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RICE-BASED CROPPING SYSTEMS RESEARCH IN THAILAND

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In the Thai national research systems, there are three main bodies namely the Ministry of Agriculture and Cooperatives, the State University Bureau and the National Research Council responsible for the agricultural research programs. Under the Ministry (see organizational chart) five agencies directly involve in the research undertaking-Land Development Department, Royal Irrigation Department, Office of the Under-Secretary of State (OUSS), Office of Agricultural Economics (OAE) and the Department of Agriculture (DOA). The Department of Agriculture is the major biological research organ handling all crop research both basic and applied. DOA is the executing body of the rice-based cropping systems research in Thailand cooperating with Office of the Agricultural Economics of the Ministry. From the University side, under the State University Bureau there are three universities in the country having agricultural research in their own activities. They are Khonkaen, Chiengmai and Kasetsart Universities. In the rice-based cropping systems research, Kasetsart University is cooperating with the Department of Agriculture implementing the research activities at the Bangpae site. The last major body which is doing some biological basic research is the National Research Council.

There are four sites in the Thai rice-based cropping systems research program namely Pimai, Ubon, Kampangphet and Bangpae. The first three sites are supervised by the Department of Agriculture and Office of Agricultural Economics and the fourth site by Kasetsart University.

There are four levels of groups in the organization. The first is a Policy Committee made of policy people from the different ministries and departments. They usually meet once a year and review previous work and set policy for the coming year or longer. Once the policy committee has met they authorize the work and send out the necessary directives. These directives then go to the members of the Planning Committee. The Planning Committee lay out the general plans for the work and authorize the allocation of resources to carry out the plans. The third level is the Working Committee, usually one per site, who make the detailed plans and detailed budgets to carry out the work. These plans and budgets then go to the site group who carry out the actual work and prepare the site research reports. The Coordinator then compile the site reports and write the final report.

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At first this may seem a rather cumbersome organization but it is essential that all levels of government be involved in the program if it is to work effectively. Also one person may be on several committees, a case of the Coordinator of the Program who is on all the committees to assure continuity and keep things moving. In the organizational structure ideas move both ways. For example the Working Group may find that technology is not available to solve a problem and suggest a totally different approach. This may have to be decided by the Policy Committee. This two way flow is essential if the program is to work effectively. Each group must be aware of the successes and failures if they are to carry out their functions. These functions may be thought of as:

Policy Committee	-	Legitimizers
Planning Committee	-	Resource Allocators
Working Committee	-	Organizers
Site Group	-	Operators

The Research Site

The research area is picked on the basis of:

1. National Priorities
2. Representative of a large area
3. It is thought current technology may be available to improve the situation.

Once an area has been selected members of the Planning and Working Committees in conjunction with local representatives select the research site. Once a site is selected the Site Group go into action. Usually a base line survey precedes the final planning for the site and determination of goals. The selection of goals is most important. To carry out interdisciplinary research it is essential that all the disciplines are working toward the same goals and if possible agreement on priorities of these goals. Time spent on agreeing on goals at the beginning will save a lot of headaches and problems later.

Four sites are in operation for the rainfed rice-based cropping systems research in farmers' fields in 1978. They are as follows:

A. PiMai site

Two districts were selected for testing rainfed cropping systems at the Pimai site this year, Pimai itself and Nonsong 10 kms. away and a slightly higher elevation. Usually, farmers in these two districts grow only one crop of rice a year. The rainfall pattern at Pimai is bimodal with the two peaks in May and September with a possibility of drought in July. Heavy rain will come in August and September thus making the tradition transplanted rice very late compared with other

areas. Traditionally the fields are vacant at the beginning of the rainy season before transplanted rice. This project is trying to grow one crop before rice to make more efficient use of land and rain to increase farmer's income.

The four patterns to be tested are:

1. Mungbean-rice
2. Peanut-rice
3. Sesame-rice
4. Corn/upland rice

There will be three replications of each pattern in each district giving a total of replications per pattern. With four patterns there will be 24 plots.

Crop management

After a good land preparation, a furrow will be made at 4 meter intervals for drainage in case of heavy rain (for the first crop only).

Mungbean. The plot will be divided into half, one for broadcasting with a seed rate of 25 kg/ha and the other planted with a spacing of 50x10 cm. 188 kg/ha of 160-20-0 fertilizer will be applied as basal or 10-15 days after emergence depending on soil moisture conditions.

