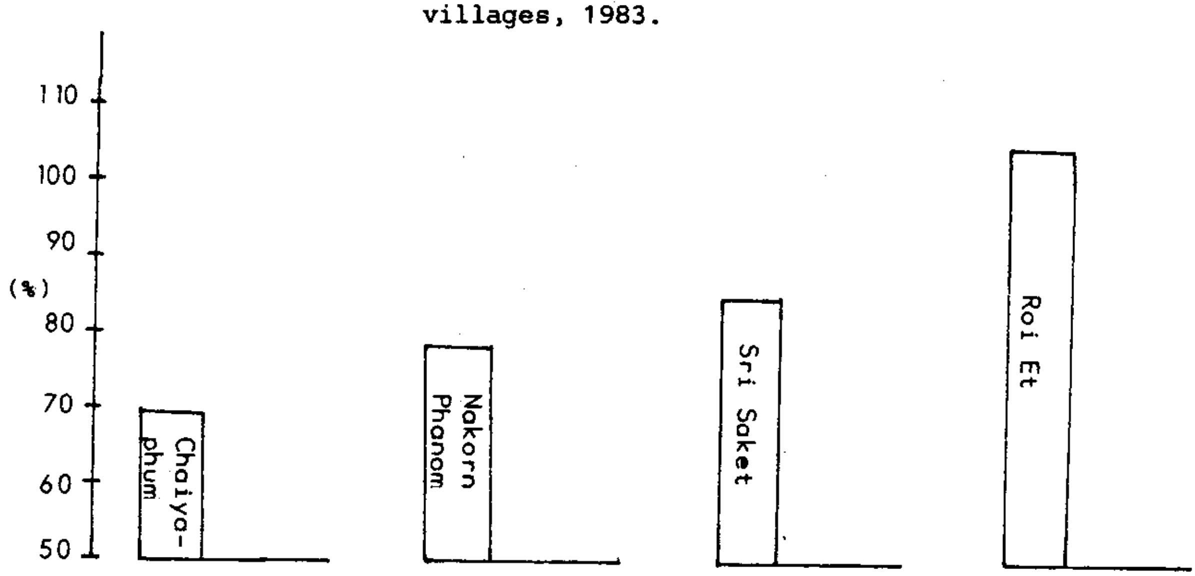
Combined soils analysis data for NERAD Principal Villages,1983

Figure 1.



In Roi Et, where the land has been cultivated for the longest time and where soil fertility levels are the lowest, cropping intensity (Figure 2.) is surprisingly the highest of all villages. This is due to a locally evelved strategy for dealing with declining nutrient levels and decreasing rice yields. Farmers commonly plant watermelon after rice, not with the primary objective of earning cash but more as a means of "stabilizing" rice yields through the residual fertility from the manure and fertilizer applied to the water melon plots which are rotated between fields from year to year in order to spread the benefit over all the paddy land.

Figure 2. Cropping intensity indices for NERAD principal villages, 1983.



In Sri Saket where fertility levels have also declined markedly the strategy appears to be one of spending more money on fertilizer applied directly to the rice crop (Figure 3). This has probably been made possible by the higher proportion of the rice harvest which is sold thus generating cash to purchase the fertilizer (Figure 4).

Figure 3. Money spent on fertilizer applied to rice for the NERAD principal villages, 1983.

