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Impacts of New Rice Technology on Thai Delta Villages*

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Introduction

In this paper I intend (1) to analyze the impact of the introduction of high yielding varieties (HYVs) of rice and related technologies on farm household economy and on rural development (improvement in the well-being of most of the rural population) in two villages in Thailand and (2) to present some implied policy proposals for rural development. This analysis is based on two village surveys conducted in July and August, 1976 in the Central Plain of Thailand under the research project "Green Revolution and Rural Development—with Particular Reference to the Role of Educational and Social Factors in Southeast Asia," sponsored by the Center for Southeast Asian Studies of Kyoto University (CSEAS). In the village surveys data was obtained from randomly selected household heads on such topics as family, ecology, technology, economy, society, and education. The two villages surveyed are located in an area more strongly influenced by industrialization and urbanization than other areas of Thailand, and thus these influences are also discussed.

I Major Characteristics of the Survey Villages

a. *Survey Area and Representativeness of the Survey Villages*

The two survey villages are located in the Central Plain of Thailand, one in Sriprachan District, Suphanburi Province and the other in Ladlumkaeo District, Phathumthani Province. The name of the villages are Sixth Village and Twelfth Village (henceforth M6 and M12).[1] Both villages have a well developed canal system. M12 is located in a backswamp in the central Chao Praya Delta, and M6 lies along the Suphanburi River, a branch of the Chao Praya, at the margin of the delta. In M12 rice growing is characterized by the problem of inundation and bad drainage in the rainy season and by irrigation by pump or *rahat* (traditional low lift pump) in the dry season. In M6, the steeper slopes allow the extensive use of gravity irrigation for rice production, with supplementary pump irrigation in both

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1) The exact locations of these villages are Tambol Wang Yang, Amphur Sriprachang, Suphanburi Province; and Tambol Kubang Luang, Amphur Ladlumkaeo, Phathumthani Province.

rainy and dry seasons.

In both villages rice production is the main economic activity, and HYVs are widely planted. Although both villages lie in rural areas monetization has spread to all aspects of the villagers' economic activity. M12 is closer to Bangkok than M6 (about 60 km distant as opposed to 150 km) and is considerably influenced by the industrialization in and around the capital. Near M12 are two factories employing considerable numbers of the young villagers as unskilled workers on a monthly or daily basis. But near M6 there are no factories, and nonagricultural job opportunities there are more severely limited than in M12. M12 is about 20 km west of the provincial capital and about 5 km from a good paved road, being accessible only by canal or by dirt road. M6 lies on the Suphanburi River, about 15 km north of the provincial capital. A paved highway passes through the village.

These villages are two of the six villages in Thailand surveyed under the CSEAS research project. The villages were selected on the basis of a physiographic zoning of Thailand by natural scientists at CSEAS and of the availability of village data accumulated by us or by other institutions. M12 was the subject of a socio-cultural survey by CSEAS in 1973, and M6 the object of agroeconomic surveys by Kasetsart University in Thailand over the past several years.[2] An effort was made to select at least one village in each physiographic zone of Thailand in order to reflect the variation in physiographic conditions.

M6 consists of 142 households (about 800 people) of which 129 are agricultural households and thirteen nonagricultural.[3] Arable land mainly comprises 2,300 *rai* of paddy land and 200 *rai* planted with water chestnuts. M12 consists of 59 households (about 300 people) of which 53 are agricultural households and six nonagricultural. M12 has about 2,300 *rai* of paddy land and about 130 *rai* of fruit orchards. The survey covered eighteen agricultural households in M6 and fifteen in M12, randomly selected from among all agricultural households in each village, and two nonagricultural households in each village, randomly chosen from among all nonagricultural households.[4]

The representativeness of the survey villages was assessed by examination of results in the sample survey and comparable results in the 1963 Agricultural Census, as shown in Tables 1, 2 and 3.[5] Table 1 compares the size distributions of landholdings in the survey villages

2) Dr. Kamphol, Dr. Tongruai, Mr. Jonjade, and Mr. Phisit of Kasetsart University contributed greatly to my village surveys, especially in M6, where they have conducted surveys in the past few years. For M12, CSEAS published *Ine to Nomin* (Paddy and Farmers) in 1975 based on its survey of M12 and other villages in Thailand, Indonesia and Japan.

3) I define an agricultural household as one whose labor force and/or land are utilized mainly for crop production and/or animal husbandry. Thus not only owner-farmers and tenants but also landlords and most landless rural laborers are classified as agricultural households. The corollary definition of agricultural income as the total net rewards from the agricultural use of labor, land and other assets owned by the agricultural household therefore differs from the conventional definition used in Japan. This definition is better suited to the conditions in LDCs.

4) First, the households, in each village were mapped and numbered continuously as they are located along a canal and/or road. Then a random sample was taken for each village by use of a random number table.

5) This is the latest available agricultural census of Thailand.