Peanut. Using spacing of 50x25 cm., 2-3 seeds will be used per hill. Half of the plot will be a check, the other half will receive 188 kg/ha of 160-20-0 fertilizer as basal or 10-15 days after emergence.

Sesame. A seed rate of 15 kg/ha will be broadcasted. Fertilizer rate will be 188 kg/ha of 160-20-0 as basal.

Corn/upland rice. Row spacing for both crops is 25 cm. corn planted in two rows side by side alternated with eight rows of rice. This gives two rows of corn every 2 meters. The plant spacing (within row) for corn is 25 cm, using 2-3 seeds per hill after crop emergence 7-10 days thinning to 1. Dry seeded rice will be drilled in row at 63 kg/ha. 313 kg/ha of 16-16-8 fertilizer will be applied for both crops as basal. 53 kg/ha of Urea will be used as topdress fertilizer at 3 weeks for corn and at panicle initiation for rice.

Rice. Three methods of plan ing the second crop of rice will be used. Transplant at 25x25 cm, transplanted randomly as the farmer currently does or broadcast seed at the rate of 63 kg/ha. 19-38-38 kg/ha of N-P_2O_5-K_2O fertilizer will be used as basal, topdress with 19 kg/ha of N 30 days before flowering.

B. Ubon site

B.1. Regular research operation

Rainfed cropping systems at Ubon was started in 1977. This year is the third year of the project. Five patterns proposed are:

1. Peanut - rice
2. Corn - rice
3. Mungb an - rice
4. Rice - rice
5. Rice - rice (ratoon)

All of those patterns are similar to last year but the third crops (peanut, mungbean and corn) were discarded. There is a great risk when the third crops are grown after rice because of water insufficiency. All of the third crops last year were lost for lack of water.

Testing of cropping systems are carried out in farmers' fields in 3 villages. Each pattern will be grown in each village using one plot of land making total plots number 20 (replicating two patterns in two villages and one pattern in the third village). The range of plot size is 400-1000 m^2.

Procedures in each pattern are as follow:

1. Peanut - rice

Growing peanut as the first crop gave good promise last year although crop maturity is quite long. But there is still enough time for rice after the peanut harvest.

Divided the plot into half, fertilizer formula of 15-15-15 at 206 kg/ha and 16-20-0 at 219 kg/ha which have equal cost will be applied in each part after crop emergence, 10-15 days. Spacing of 25x33 cm will be used. Two seeds will be used per hill and no need for thinning. Weed and insect control as needed.

Rice will be transplanted after the peanut harvest with spacing 25x25 cm. Fertilizer formula of 15-15-15 at 206 kg/ha will be used as basal and 21-0-0 at 88 kg/ha as topdressing. Weed and insect control as needed.

2. Corn - Rice

The growing period of corn is about 70 days making ample time for the rice crop. From last years results, corn gave quite a good yield.

Divide the plot into half, one part will be applied with fertilizer formula of 15-15-15 at 206 kg/ha as basal and 21-0-0 at 88 kg/ha as top dressing, 15-30 days after planting. The equal cost of fertilizer of formula 15-15-15 at 263 kg/ha will be used for the other half of the plot as basal only. Crop spacing is 25x75 cm, 3 seeds per hill. One plant per hill will be left after crop emergence, 7-10 days.

Crop management for rice will be the same as (1).

3. Mungbean - Rice

Mungbean can be grown as a crop before rice, having a short growing period but from last year testing it gave low yields. One of the reasons is wide spacing. Closer spacing will be tested this year.

Fertilizer management will be the same as peanut. Spacing of 25x25 cm and 25x50 cm will be compared in each of the two fertilizer treatments. The seed number of 5 will be used per hill and thinning to 2 when they emerge in 7-10 days.

For rice same as (1).

4. Rice - Rice

The growing of two rice crops in this rainfed area should be possible by using a nonphotoperiod sensitive variety as the first crop follow by a photoperiod sensitive variety.

The first crop will be direct seeded in rows 33 cm apart using a seed rate of 63 kg/ha. When the crop emerges in 10-15 days apply fertilizer formula of 15-15-15 at 206 kg/ha as basal and 21-0-0 at 88 kg/ha at panicle initiation.

The second crop will be transplanted and fertilizer management will be the same as in (1).