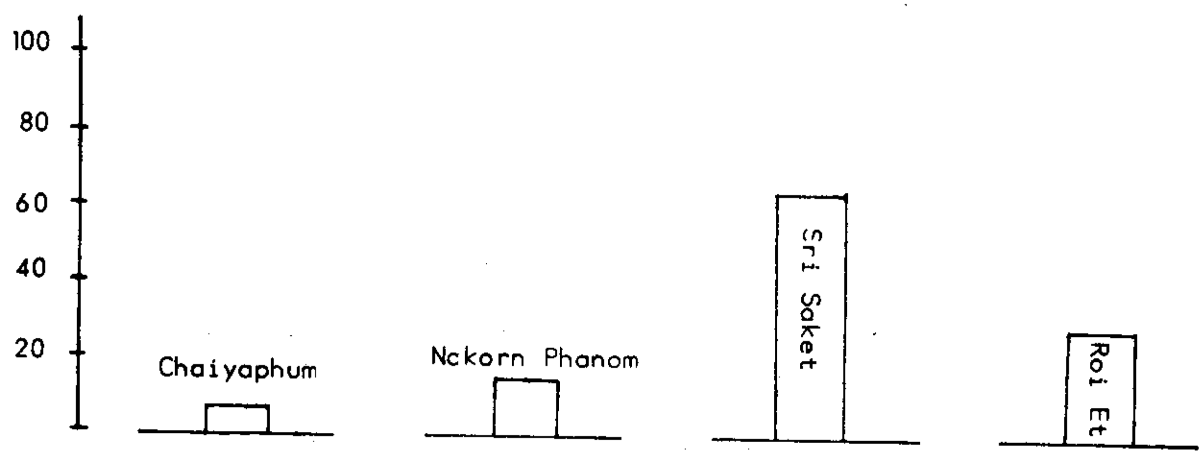
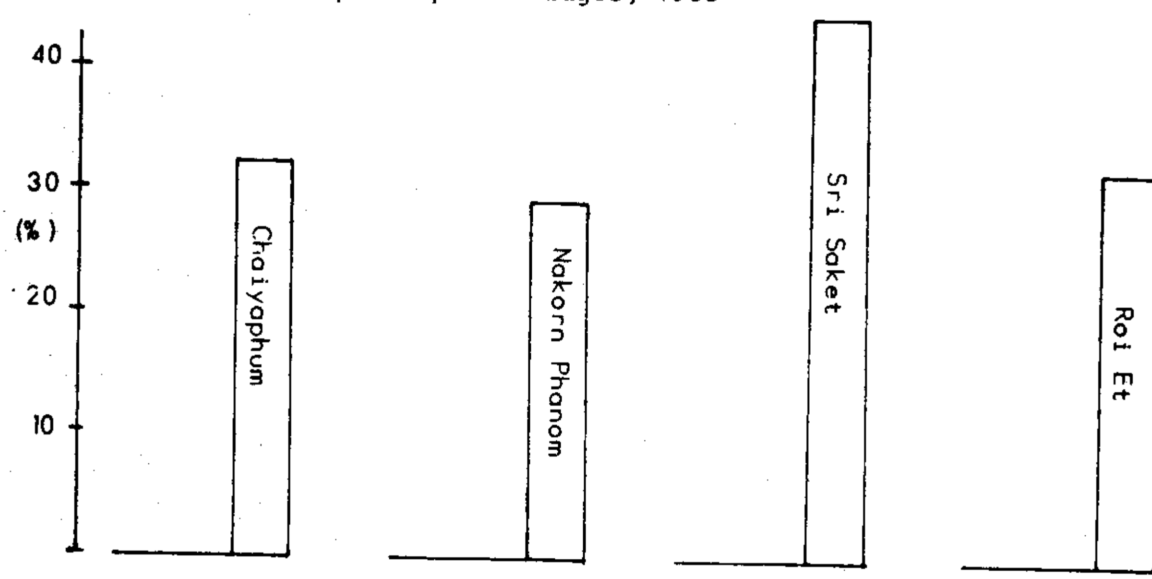
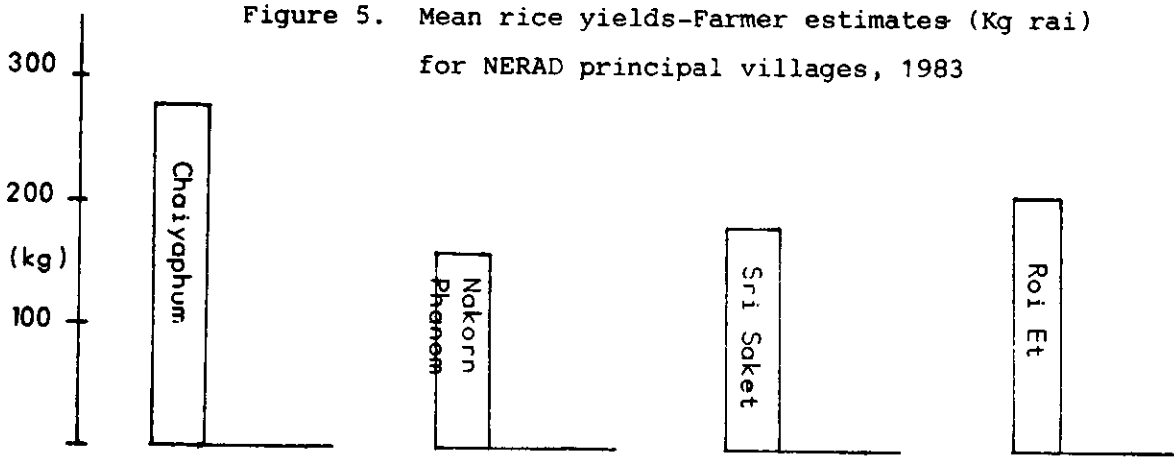


Figure 4. Percent of rice harvest sold in the NERAD principal villages, 1983



In Chaiyaphum and Nakorn Phanom where the land has been cropped for a shorter period, soil nutrients have not yet declined to such low levels and farmers are following the strategy of "mining" soil nutrients with continuous low input mono-cropping. Figure 5 indicates that all 3 strategies produce apporximately equivalent rice yeilds. However, the dominant strategy in Chaiyaphum and Nakorn Phanom of mining natural fertility is not sustainable in the long term.

