

Promoting Implementation of Crop Diversification in Rice-Based Irrigation Systems in Thailand

Anchalee Ouraikul

*Senior Economist, Office of Agricultural Economics
Ministry of Agriculture and Cooperatives, Bangkok, Thailand*

Lersak Rewtarkulpaiboon

*Irrigation Engineer, Royal Irrigation Department
Ministry of Agriculture and Cooperatives, Bangkok, Thailand*

Surichart Somwatanasak

*Subject Matter Specialist, Department of Agricultural Extension
Ministry of Agriculture and Cooperatives, Bangkok, Thailand*

INTRODUCTION

AGRICULTURE DOMINATES THE economy of the Kingdom of Thailand, contributing more than 33 percent of the total national export in 1990. About 70 percent of the total working population is engaged in agriculture and agriculture-related activities.

Rice constitutes the main agricultural crop, cultivated in about 9.5 million ha or approximately 62 percent of the total cultivated area. In the 1970s, the government promoted agricultural development to increase rice production to feed the growing population and increase export. At the end of the fiscal year 1990, about 3.5 million ha were irrigated, and about 2.5 million ha were planted to wet season rice (Tables 1 and 2). The yield averages 3.13 t/ha.

Rice has been the largest foreign exchange earner with a record export value of US\$1,110 million, or 5 percent of the total export in 1990. However, the sharp drop in the world prices of rice in the early 1980s has made rice production less profitable. Moreover, the population growth has slowed down and the per capita rice consumption has started to decline. It thus becomes difficult to justify irrigation and agricultural projects for rice production.

Table 1. Irrigation projects and irrigated areas in Thailand.

Region	Large-scale projects		Medium-scale projects		Total	
	Number	Irrigated area (ha)	Number	Irrigated area (ha)	Number	Irrigated area (ha)
North	12	265,296	222	353,767	234	619,063
Northeast	11	280,785	314	257,161	325	537,946
Central	44	1,793,582	152	216,288	196	2,009,870
South	6	123,596	88	213,250	94	336,846
Total	73	2,463,258	776	1,040,465	849	3,503,725

Notes: Large-scale project - More than 12,800 ha of irrigated area and more than 100 million m³ of reservoir capacity.
Medium-scale project - Less than 12,800 ha of irrigated area and less than 100 million m³ of reservoir capacity.

Table 2. Irrigated areas (ha) for wet season rice in Thailand, (1985-90).

Region	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90
North	333,193	390,591	359,513	364,529	382,686	376,705
Northeast	326,572	348,269	358,974	355,140	362,034	375,510
Central	1,476,844	1,447,349	1,467,921	1,467,451	1,445,280	1,487,515
South	176,830	178,560	203,608	230,010	229,762	248,313
Total	2,313,438	2,364,769	2,387,017	2,417,130	2,419,761	2,488,044

The Royal Irrigation Department (RID) is responsible for irrigation, drainage, and flood control projects in Thailand. It has classified water management of irrigated areas into three stages:

Stage I. Upon completion of the irrigation project, water user groups are organized ditch by ditch and trained in appropriate water uses. The leaders of each water user group are trained in water management by the RID or other concerned government agencies.

Stage II. After the farmers learn how to use water properly, production technologies in accordance with physiography, soil, climate, market, etc., of each region are introduced to increase yield both in quantity and quality. At this stage, the activities of the water user groups organized in Stage I may be modified.

Stage III. Projects which have passed Stage II may still encounter water shortage problems. In order to address these problems, groundwater development may have to be implemented.

Presently, the water management of existing irrigation projects is mostly under Stage I. A few are in Stage II but no project has yet reached Stage III.

CROP DIVERSIFICATION IN RICE-BASED SYSTEMS

In the wet season, crop diversification in Thailand is limited because farmers prefer to grow rice to guarantee their food supply. Furthermore, water is excessive for upland crops in most irrigated areas and is fully allocated to the irrigated areas without regard of the dry season planting. Thus, the area for the following dry season crop has to depend on the water situation at the end of the wet season, especially in irrigation systems which get water from reservoirs.