5. Rice - Rice (ratoon)

Rice - rice (ratoon) pattern was tested last year, both the main and ratoon crop gave a low yield because of sterility. Two new nonphotoperiod sensitive varieties will be tested this year. Crop and fertilizer management will be the same as the first crop of (4). Divide the plot into half for each variety.

6. Plow land for second rice crop quickly.
7. Transplant and fertilizer according to plan.
8. Weed 2-3 weeks after transplanting.

How the program will work

The farmer will agree to grow two crops in one year on one of his fields. The field will be inspected by the staff, given a number, measured and agree with farmer on pattern to be grown. The farmer will then plow the land with first good rain in April. The project will supply the farmer with the seed and fertilizer for that field. The farmer will plant, fertilize, weed and take good care of the crop. Just before harvest the staff will take a crop cut of 6 m^2 from the field to get exact yield. The farmer will then harvest the crop and prepare the land quickly for the second crop of transplanted rice. The project will supply seed for the seedbed. The project will also supply fertilizer for the rice crop as well as insecticide if needed. The farmer will weed the crop 2-3 weeks after transplanting. Just before harvest the staff will take a crop cut of 6 m^2 to get the exact yield.

To evaluate the effect of the program for problems which may occur when the extension people take over three sociologists from Kasetsart University have been included in the team this year. They are monitoring the farmers reactions to the approach used and the technology suggested. To assist in a smooth transfer to extension the local and district extension personnel have been invited to participate in all meetings, demonstrations and monitoring activities.

Returns

The project believes the farmers can grow two crops and make more money than they are now. The project will supply seed, fertilizer and insecticide for the test fields and the farmer only has to pay back if he gets a good yield. For each crop a good yield is:

Corn	13125 ears/ha
Yard long bean	2188 kg/ha
Peanut	938 kg/ha
Rice	1875 kg/ha

If the farmers yield is below this he pays back nothing. If the yield is this level or more he pays for the seed fertilizer and spray.

In the ratoon crop, the stubble will be cut at 10-15 cm above the water level at that time. The fertilizer rate will be the same as the main crop applied the day the stubble is cut.

B.2. Additional research-related operation

Two crops in one year at Kaw Wang

Our goal is to have the farmers grow two good crops each year. Based on our last two years work we think that a crop can be grown before the regular rice crop. We would like to work with farmers on 50 fields to test this idea. There are five cropping patterns we would like to try:

Glutinous corn	-	Rice	RD 6 or 7
Yard long bean	-	Rice	
Peanut	-	Rice	
RD 7	-	Rice	
RD 9	-	Rice	

We would like to try each pattern on 10 fields. Farmers will get to choose which pattern they want to test.

What the Cropping Systems Project will do

1. Supply seed.
2. Supply fertilizer.
3. Supply insecticide.
4. Make a sprayer available.
5. Supply a written set of instructions for each crop.
6. Make staff available to advise the farmers.
7. Take crop cuts to get exact yield.

What the farmer will do

1. Prepare the land with first rain in April.
2. Apply seed and fertilizer according to plan.
3. Weed and crop 2 weeks after emergence.
4. Spray if needed.
5. Harvest as soon as crop is ready.

The recommendation for each crop is:

First crop

Crop	Spacing (cm)	Seeds	Fertilizer (kg/ha)	
			Basal	Topdress
Glutinous corn	25x75	3/hill	31-31-31	19-0-0
Yard long bean	50x75	5/hill	31-31-31	0
Peanut	25x33	2/hill	31-31-31	0
RD 7	Drill x 33	63 kg/ha	31-31-31	19-0-0
RD 9	Drill x 33	63 kg/ha	31-31-31	19-0-0

Second crop

RD 6 or 7	25x25	3 seedlings/hill	31-31-31	19-0-0

Thinning : to 1 and 2 for corn and yard long bean respectively.

Fertilizer : 31-31-31 is 15-15-15 at 206 kg/ha and 19-0-0 is 21-0-0 at 88 kg/ha

C. Kampangphet site

Cropping systems research started one year ago with exploritory plots in several areas. Kampangphet is in the lowest rainfall zone of Thailand receiving 800-1000 mm of rain per year. Early rains have a high variability with a peak of 300 mm in September. The farmers traditional practice is to transplant one crop of rice in August if his seed bed has survived. The projects objectives is to make use of the rains which start in May to grow a short duration crop before the traditional rice crop or direct seed a rice crop with the first heavy rains to be followed by a field crop.