Figure 5. Mean rice yields-Farmer estimates (Kg rai) for NERAD principal villages, 1983



Farmers also have various strategies for dealing with the uncertainty of rainfall in the region. For rice these include: use of photo-sensitive rice varieties; small, bunded fields; rice-storage and by following what can best be termed "compensatory" cropping strategies. A good example of the latter also comes from Roi Et where farmers plant kenaf in the paddy before rice. In dry years the kenaf produces higher yields firstly because water-logging problems are reduced and secondly because the kenaf can be left in the field for longer as rice transplanting is either not possible or is at least delayed by lack of rain. Thus, there is some compensation for reduced rice yeilds in dry years by higher cash earnings from kenaf.

Results

NERAD has been running cropping system trials for 2 years in farmers fields in 9 tambons in 4 Changwats in Northeast Thailand. Two sets of trials have been conducted. Firstly, cropping intensification trials have been conducted over the entire tambon following DOA recommended practices for planting dates, fertilizer rates, etc. The second set of trials were conducted in only one principal village per tambon and were designed to solve current farmer problems identified during an interdisciplinary, needs-assessment conducted in each village. A summary of the results of last year's trials are presented in Appendix 1.

Almost 100 trials, generally replicated over 5 farmers, were conducted with varying degrees of success. Available resources, however, were over-extended causing problems of inadequate data on which to base decisions for improving the systems and a means of prioritising the trials in order to concentrate effort on the technologies with the highest potential for benefitting farmers in each tambon was needed.

To achieve this, a technical workshop was held to review the results of all the trials conducted and to classify the technologies into 3 categories:

1. Successful technologies which are considered suitable for expansion through extension demonstrations.
2. Promising technologies which still require further testing or modification by component technology research.
3. Technologies which under present or expected future conditions are unlikely to significantly benefit farmers.

As a result of this "triage" process, technologies assigned to category 1 will be demonstrated in an extension phase by DOAE with technical support from DOA. Those trials classified as category 3 will be discontinued or passed back to the research stations but regularly reviewed to determine if technological advances or economic circumstances have changed sufficiently to warrant further testing. The project's cropping system trials program will concentrate on category 2 with an intensive series of on-farm trials including superimposed, component technology work to solve the remaining problems and develop the systems until they are ready for the extension phase. The overall cropping systems strategy will be implemented according to the system summarised in Figure 6.

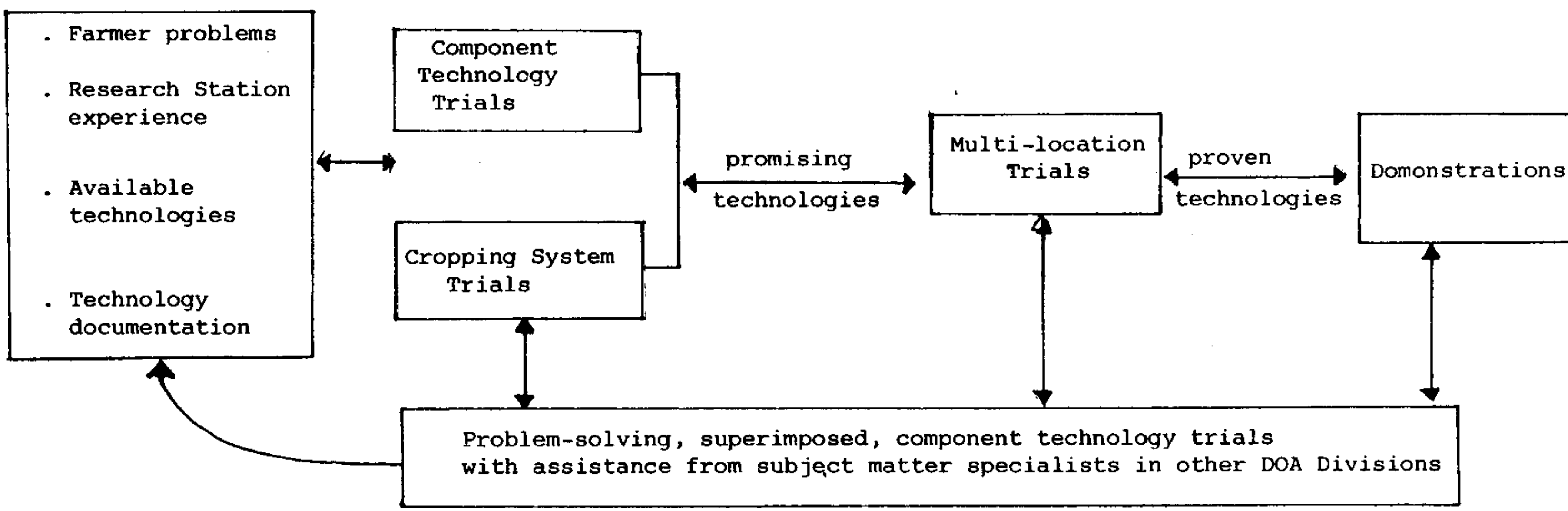
Instead of reviewing the results of all the trials, some examples will be chosen to illustrate the triage process, to demonstrate the importance of understanding traditional cropping strategies and to assess the potential for cropping systems development in the Northeast. These examples are presented in Tables 2-4.