The potential for crop diversification is generally confined to areas with access to water during the dry season. Table 3 shows distribution of irrigated areas for dry season cropping from 1985 to 1989. It shows a breakdown of irrigated areas for dry season rice, upland crops, vegetables, sugarcane, fruit trees, perennial crops and fish ponds. Table 4 shows the percentage of irrigated area used for diversified cropping, 1985 to 1989.

Tables 5 to 9 present the distribution of areas for regional crop cultivation from 1985 to 1989 in Thailand. It is to be noted here that administratively, the RID manages the irrigation system by dividing the country into 12 regions as shown in Figure 1. Table 10 shows the planted and irrigated areas of selected irrigation projects in 1989-90. It can be observed that good potential areas for diversified crops are in the north and in some portions of the central plain.

Table 3. Distribution of irrigated areas (ha) for dry season cropping, 1985-89.

Year	Rice	Upland crops	Vegetable	Sugarcane	Fruit trees	Perennial crops	Fish ponds	Total
1985	569,100	107,360	27,400	49,459	56,990	23,130	29,096	862,535
1986	556,282	113,233	33,444	61,292	103,139	54,904	35,536	957,830
1987	509,157	116,800	29,931	67,119	96,883	59,297	37,023	916,210
1988	562,958	112,128	29,846	99,963	103,587	51,448	42,157	1,002,087
1989	699,724	113,025	26,506	108,802	99,056	42,899	44,804	1,134,816
Average	579,444	112,509	29,426	77,327	91,931	46,335	37,723	974,696

Table 4. Percentage of irrigated areas used for diversified cropping.

Year	Irrigated area (‘000 ha)	Diversified cropping area (‘000 ha)	Percentage of diversified cropping area
1985	3,179	293	9.23
1986	3,240	402	12.39
1987	3,360	407	12.11
1988	3,396	439	12.93
1989	3,460	435	12.57

Table 5. Distribution of areas (ha) for dry season cropping in 12 regions according to RID administration, 1985.

RID Region	Rice	Upland crops	Vegetables	Sugarcane	Fruit trees	Perennial crops	Fish ponds	Total
1	2,150	21,330	2,420	-	-	-	-	25,900
2	4,320	11,750	2,030	-	160	-	-	18,260
3	26,670	11,530	660	120	-	-	6	38,986
4	4,780	5,870	550	8	-	-	-	11,208
5	2,700	3,900	590	2	-	-	30	7,222
6	4,060	7,990	1,950	-	-	-	-	14,000
7	311,260	4,910	6,650	10,310	15,470	1,560	3,390	353,550
8	109,290	17,010	950	20	16,380	3,090	12,180	158,920
9	51,440	1,120	600	-	30	20	10,630	63,840
10	36,060	20,370	10,290	38,990	18,080	13,670	2,850	140,310
11	1,420	420	530	7	6,840	4,790	10	14,017
12	14,950	1,160	180	2	30	-	-	16,322
Total	569,100	107,360	27,400	49,459	56,990	23,130	29,096	862,535

Table 6. Distribution of areas (ha) for dry season cropping in 12 regions according to RID administration, 1986.

RID Region	Rice	Upland crops	Vegetables	Sugarcane	Fruit trees	Perennial crops	Fish ponds	Total
1	2,187	26,766	1,958	-	8,008	23	70	39,012
2	2,722	15,920	2,286	413	15,127	17,906	765	55,138
3	22,230	12,457	624	128	1,980	259	123	37,801
4	11,141	3,061	1,491	47	339	-	221	16,300
5	4,329	8,297	927	-	160	17	412	14,144
6	2,551	5,530	805	-	-	-	32	8,918
7	293,731	8,361	8,114	8,888	16,185	1,850	4,451	341,580
8	102,861	10,413	712	3	20,345	3,796	13,233	151,363
9	55,575	2,168	378	64	2,333	2,430	10,708	73,657
10	45,443	19,780	15,617	51,742	29,654	20,985	5,471	188,691
11	1,034	308	492	4	8,948	5,953	44	16,683
12	12,478	271	42	2	59	1,684	6	14,542
Total	556,282	113,233	33,444	61,292	103,139	54,904	35,536	957,830

Table 7. Distribution of areas (ha) for dry season cropping in 12 regions according to RID administration, 1987.