The cropping patterns to be tested are:

1. Glutinous corn - Rice
2. Mungbean - Rice
3. Soybean - Rice
4. Rice - Mungbean
5. Rice - Peanut
6. Rice - Sweet potato

Each pattern will be replicated 4 times with each of the 12 cooperators having 2 experimental plots.

Yield and pay back at Kaw Wang at Ubon (all price in Baht).

Yield	Estimated value	Gross return	Est. fert. seed spray cost	Pay back	Net to farmer	Yield Min pay	Yield Max pay
Rice (kg/ha)							
1563	2.5/kg	3906	1331	0	3906		
1875		4688	1331	0	4688		
2375		5938	1331	1250	4688	1875	2408
2438		6094	1331	1331	4763		
3125		7813	1331		6481		
Corn (ears/ha)							
13,125	0.33/ear	4369	1331	0	4369		
16,250		5413	1331	725	4688	14,206	18,056
18,125		6038	1331	1331	4706		
25,000		8325	1331		6994		
Peanut (kg/ha)							
625	5/kg	3125	1856	0	3125		
938		4688	1856	0	4688		
1125		5625	1856	938	4688	938	1306
1313		6563	1856	1856	4706		
1625		8125	1856	1856	6269		
Yard long bean (kg/ha)							
2188	2/kg	4375	2044	0	4375		
2375		4750	2044	63	4688		
2875		5750	2044	1063	4688	2344	3363
3375		6750	2044	2044	4706		
4375		8750	2044	2044	6706		

Crop management

Glutinous corn - Rice

The corn will be planted 3 seeds per hill with a spacing of 75x25 cm thinned to 1 plant per hill at 10 days after emergence. With little previous experience on fertilizer response in this area it was decided to conduct a factorial design experiment with 3 rates of nitrogen 2 rates of phosphorus and potash. The rates are:

75, 100, 125	kg/ha N
0, 125	kg/ha P_2O_5
0, 125	kg/ha K_2O

The transplanted rice following will all receive a split application of fertilizer 28-25-0 kg/ha at basal and 28-0-0 kg/ha at P.I. The nitrogen will be applied half at basal and half at 30 DAE. All the P_2O_5 and K_2O will be applied as basal.

Mungbean - Rice

The mungbean will be tested with three levels of fertilizer.

	N	P_2O_5	K_2O (kg/ha)
1.	19	56	38
2.	30	38	0
3.	27	27	27

The rice crop following mungbean will be treated the same as that following corn.

Soybean - Rice

The soybean will be given the same fertilizer treatments as mungbean. The rice crop following soybean will be treated the same as that following corn.

Direct seeded rice - Mungbean

The seed will be planted in rows 25 cms apart at a seed rate of 63 kg/ha. The fertilizer rate is 56-25-0. There will be two rice varieties RD 7 and RD 11 with 4 reps of each.

The mungbean following will be planted in rows 30 cms apart and 20 plants per meter. The fertilizer rate will depend upon results of early planting of mungbean.

Direct seeded rice - Peanut

The direct seeded rice will be the same as direct seeded rice - mungbean.

The peanut will be planted in rows 30 cms apart and 20 cms between plants in row. Since the peanut is a long duration high risk crop no fertilizer will be applied.

Direct seeded rice - Sweet potato

The rice will be grown as above.

The sweet potato will be planted 30x25 cms with no fertilizer.

D. Bangpae site:

1978-79 crop year

Beginning May, 1978

1. Crop before rice (May - July): early rainy season

1.1 Cropping pattern: mungbean (M7A), soybean (S.J. 2) glutinous corn, sweet corn (super sweet DMR), mungbean + sweet corn, soybean + sweet corn

6 replication across fields

3 planting date (superimposed trial)*

1.2 Cropping pattern intercrop with sugarcane: mungbean, soybean, glutinous corn and sweet corn

4 replications (research manage trial)*

1.3 Component technologies

1.3.1 Herbicide screening in mungbean

1.3.2 Row planting v.s. broadcasting with or without pre-emergence herbicide with or without fertilizer application in mungbean.

1.3.3 Intercrop soybean and glutinous corn at various combinations.

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* Superimposed trials are trial with large plot, farmers field as replication, plot size range from 1000-1600 sq. m while research manage trial are small plot trial with complete replication.