A green manure trial was implemented in Sri Saket to address the problems of low soil fertility and the high cost and associated risk of applying fertilizer to rice. Both the objectives of increasing rice yield and reducing fertilizer requirements were met by the trial. Although yield increases were only moderate, the farmers' response was extremely enthusiastic and the technology is already being rapidly adopted in the area. It is believed that the reason for this is that it satisfies the farmers' rice yield stabilization objective but does so in a low-cost, low-risk manner. Cuban kenaf before rice is also considered ready for extension for similar reasons as an improved compensatory system for fluctuating rice production. At present prices, the 747 Baht net returns from kenaf represents over 350 kg rice per rai which is an acceptable yield level.

Yield and returns from the direct-sown rice and the sesame before rice technologies were rather variable and well below potential. However, they represent viable compensatory and income stabilization strategies respectively with considerable potential for meeting these objectives in their respective areas. For this reason

Figure 6. Implementation of NERAD Cropping System Trials

Location :	Project data-base, Changwat/Region	Principal villages	Entire tambon	Tambon or wider



Leadership :	NEROA/OAE/DOA	NEROA/DOA/DLD	DOA/NEROA/DOAE	DOAE/DOA
Participation :	DOAE DLD CPD	DOAE OAE CPD	CPD OAE DLD	NEROA CPD OAE DLD

Table 2. Ecamples of successful technologies to be moved to the extension phase

1. COWPEA (green manure) - RICE	Sri Saket
FARMER PROBLEMS IDENTIFIED	1. Low soil fertility 2. High cost and risk of fertilizing rice 3. Pre-rice season underemployment
OBJECTIVES OF THE TRIAL	1. Increase rice yields 2. Reduce fertilizer requirements in rice
RESULTS (mean of 15 plots)	Cowpea-Rice 15-15-15 20kg/+NH_4SO_4 YIELD=543kg/rai (DM105) 16-20-0 rai 10kg/rai Fallow-Rice 15-15-15 20kg/+NH_4SO_4 YIELD=487kg/rai (DM105) 16-20-0 rai 10kg/rai Fallow-Rice+44kg(mean)fertilizer YIELD=444kg/rai (local) - Yields are significantly different
CONCLUSION	LOW-INPUT, LOW-RISK 'STABILIZATION' STRATEGY

2. CUBAN KENAF - RICE	Chaiyaphum
FARMER PROBLEMS IDENTIFIED	1. Unstable rice yields 2. Root rot disease build up on limited upland area where kenaf is continuously monocropped.
OBJECTIVES OF THE TRIAL	1. Identify a pre-rice cash-crop for the paddy land. 2. Test a root-rot resistant kenaf variety
RESULTS (mean of 5 plots)	Cuban Kenaf yield=280kg/rai net returns=747B/rai Upland Thai Kenaf (control)=207 kg/rai Rice after Cuban Kenaf = 46 kg/rai (4 plots=0)
CONCLUSION	INPROVED COMPENSATORY SYSTEM

they will receive high priority for further on-farm component technology trials to overcome the remaining problems. For direct sown rice this will include planting methods to obtain better plant spacing to facilitate weeding, herbicide trials and planting date trials. For sesame the component technology work will concentrate on planting date trials in an attempt to avoid water-logging and drought.