RID Region	Rice	Upland crops	Vegetables	Sugarcane	Fruit trees	Perennial crops	Fish ponds	Total
1	2,877	25,343	2,269	-	8,008	23	68	38,589
2	1,528	13,652	1,874	499	15,271	17,906	567	51,299
3	25,328	15,476	209	4,357	1,980	259	141	47,752
4	4,365	4,094	994	64	245	2	197	9,961
5	4,811	99,400	707	93	221	33	631	15,897
6	3,512	6,786	2,093	-	-	-	25	12,417
7	272,785	5,820	8,032	9,04	15,206	1,521	7,262	321,230
8	83,379	9,720	1,012	83	16,573	4,063	14,056	128,886
9	50,051	2,768	762	166	3,842	2,674	10,792	72,056
10	44,196	21,875	11,195	52,243	26,306	21,158	3,245	180,218
11	3,089	322	674	4	9,076	7,332	38	20,534
12	13,234	543	111	4	154	4,325	1	18,372
Total	509,157	116,800	29,931	67,119	96,883	59,297	37,023	916,210

Table 8. Distribution of areas (ha) for dry season cropping in 12 regions according to RID administration, 1988.

RID Region	Rice	Upland crops	Vegetables	Sugarcane	Fruit trees	Perennial crops	Fish ponds	Total
1	2,398	28,617	2,151	-	8,008	23	-	41,197
2	3,647	17,488	3,747	499	15,297	14,181	119	54,978
3	31,344	10,432	673	6,985	1,751	109	44	51,338
4	16,746	6,824	2,158	51	156	204	453	26,592
5	8,432	12,328	1,930	147	11	17	949	23,814
6	7,099	3,425	240	-	-	-	27	10,790
7	256,573	3,947	6,644	11,174	18,434	624	7,360	304,410
8	97,326	4,299	652	88	19,580	1,812	16,653	140,410
9	51,568	1,948	398	199	3,927	3,480	12,684	74,204
10	69,758	22,063	10,366	80,813	27,083	22,684	3,845	236,611
11	3,302	372	700	1	9,270	6,773	18	20,436
12	14,763	387	189	6	72	1,540	4	16,961
Total	562,958	112,128	29,846	99,963	103,587	51,448	42,157	1,002,087

Table 9. Distribution of areas (ha) for dry season cropping in 12 regions according to RID administration, 1989.

RID Region	Rice	Upland crops	Vegetables	Sugarcane	Fruit trees	Perennial crops	Fish ponds	Total
1	2,664	28,609	1,736	-	8,008	23	-	41,040
2	2,339	19,347	2,594	499	11,669	2,521	89	39,059
3	75,258	13,079	139	9,487	1,907	160	156	100,184
4	24,287	5,172	1,828	52	16	30	443	31,828
5	12,966	13,864	1,281	-	-	-	147	17,044
6	7,608	8,071	1,218	-	-	-	147	17,044
7	314,793	3,155	7,954	12,825	12,919	635	10,767	363,064
8	96,492	4,919	391	5	22,055	1,884	14,761	140,507
9	48,985	1,733	313	18	3,916	3,163	12,970	71,098
10	98,032	14,259	8,283	85,798	29,208	22,583	4,496	26,258
11	1,985	347	653	1	8,744	6,395	3	18,128
12	14,315	470	118	1	605	5,505	43	21,056
Total	699,724	113,025	26,508	108,686	99,047	42,899	44,022	886,310

Table 10. Planted and irrigated areas in selected irrigation projects, 1989-90.