1.3.4 Insecticide trial (control v.s. Azodrin v.s. Phosdrin v.s. Lannate) (super imposed*)

1.3.5 Soil management study under conventional tillage and no tiliage system.

1.3.6 Hormone trial in mungbean

Note: All experiments in component technology are research manage trial unless indicated otherwise.

II. Rice crop (August - December): peak rainfall

2.1 Cropping pattern: non-photosensitive varieties v.s. photosensitive varieties.

2.2 Component technologies (research manage)

2.2.1 Various rate of Dalapon in broadcast rice.

2.2.2 Various rates of Dalapon in transplant rice.

2.2.3 Screening pre and post transplant herbicide in transplanting rice.

2.2.4 Various granular herbicide testing.

III. Crops after rice (January - April): No rainfall

3.1 Cropping pattern: mungbean, soybean, sweet corn, glutinous corn, mungbean + sweet corn and soybean + sweet corn

6 replications, 1 planting date (superimposed)

Note: Only mungbean crop survive.

3.2 Component technologies

3.2.1 Superimposed trial in mungbean

a. Insecticide trial (Azodrin 25 c.c/20 l. H_2O v.s. control)

b. Hormone trial (Setti hormone; locally made foliar nutrient in the form of urea (46.6% N) spray at vegetative stage, reproductive stage and control)

c. Herbicide trial

c.1 Row planting mungbean with or without Lasso (alachlor) application as pre-emergence herbicide.

c.2 Broadcasting mungbean with or without Lasso application.

3.2.2 Research manage trials

a. Plant population study in mungbean.

b. Rate and duration of filling period in soybean.

c. No tillage v.s. conventional tillage management in mungbean which influence soil moisture.

d. Herbicide study in mungbean grown after rice in no-tillage practices.

e. Sorghum and sesame trials after rice crops.

Conclusions for cropping pattern

Suitable pattern for Bangpae agro-climatic region are as follows:

1.	Mungbean (M7-A)	Rice (photo-sensitive var.	Mungbean M7A
2.	Sweet corn (Super Sweet DMR)	Rice (photo-sensitive var.)	Mungbean M7A
3.	Glutinous corn	Rice (photo-sensitive var)	Mungbean M7A

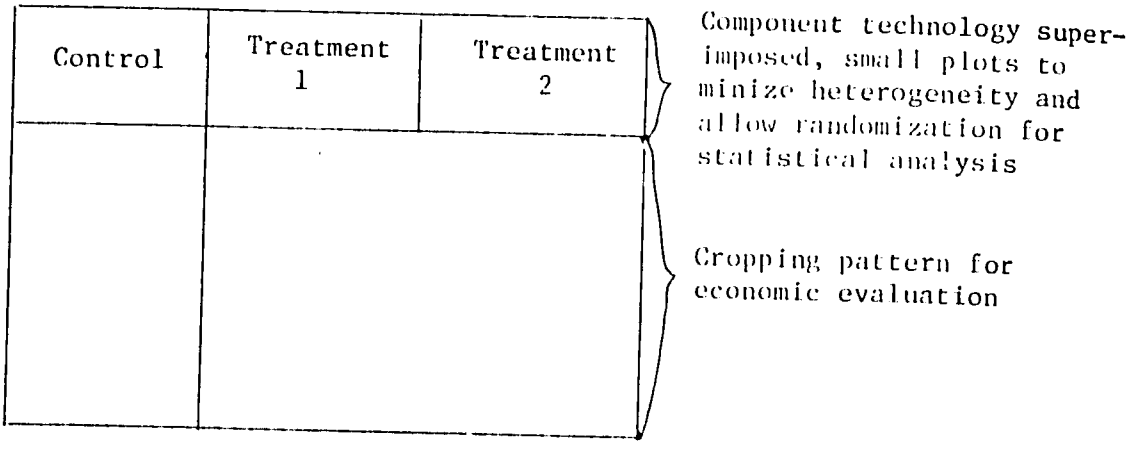
Remark: 1. Mungbean before rice crop is most suitable among other crop at Bangpae, after rice is harvested mungbean is the only crop which can survive under limited soil moisture and low management.

2. Sweet corn before rice crop is very high value crop before rice, however it has to be grown in lesser hectarage compared to mungbean so that farmer can give more fertilizer and better cultivation and take care their crops from stealing.