Although net returns from sweet-corn before rice were acceptable, this trial was based on the erroneous assumption that farmers wish to increase cropping intensity on their paddy land. Farmers in Nakorn Phanom, however, have plenty of underutilized upland area which they prefer to use for cash cropping where it does not interfere with their subsistence rice production. The objectives of the mungbean-before-rice trial are considered to be valid and in line with farmers' objectives but currently the available mungbean varieties are not suitable for local conditions due to their preference for clay soils, sensitivity to water-logging and their susceptibility to common pests and diseases. It is therefore considered that more on-station breeding work is necessary before further on-farm trials of this technology are considered.

Table 3. Examples of promising technologies for intensive on farm testing and component technology trials

1. DIRECT SOWN RICE (UPPER PADDY)	Chaiyaphum
FARMER PROBLEMS IDENTIFIED	1. Unstable subsistence rice production. 2. Upper paddies planted only 1 year in 3
OBJECTIVES OF THE TRIAL	1. Produce rice in the upper paddies every year 2. Identify situations where D.S. rice will give higher or more stable yields than T.P. rice.
RESULTS (mean of 5 plots)	D.S. Rice(RD6)YIELD=154Kg/rai(Rat+weed problems) Net returns = 127 Baht/rai T.P. Rice (control) YIELD=0kg/rai (Insufficient water for transplanting)
CONCLUSION	COMPENSATORY STRATEGY FOR DRY YEARS
2. SESAME-RICE	Roi Et, Sri Saket
FARMER PROBLEMS IDENTIFIED	1. Limited market and uustable prices for present cash crops(water melon and yard long bean).
OBJECTIVES OF THE TRIAL	1. Test the potential of a traditional technology successful elsewhere in a situation with similar agro-ecological conditions. 2. Identify a viable pre-rice crop with high and stable prices.
RESULTS (mean of 5 plots)	Sesame YIELD = 90 kg/rai(intermittent water logging/ drought) Net cash returns = 747 Baht/rai Rice YIELD - Unaffected by sesame
CONCLUSION	PROMISING INCOME STABILIZATION STRATEGY

Table 4. Examples of technologies unlikely to significantly benefit farmers

1. SWEET CORN - RICE	**Nakorn Phanom**
FARMER PROBLEMS IDENTIFIED	1. Underutilization of paddy land.
OBJECTIVES OF THE TRIAL	1. Increase cropping intensity in the paddy
RESULTS (mean of 13 plots)	Corn YIELD = 2924 saleable ears per rai Net returns = 476 Baht per rai Rice YIELD - no detectable effect of sweet corn on yield
CONCLUSION	TRIAL OBJECTIVES DO NOT FIT FARMER'S STRATEGY
2. MUNGBEAN - RICE	**Roi Et**
FARMER PROBLEMS IDENTIFIED	1. Declining soil fertility 2. Limited markets and unstable prices for traditional cash crop (water melon)
OBJECTIVES OF THE TRIAL	1. Improve soil condition by incorporation of legume crop residues 2. Stabilize returns from cash crops
RESULTS (mean of 5 plots)	Mungbean yield = 44 kg per rai Net returns = 88 Baht per rai Rice(yield = 348 kg per rai)not signifi- Rice(control) = 344 kg per rai)cantly different
CCNCLUSION	STABILIZATION OBJECTIVES NOT ACHIEVED IN TRIALS

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APPENDIX I.