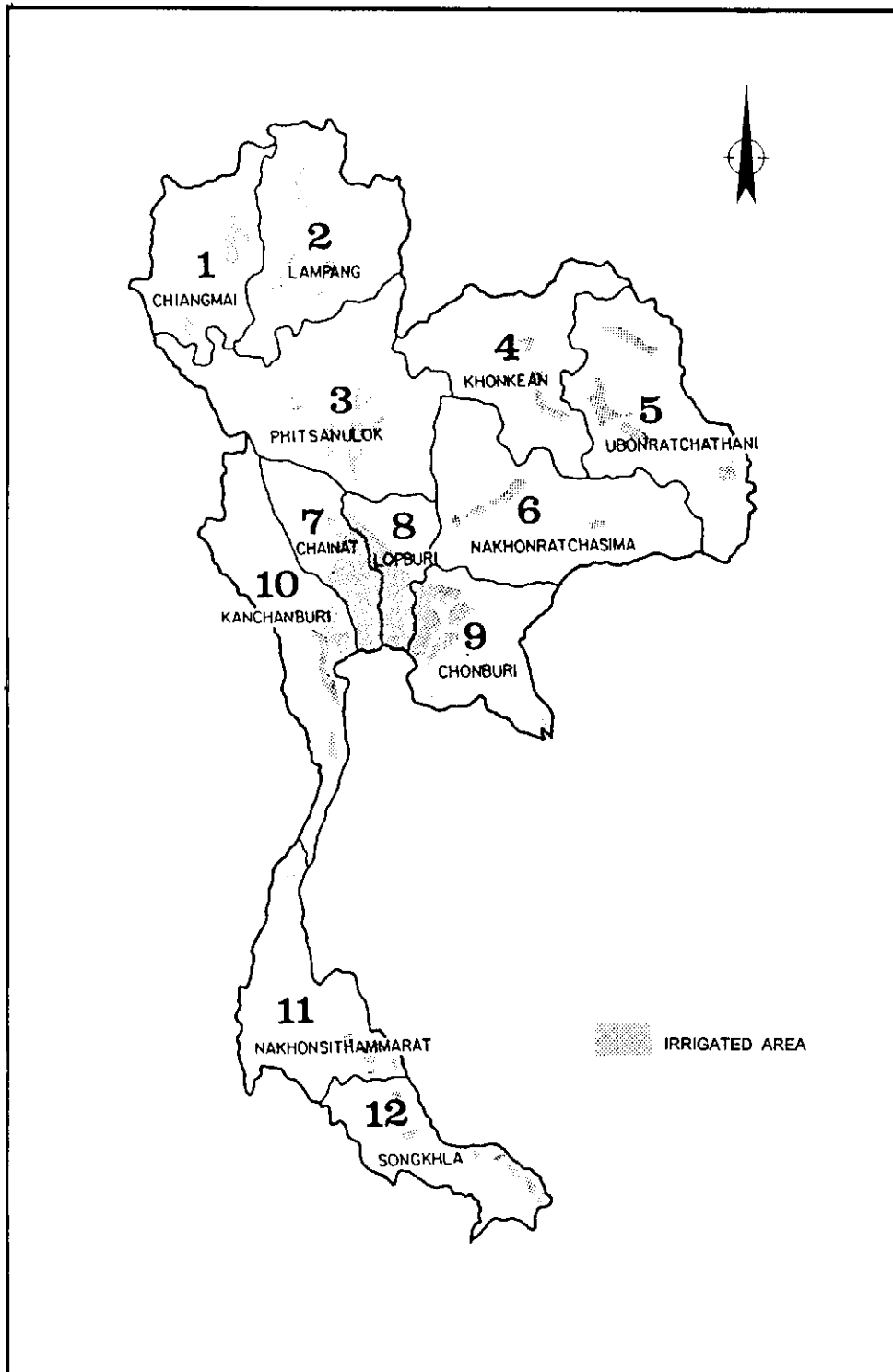
Project	Project area (ha)	Area of wet season rice (ha)	Area planted to dry-season crops (ha)							Total
			Rice	Upland crops	Vegc- tables	Sugar- cane	Fruit trees	Perennial crops	Fish ponds	
Northern Region	125,412	105,080	16,957	26,531	3,340	449	2,290	15	110	50,322
Mae Taeng	23,000	17,600	285	10,192	305	-	2,572	-	21	13,375
Mae Faek	11,200	7,088	211	3,516	274	-	-	-	-	4,001
Mae Ping Kao	7,200	7,360	1,005	1,175	985	-	-	-	-	3,165
Mae Kuang	9,600	9,363	3	1,474	469	-	-	-	-	1,946
Kew Lom	24,480	17,386	729	7,455	1,270	499	348	15	89	10,405
Phitsanulok	50,032	46,283	14,724	2,719	37	-	-	-	-	17,480
Northeastern Region	204,412	187,506	56,861	15,836	2,051	-	12	-	621	75,381
Nong Wai/Nam										
Phong	48,400	40,676	29,912	2,825	302	-	3	-	202	33,244
Lam Nam Oon	32,480	28,098	846	2,464	52	-	9	-	166	3,537
Lam Pao	50,400	49,060	14,678	3,737	590	-	-	-	-	19,005
Lam Dom Noi	24,000	26,052	4,220	1,374	144	-	-	-	199	2,644
Lam Praploeng	11,123	13,306	6,260	449	72	-	-	-	54	5,792
Lam Takong	22,000	16,253	679	3,274	425	-	-	-	-	4,378
Central Region	389,106	161,382	74,515	9,724	11,321	50,060	39,245	4,392	9,119	198,376
Mae Klong	389,106	161,382	74,515	9,274	11,321	50,060	39,245	4,392	9,119	198,376
Total	719,000	453,969	148,333	52,091	16,712	50,509	42,177	4,407	9,850	324,079