3. Glutinous corn produce similar amount of yield and receive similar management as sweet corn. However, crops may damage due to out break of downy mildew disease. Trial will be conducted in 1979 crop year to find out the effectiveness of fungicide treatment for glutinous corn seed while resistant variety is not developed yet.

1979 Work Plan

I. Crop before rice. Diagram below are plans for superimposed trials conducted in 1979.



Note: T1 = best treatment indicated from research manage trial conducted previously OR recommended rate.

T2 = second to the best treatment.

A. Superimposed trials

Studies	Mungbean (M-7-A)	Sweet corn, Super sweet DMR	Glutinous corn
1. Fertilizer studies	Control F1 = 50 kg N/ha F2 = 25 kg N/ha	Control F1 = Split application 50 kg N/ha F2 = Single application	Control F1 = split application 50 kg N/ha F2 = Single application
2. Herbicide studies	Control H1 = 5000cc Lasso/ha H2 = 3750cc Lasso/ha	Control H1 = 5000cc Lasso/ha H2 = 3750cc Lasso/ha	
3. Disease studies (Downy mildew disease control)			Control C1 = Ridomil at 0.2 gm/kg of seed mixed at planting C2 = Ridomil spray at early symptom of disease outbreak
4. Insect control	Control I1 = Threshold I2 = Recommended	Control I1 = Threshold I2 = Recommended	Control I1 = Threshold I2 = Recommended

B. Research manage trials

1. Insect monitoring program.
2. Herbicide study in sweet corn.
3. Alternate cropping pattern { sesame / mungbean + sweet corn, direct seeded rice }
4. Fertilizer trial in mungbean.
5. Planting date experiments in mungbean and sweet corn.
6. Mungbean variety evaluation.

II. Rice crops

Superimposed trials

1. Fertilizer trials in photosensitive rice.
2. Comparison between photosensitive rice and non-photosenstive rice variety.
3. Herbicide trials in broadcast rice.

Research manage trials

1. Effect of Furadan as seedling treatments in transplant rice.
2. Spray program in rice for insect control as related to pest monitoring.
3. Row-planting v.s. broadcasting in direct seeded rice.

III. Crop after rice

3.1. Superimposed trial in mungbean

3.1.1 Herbicide trial in mungbean.

3.1.2 Fertilizer trial in mungbean.

3.1.3 Insecticide trial in mungbean.

Note: The above superimposed trial in mungbean after rice will consist of different treatments similar to the mungbean superimposed trial before rice in 1979.