NERAD CROPPING SYSTEM AND COMPONENT TECHNOLOGY TRIALS

RESULTS SUMMARY

Changwat : Chaiyaphum Tambon : Kwang Jon/That Thong Year : 1984

Land Type	SYSTEM	YIELD(kg/rai)			CONTROL PLOT YIELD (kg/rai)			SELLING PRICE (฿/kg)			INPUT COSTS (excluding labour) (฿/rai)			NET RETURNS (฿/rai)		
		mean	min	max	mean	min	max	mean	min	max	mean	min	max	mean	min	max
Lower paddy	Mungbean[1/]	-	0	75	-	-	-	10	10	10	233	233	233	-	-	511
	T.P. Rice	440	399	480	375	367	382	2.02	2.0	2.05	168	168	168	711	630	792
Upper paddy	Mungbean	52	22	83	-	-	-	10	10	10	248	248	248	272	-28	582
	D.S. Rice	154	60	247	0	0	0	2.02	2.0	2.05	184	168	200	127	-48	294
Upland	Mungbean(1983) Kenaf (Disease break rotation)	154	70	238	175	145	204	9.8	9.0	10.6	231	208	253	1163	422	1904
	Thai kenaf	116	94	138	207	205	210	8.5	8	9	200	193	208	804	560	1049
	Peanut	192	93	292	-	-	-	6.5	6.0	7.0	407	390	425	690	53	1327
Upper paddy	Cuban kenaf[1/]	285	158	469	207	205	210	8.5	5.8	10.3	230	208	252	2498	1028	3969
	Rice (RD6)[2/]	210	-	-	173	-	-	2	-	-	183	-	-	237	-	-
Upland	Thai kenaf	175	133	235	-	-	-	9.7	7.5	10.3	236	-	-	1437	900	1996
	Red Sorghum	HARVEST DATA NOT YET AVAILABLE														
	Peanut	512	-	-	-	-	-	5	-	-	652	-	-	1908	-	-
	Red Sorghum	HARVEST DATA NOT YET AVAILABLE														
Upper paddy	White sesame	86	-	-	-	-	-	25	-	-	292	-	-	1846	-	-
	Rice	INSUFFICIENT WATER FOR TRANSPLANTING														

1/ DOA and RAT results combined

2/ Rice could not be transplanted due to lack of water.
Results are for 1 plot which was direct sown.

NERAD CROPPING SYSTEM AND COMPONENT TECHNOLOGY TRIALS

RESULTS SUMMARY

Changwat : Chaiyaphum   Tanbon : Lahan   Year : 1984

Land Type	SYSTEM	YIELD(kg/rai)			CONTROL PLOT YIELD (kg/rai)			SELLING PRICE (฿/kg)			INPUT COSTS (excluding labour) (฿/rai)			NET RETURNS (฿/rai)		
		mean	min	max	mean	min	max	mean	min	max	mean	min	max	mean	min	max
PADDY LAND	Cubankenaf	276	217	328				8.2	6.3	7.2	246	246	246	1593	1529	1804
	Rice (N.G.)	414	380	465				2.5	2.5	2.5	344	344	344	690	606	819
	Mungbean[1]	-	0	23				8	-	-	282	-	-	-	-282	-98
	Rice	-	-	580				2.5	-	-	344	-	-	-	-	1106
	Mungbean[2]	75	0	208				8.5	8	.9	425	285	565	329	-ve	1407
	Rice (RD 15)	667	310	1025	460	300	620	2.3	2	2.6	525	350	700	1288	431	[illegible]
	Rice (RD 7)[3]	1325	-	-	490	-	-	2.3	-	-	565	-	-	2880	-	-
	Cucumber or Broccolli or Tomatoes or Onions				NOT YET HARVESTED											
	Peanuts	365	280	480				5	5	5	652	652	652	[illegible]	748	1748
	Red Sorghum				NOT YET HARVESTED											
	Mungbean				ALL 3 PLOTS FAILED - PLOUGHED IN											
	Cucumber	570	520	610				1	1	1	472			98	48	138
	Peanut	122	116	128				5	5	5	222	222	222	388	358	418
	intercropped with Cassava	1980	1860	2100				0.6	0.6	0.6	300	300	300	888	816	960

1/ tambon trials

2/ Principal village trials

3/ Only 1 trial plot implemented

NERAD CROPPING SYSTEM AND COMPONENT TECHNOLOGY TRIALS

RESULTS SUMMARY

Changwat : Nakorn Phanom   Tambon : Na Ngua   Year : 1984

Land Type	SYSTEM	YIELD(kg/rai)			CONTROL PLOT YIELD (kg/rai)			SELLING PRICE (฿/kg)			INPUT COSTS (excluding labour) (฿/rai)			NET RETURNS (฿/rai)		
		mean	min	max	mean	min	max	mean	min	max	mean	min	max	mean	min	max
UPLAND	Sesame	126	102	150												
	Watermelon	3213	450	5103												
	Peanut	50	31	93												
	Watermelon	3331	585	5590												
	Thai kenaf	177	63	283												
	Watermelon	2742	1175	5455												
PADDY LAND	Sweetcorn	900	310	1423												
	peanut	142	56	288												
	Sweetcorn	595	448	742												
	Rice	245	228	262												
	Cowpea	8	0	21												
	Rice	337	247	430												