Source: Royal Irrigation Department, 1990.

Among the diversified crops grown, upland crops are predominant and contribute about 40 percent to the total cropped area. Soybean, mungbean, groundnut, taro and vegetables are the popular cash crops grown in the central plain after rice. Tobacco, garlic, onion and soybean are cultivated in the north, while groundnut, sesame, mungbean and watermelon are generally grown in the northeast. In some areas, rice fields have been converted permanently into fish ponds or orchards.

Soybean production is only 0.6 million mt per year, which is not enough for domestic requirements and therefore, soybean has to be imported. Thus, soybean is given top priority in rice-based systems. Mungbean has a high demand in foreign markets, along with vegetables and fruits. Fishery products, particularly shrimp and prawn, have an increasing demand in the world market.

Figure 1. The 12 regional Irrigation Offices and irrigated areas in Thailand.



PROGRAMS RELATED TO PROMOTING CROP DIVERSIFICATION

Shifting Rice Lands to Other Farming Activities

Rice is the single most important crop in Thailand, and the major source of income for farmers and provides export earnings averaging more than 35,000 million bahts a year. However, there is now stronger competition among rice exporting countries in the world market and the water supply in irrigated areas is becoming limited. Thus, the Agriculture Ministry is conducting a project which is looking into ways of using rice lands for other farming activities.

The project aims at (i) assisting farmers in irrigated areas to utilize water more effectively, and (ii) providing these farmers with farming alternatives so that they will not depend on rice alone.

In the short term plan, other crops which require less water and which have a high market demand like mungbean, maize, vegetables and some upland crops could be planted instead of a second crop of rice. In the long run, these lands could be converted to orchards, pastures for dairy cows, or used for other more permanent enterprises.

Part of the project is the provision of government support to the participating farmers along with the following incentives:

1. Seedlings and other inputs. The government provides, without cost, seedlings of upland crops and vegetables. Seedlings of fruit trees and dairy cows are given on loan, at low interest rates.
2. Technology transfer. The government organizes training courses on farm management, crop cultivation methods, and dairy cow raising.
3. Marketing. In order to ensure a stable market and stable prices, the Agriculture Ministry has invited the private sector to join the projects through contract farming.

Extension Programs for Soybean Production

Soybean plays an important role in many industries in Thailand, especially in animal production. The government has tried to promote soybean production to meet the domestic consumption demand but to no avail. In 1988-89, soybean production was estimated at 0.283 million mt while the domestic demand was 0.453 million mt. Meanwhile, animal production has expanded rapidly.

At present, soybean is largely cultivated in the northern part of Thailand. Production is estimated at 70 percent in the rainy season, and 30 percent in the dry season.

Soybean production can be increased by increasing the yield per hectare and/or by increasing the growing area. In irrigated areas, soybean can replace rice. Water requirement for soybean is 3-4 times lower than that for rice and farmers can earn more from soybean when water is limited.