3.2 Research manage trial in mungbean

3.2.1 Insect monitoring.

3.2.2 Plant population and growth study of mungbean.

3.2.3 Soil moisture monitoring program under different surface management.

3.2.4 Alternate cropping pattern using other suitable mungbean varieties and other drought resistant crop.

3.3. Multilocation testing - mungbean

3.4. Second rice crop testing as alternate pattern after 1st rice crop.

3.4.1 Identify area suitable for growing second rice crop across the district.

3.4.2 Varietal testing of rice grown as second rice crop.

3.4.3 Comparison between ratooning rice broadcasting and transplant second rice crop.

3.4.4 Fertilizer trials in second rice crop.

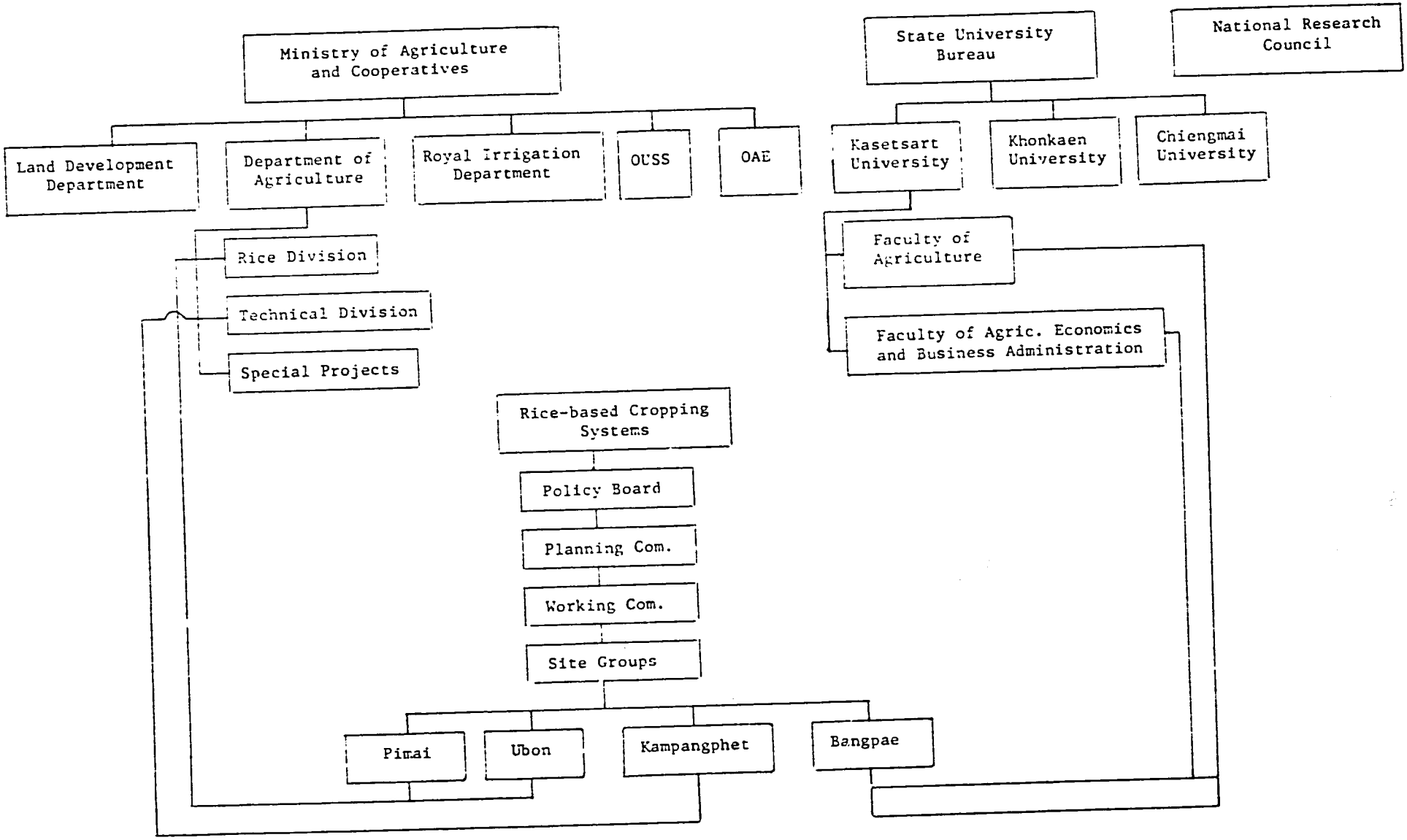
3.4.5 Herbicide trials in second rice crop.

Other research activities

Chiengmai University is also conducting cropping systems research in farmers' fields in villages near the university. The research workers found many problems associated with its work especially when introducing the third crop for the year-round operation. The third crop fall on the summer months when farmers prefer to rest and to set involve in social activities. So that the labor constraint and willingness of the farmers come into consideration. The farmers have to be convinced that the third crops do pay and command a good price in the market. They are interested in tomato planting in the summer months. However, one of the problem occurring in the summer months is the uncertainty of getting the water on time and in sufficient amount for a successful crop growing.

Khonkaen University in the Northeast also involves in the cropping systems research in the villages under rainfed condition. They are testing cropping patterns in the upland area, in the upper paddy and in the lowland fields. The research staff are gathering information so that conclusive evidences of any proper cropping pattern for particular area are not available at the present. Mungbean and cowpea are possible for growing before upland rice in the upland paddy fields. In the lowland paddy fields, mungbean before rice around Khonkaen province seems to be a stable combination in a good year of normal rainfall but in irregular year especially having long drought periods in the early monsoon, peanut before rice is promising.

Future research plans

It was a very dry year for the Northeast in particular in 1977 comparing to a very wet year in 1978. So that a comparison is being made of the results of the cropping pattern trials under the rainfed conditions. We hope that 1979 will be a normal year and the results of the trials will help us to come up with a good conclusion especially at Ubon site. We hope to stop research work at Ubon but the extension people will carry on their own stage of operation. At Pimai, the research will continue for another year hoping to arrive at some conclusions leading to farmers' recommendation. Kampangphet and Bangpae will continue the research operations at the same time. Other site selections will be made, identified and operated, representing priority areas and serving different agro-climatic and economic zones of the country.

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