NERAD CROPPING SYSTEM AND COMPONENT TECHNOLOGY TRIALS

RESULTS SUMMARY

Changwat : Nakorn Phanom   Tambon : Na Thom   Year : 1984

Land Type	SYSTEM	YIELD(kg/rai)			CONTROL PLOT YIELD (kg/rai)			SELLING PRICE (฿/kg)			INPUT COSTS (excluding labour) (฿/rai)			NET RETURNS (฿/rai)		
		mean	min	max	mean	min	max	mean	min	max	mean	min	max	mean	min	max
UPLAND	Sweetcorn	547	493	626												
	Peanut	108	97	123												
	Sesame	8	3	12												
	Peanut	133	100	167												
	Jute	347	300	377												
	Watermelon	2255	450	3870												
PADDY	Cassava intercrop	4101	8009	4662												
	Peanut	0	0	0				PEANUT FAILED								
	Sweetcorn	75	0	220												
	Rice	104	88	142												
	Cowpea	3	0	9												
	Rice	66	60	72												
	Rice	71	57	85												
	Mingbean	UNABLE TO PLANT														

NERAD CROPPING SYSTEM AND COMPONENT TECHNOLOGY TRIALS

RESULTS SUMMARY

Changwat : Sri Saket Tambon : Taket Year : 1984

Land Type	SYSTEM	YIELD(kg/rai)			CONTROL PLOT YIELD (kg/rai)			SELLING PRICE (฿/kg)			INPUT COSTS (excluding labour) (฿/rai)			NET RETURNS (฿/rai)		
		mean	min	max	mean	min	max	mean	min	max	mean	min	max	mean	min	max
LOWER PADDY	Mungbean	29	21	41				9	9	9	476	476	476	-216	-288	-112
	Rice	436	351	555				2.8	2.8	2.8	396			656	-31	916
	Peanut	105	20	160				7	7	7	892	892	892	-616	-753	227
	Rice	344	284	593				2.8	2.8	2.8	398			868	342	1127
	Yard bean	470	330	660				5	5	5	1200	1200	1200	1150	450	2100
	Rice	434	404	485				2.8	2.8	2.8	398			799	733	900
	Cowpea	0	0	0				-	-	-	148	148	148	NEGATIVE		
	Rice	470	416	553				2.8	2.8	2.8	398			967	816	1199
	Sesame	13	7	20				14	14	14	470	470	470	-283	-377	-190
	Rice	507	470	583				2.8	2.8	2.8	398			1021	881	1234
	Baby corn	116	77	160				3	3	3	1075	1075	1075	-728	-845	-595
	Rice	442	361	496				2.8	2.8	2.8	398			763	611	919
	Cowpea G.M.	PLOUGHED IN AS GREEN MANURE						-	-	-						
	Rice	543	425	864	487[1/] 444[2/]	368[1/] 347[2/]	619[1/] 720[2/]	2.8	2.8	2.8	0[3/]	-	-	157	-	-

1/ Chemical fertilizer only

2/ Farmer practices

3/ Seed the only input produced by farmers themselves

NERAD CROPPING SYSTEM AND COMPONENT TECHNOLOGY TRIALS

RESULTS SUMMARY

Changwat : Sri Saket Tambon : Tae Year : 1984

Land Type	SYSTEM	YIELD(kg/rai)			CONTROL PLOT YIELD (kg/rai)			SELLING PRICE (฿/kg)			INPUT COSTS (excluding labour) (฿/rai)			NET RETURNS (฿/rai)		
		mean	min	max	mean	min	max	mean	min	max	mean	min	max	mean	min	max
	Mungbean	66	37	100				9			476			197	27	423
	Rice	460	361	575				2.8			398			291	613	1212
	Peanut	145	130	170				7			892			122	17	297
	Rice	528	426	621				2.8			398			1031	794	1343
	Yardbean	717	600	800				5			1200			2382	1800	2800
	Rice	604	547	658				2.8			398			1027	573	1444
	Cowpea	1089	500	1933							148					
	Rice	541	414	693				2.8			398			1117	760	1542
	Sesame	32	30	33				14			470			-15	-12	4
	Rice	512	574	599				2.8			398			1035	680	1279
	Baby corn	65	53	87				3			1075			-880	-815	-915
	Rice	558	508	610				2.8			398			1163	1024	1309