Research has looked at improving the existing technology and the rice-soybean and rice-tobacco cropping patterns, for which local varieties are being used at present. In six years (1982-1988), the study found that the farmers accept the rice-soybean-soybean cropping system. When compared with the yield value of 18,012 baht/ha, from the rice-soybean-mungbean pattern, rice-soybean-soybean gives a return of 23,368 baht/ha, a difference of 5,365 baht/ha or 29.7 percent.

Factors which affect the adoption of the cropping system are as follows:

1. Farmer's experience. The farmers have acquired the skill and knowhow in soybean production.
2. Soybean yield. The new varieties of soybean (SJ. 4,5 and Nakornsawan varieties) give higher yields than the local varieties.
3. Price. The price and the availability of soybean convince farmers to grow it and expand the soybean production area.
4. Benefit. The benefit and yield/unit area of soybean are higher than those for existing crops.
5. Harvesting process. Soybean is harvested easily, rapidly, and in one gathering.

It was found that at the end of the 1987-88 growing season, 76.6 percent of the farmers wanted to continue soybean production the following year. Only the farmers in the Western and Central regions were not receptive to soybean because of low yields, stable prices and markets for rice, and inadequate knowledge of soybean production. Other results have shown the following:

1. If soybean is planted later than January, the flowers will not be fertilized.
2. The recommended method of dropping seeds into rice stubbles is not accepted by farmers.
3. Farmers use a higher seeding rate because they broadcast the seeds, which makes it difficult to control weeds, resulting in poor yields.
4. Farmers did not realize that caterpillars and other pests from deformed seeds, and rats can be a serious threat when soybean is grown in rice areas.

The future extension program for soybean production should include seed production, adequate water during the growing season, equipment that farmers can acquire, Rhizobium culture for new growing areas, and consumption of soybean at the farm level.

PROBLEMS IN PROMOTING CROP DIVERSIFICATION PROGRAMS IN IRRIGATED AREAS

1. The irrigation and drainage infrastructures of the command areas are not well-suited to meet the irrigation and drainage requirements.
2. The rice farmers usually expand their cultivated areas during the dry season without due regard to the availability of water. Consequently, water shortages and low crop yields result.
3. Because of the farmers' lack of collateral (land title) required by banks, institutional credit becomes a problem. This makes it difficult for the farmers to buy the modern inputs needed to increase yield and, consequently, the country's competitiveness in the export market.
4. There is a high risk involved in investing in crop diversification as experienced by several agro-businesses during the last decade.
5. Substitute crops to replace rice during the dry season are still not well-known. Since the farmers are used to growing rice in the dry season for a long time, the price and availability of markets have convinced them to maintain this practice.

6. There are conflicts among water users who grow different crops. Different maturing rice varieties and field crops have different demands for water in terms of quantity and timing.
7. Nonagricultural employment which provides more income than on-farm activities during the dry season causes labor shortages in the rural areas. This, in turn, has the following effects:
 - i. Farmers not expanding their cultivated land in the dry season.
 - ii. Delay in planting and harvesting that affects the quality of some crops.
 - iii. Social problems in rural and urban areas.
8. Some areas are not suitable for growing field crops. For instance, the irrigated area in the northeastern region which is partly clay and partly silty is left idle in the dry season.
9. In some irrigated areas, the farmers do not plan their irrigation because they lack the know-how on appropriate water applications.
10. In some areas especially in the central plain, the farmers grow rice continuously in the wet and dry seasons. This causes some pest problems. In 1980, brown plant hoppers spread out and damaged the rice production in the dry season. Incidentally, some farmers apply chemicals incorrectly.
11. In terms of the market, the farmers do not trust the market availability of other crops, the price of existing crops still attracts the farmers more than other considerations, the promotion of contract farming according to government policy benefits only the minority, and some joint projects with private sectors have not achieved their objectives.

APPROPRIATE STRATEGIES TO PROMOTE CROP DIVERSIFICATION

Research and Extension

The linkage between research and extension in Thailand has been through committees and sub-committees with different levels of coordination.