NERAD CROPPING SYSTEM AND COMPONENT TECHNOLOGY TRIALS

RESULTS SUMMARY

Changwat : Roi Et Tambon : Nong Kaew Year : 1984

Land Type	SYSTEM	YIELD(kg/rai)			CONTROL PLOT YIELD (kg/rai)			SELLING PRICE (฿/kg)			INPUT COSTS (excluding labour) (฿/rai)			NET RETURNS (฿/rai)		
		mean	min	max	mean	min	max	mean	min	max	mean	min	max	mean	min	max
LOWER PADDY	Mungbean	48	24	69	-	-	-	10	10	10	344	344	344	126	-104	346
	Rice	336	292	376	319	269	369	1.5	2.0	2.7	178	178	178	654	415	838
	Kenaf (Thai)	437	263	530	397[1/]	290[1/]	530[1/]	8.5	8.5	8.5	218	218	218	3500	2014	4284
	Rice	254	173	278	319	269	369	2.4	2.3	2.7	178	178	178	441	228	584
	Cuban Kenaf	397	290	530	437[2/]	263[2/]	530[2/]	8.5	8.5	8.5	218	218	218	3159	2248	4287
	Rice	256	158	348	319	269	369	2.5	2.5	2.5	178	178	178	451	218	627
	Cowpea (G.M.)							SUBSISTENCE USE								
	Kenaf		KENAF			NOT		PLANTED								
	Rice	410	410	410	326[4/] 436[5/]	-	-	2.0	-	-	28	-	-	792	-	-
UPPER PADDY	White Sesame	-	0	44	72[3/]	66[3/]	78[3/]	15	15	15	428	428	428	-	-428	227
	Rice	253	144	331	274	272	276	2.7	2.7	2.7	178	178	178	605	212	715
	Peanuts															
	Black Sesame	72	66	78	-	-	-	12	12	12	447	447	447	413	343	484
	Rice	257	198	308	274	272	276	2.7	2.7	2.7	178	178	178	515	356	655
	Peanuts															
	Thai Kenaf	309	176	429	224[1/]	81[1/]	307[1/]	8.5	-	-	218	218	218	2407	1279	3426
	Rice	258	199	317	274	272	276	2.7	2.7	2.7	178	178	178	519	359	679
	Peanut															
	Cuban Kenaf	224	81	307	309[2/]	176[2/]	429[2/]	8.5	-	-	218	218	218	1686	467	2395
	Rice	242	166	318	274	272	276	2.7	2.7	2.7	178	178	178	477	272	682
	Peanut															

1/ Cuban Kenaf yields taken as control
2/ Thai kenaf yields taken as control
3/ Black sesame taken as control
4/ Fallow-rice control plot
5/ Watermelon-rice control plot

NERAD CROPPING SYSTEM AND COMPONENT TECHNOLOGY TRIALS

RESULTS SUMMARY

Changwat : Roi Et   Tambon : Na Muang Year : 1984

Land Type	SYSTEM	YIELD(kg/rai)			CONTROL PLOT YIELD (kg/rai)			SELLING PRICE (฿/kg)			INPUT COSTS (excluding labour) (฿/rai)			NET RETURNS (฿/rai)		
		mean	min	max	mean	min	max	mean	min	max	mean	min	max	mean	min	max
LOWER PADDY	Mungbean	40	18	67				10	10	10	344	344	344	51	-168	322
	Rice	359	283	498	369	266	486	2.3	2.0	2.5	178	178	178	648	527	819
	Thai Kenaf	444	283	638	358[1/]	191[1/]	612[1/]	8.5	8.5	8.5	218	218	218	3555	2188	5201
	Rice	342	270	433	369	266	486	2.3	2.2	2.3	178	178	178	606	445	788
	Cuban Kenaf	358	191	612	444[2/]	283[2/]	638[2/]	8.5	8.5	8.5	218	218	218	2878	1406	4980
	Rice	355	243	419	369	266	486	2.4	2.3	2.6	178	178	178	637	461	814
UPPER PADDY	White Sesame	102	85	112	141[3/]	120[3/]	148[3/]	15	15	15	428	428	428	1101	830	1248
	Rice	330	252	559	307	227	430	2.3	2.0	2.7	178	178	178	590	327	1331
	Peanut															
	Black Sesame	141	120	148	102[4/]	85[4/]	112[4/]	15	15	15	447	447	447	1245	993	1330
	Rice	362	205	509	307	227	430	2.2	2.0	2.7	178	178	178	636	233	1198
	Peanut															
	Thai Kenaf	385	264	574	308[1/]	212[1/]	458[1/]	8.5	8.5	8.5	218	218	218	3052	2027	4662
	Rice	316	156	500	307	227	430	2.7	2.4	2.8	178	178	178	581	261	1174
	Peanut															
	Cuban Kenaf	308	212	458	385[2/]	264[2/]	574[2/]	8.5	8.5	8.5	218	218	218	2398	1585	3676
	Rice	368	188	610	307	227	430	2.4	2.0	2.7	178	178	178	700	199	1468
	Peanut															

1/ Cuban kenaf yields taken as control

2/ Thai kenaf yields taken as control

3/ Black sesame yields taken as control

4/ White sesame yields taken as control