Under the Research and Extension Coordination Committee, policies are formulated in line with the National Economic and Social Development Plan and according to the policy of each department. After the policy is set, a workplan is formed and proposed to the Agricultural Research and Extension Coordination Committee. The workplan is then forwarded to the Agricultural Research and Extension Coordination Sub-Committees at the regional offices for implementation.

There are seven programs/projects being implemented under this linkage scheme:

Research. The Department of Agriculture is responsible for carrying out the task according to the workplan while the DOAE provides the necessary information from the field. Feedback from farmers is also considered in drawing up research plans and policies.

Seed multiplication. In practice, the DOA breeds and certifies the new varieties, and produces breeder seeds and foundation seeds. From the foundation seeds, the DOAE produces registered seeds and extension seeds which are then distributed extensively to the farmers.

On-farm trials. This is to test or adjust the technology from research stations under field conditions. This is conducted by the DOA in cooperation with the DOAE.

Multi-location trials. The results of on-farm trials are tested in various locations. The socioeconomic conditions of the farmers are considered as the major factor that contributes to the adoption of technology. The DOAE, in cooperation with DOA, conducts this task.

Demonstration trials. The results of multi-location trials are extended to the majority of farmers by means of demonstration plots or field days. The DOAE is responsible for this task and the DOA assists in providing detailed information.

Information distribution. Research results at all levels are distributed to technologists, extension agents and farmers in general by means of academic documents, publications and audio-visual aids. This is done by the two departments.

Technology transfer. Technology as innovation is transferred from the research section to the extension section to enhance the ability of extension technologists. This is done through conferences, seminars, workshops, trainings, study tours or by consulting the agricultural service centers in every research institute.

Appropriate Incentives

To convince rice farmers to plant other crops, the government would have to provide the following incentives:

1. Stable prices and markets for the new products. A minimum price guarantee that would provide a total income of not less than that received from rice should be established.
2. Provision of inputs. Besides the price guarantee, the government should help provide the farmers with the required inputs such as seedlings, fertilizers and pesticides to encourage them to participate in the project.
3. Provision of low interest loans. Turning rice lands to other farm types like orchard farms and dairy cow raising pastures would require high investments. Most farmers lack cash, therefore, the government must provide them with low-interest loans to persuade them to undertake the projects.
4. Appropriate technology. Because the farmers may not be acquainted with the new farming activities, training courses and other means should be available to guide farmers and demonstrate the new practices.
5. Working together as a cooperative. To encourage farmers to help each other, to have easy transfer of technology, and to have bargaining power in the markets, the participating farmers must be formed into groups.

CONCLUSIONS AND RECOMMENDATIONS

Roles of National Institutes and Agencies

Government and private institutions and agencies play an important role in convincing rice farmers to shift from rice cultivation to other farming activities. The government sector should focus on the following:

1. **Research.** It is necessary for the government to do research on suitable crops for diversification.
2. **Technology transfer.** The results of research, new techniques developed, should be transferred to the participating farmers.
3. **Good quality inputs.** Seedlings, fertilizers, pesticides and other production inputs should be adequately provided.
4. **Improved irrigation systems and water management.** The irrigation systems must be improved for better water use for agricultural diversification. The RID has to provide training in advanced water management for the water user groups.

Financial institutions, traders, and the farmers themselves have their respective roles to play. Low-interest loans should be provided to the farmers by private financial institutions and partly compensated by the government to lower the interest rate. Exporters or processors can be involved in contract farming. The government can provide incentives such as import or export quotas, low-interest package credit, etc.

Role of Other Countries and International Agencies

International cooperation for implementing crop diversification can provide exchange of experiences and facilitate the transfer of technology. This is particularly important among Asian countries because of similar climates, customs and traditions.

Another important consideration is the necessary investment capital. Without support from governments or international agencies, crop diversification will not succeed.

In the past, the USAID granted support to the RID for the implementation of agricultural diversification in the Nam Oon Irrigation Project. At present, the ADB has provided a grant of about US\$750,000 to the RID to study agricultural diversification in the lower west bank portion of the Chao Phraya Project with an area of 249,000 ha. The study has been undertaken by a team of consultants from Thailand, Australia and Japan. It was expected to be completed in December 1990.