Table 1 Distribution of Land Holdings Per Farm

Size of Holding (*rai*)	Survey Results M6 No. of Farms (%)	1963 Agricultural Census Suphanburi Total (%)	1963 Agricultural Census Amphur Sriprachan (%)	Survey Results M12 No. of Farms (%)	1963 Agricultural Census Phathumthani Total (%)	1963 Agricultural Census Amphur Ladlumkaeo (%)
0- 5.9	7(38.9)	(11.9)	(13.7)	1 (6.7)	(10.7)	(4.7)
6- 14.9	5(27.8)	(19.3)	(23.8)	2(13.3)	(12.7)	(9.1)
15- 29.9	3(16.7)	(29.0)	(35.0)	4(26.7)	(18.2)	(24.1)
30- 44.9	3(16.7)	(19.6)	(17.1)	1 (6.7)	(20.2)	(24.4)
45- 59.9	0 (0)	(10.2)	(6.6)	2(13.3)	(12.7)	(17.9)
60-139.9	0 (0)	(9.6)	(3.5)	5(33.3)	(23.3)	(19.5)
140 and over	0 (0)	(0.4)	(0.1)	0 (0)	(2.2)	(0.3)
Total	18(100.0)	(100.0)	(100.0)	15(100.0)	(100.0)	(100.0)
Average Size (*rai*)	12.5	29.0	22.3	42.5	42.1	39.8

and in the corresponding *amphur* (district) and province. The similarity of the distribution pattern for M12 and for the province and *amphur*, especially the double peak, indicates that M12 is a representative village in Phathumthani Province. But for M6 the distribution pattern shows little similarity to those for the province or *amphur*. There are two reasons for this. First, landless laborers and noncultivating landlords (who manage no landholdings) were not covered in the 1963 census but were covered in my survey (in M6 two farms in each category were surveyed, while in M12 only one landless laborer was surveyed). Second, during the early 1960s double cropping of rice was not practiced in Suphanburi Province, but from the early 1970s double cropping of HYVs became widespread in M6. This technological innovation between the time of the census and my survey, and the fact that M6 is economically more developed than the province as a whole, probably accounts for the greater fragmentation of landholdings in M6. In Suphanburi Province there is a considerable geographi-

Table 2 Distribution of Planted Areas of Paddy Per Farm

Planted Area (*rai*)	Survey Results M6 (%) No. of Farm	1963 Agr. Census Suphanburi Total	Survey Results M12 (%) No. of Farm	1963 Agr. Census Phathumthani Total
Total	18(100.0)	—	15(100.0)	—
0	7(38.9)	not available	3(20.0)	not available
0.1— 5.9	0 (0)		0 (0)	
6 — 14.9	2(11.1)		1 (6.7)	
15 — 29.9	4(22.2)		3(20.0)	
30 — 44.9	1 (5.6)		1 (6.7)	
45 — 59.9	4(22.2)		4(26.7)	
60 —139.9	0 (0)		3(20.0)	
140 and over	0 (0)		0 (0)	
Average Acreage (*rai*)	18.9	27.6	37.3	43.1

cal bias in the availability of irrigation water for rice, with a wide irrigated belt for double cropping lying along the Suphanburi River around and north of Suphanburi City. I believe M6 is a good representative of double cropping villages in this belt.

Table 2 shows that average planted areas of rice per farm in my survey and in the 1963 census are very close to each other for M12. For M6, these acreages are not similar, but are much closer to each other than average per farm landholdings shown in Table 1. This is because of the double cropping of rice in M6 just mentioned. The distribution pattern of areas planted to rice show two peaks for both M12 and M6, excluding non-rice-growing farms. This indicates that the scale of rice production in both survey villages is polarized.

Rice production is the dominant agricultural activity in both villages. This is reflected by the high proportion of land in crops in both provinces (Table 3). The proportion of land in crops which is irrigated differs greatly in Suphanburi Province overall from that in Sriprachan District in the same province, whereas the difference between Ladlumkaeo District and Phathumthani Province is negligible. This arises from the differences in topographical conditions and the resulting geographical bias in irrigation investment between these two provinces. Suphanburi Province, which has relatively slopping topography, consists of a well irrigated belt along the Suphan River and rain-fed rice-growing areas located further from the river to the west. Sriprachan District, including M6, is located in the irrigated belt. Phathumthani Province has flat topography and a homogeneously developed canal system.

The area around M6 was originally settled about 100 years ago by Chinese. At that time the area was covered mainly by forest, and rice production was limited to depressional areas. Farmers and nonfarmers in M6 are mostly descendants of these Chinese settlers, although most of the farmers I met in M6 showed no trace of their Chinese ancestry. I was informed by the local people that there are many villages in Suphanburi Province whose residents are descended from the original Chinese settlers. M6 was separated from the First Village (M1) 20 years ago because of population growth. M12 was originally settled by Thai farmers who moved from the levees of the Chao Praya River and the Suphanburi River about 15 km east

Table 3 Land Use, 1963 Agricultural Census (%)

Location	Arable Land			Land in Tree Crops	Pasture	Woodland	Other
	Land in Crops		Fallow and Others				
	Total	Irrigated					
Suphanburi, Total	88.7	59.8	1.7	2.1	0.1	4.1	3.4
Amphur Sriprachan	91.1	85.8	0.5	2.5	*	1.5	4.4
Phathumthani, Total	93.3	88.6	1.7	1.5	0.4	0.2	2.9
Amphur Ladlumkaeo	93.4	91.3	0.3	2.7	*	0.2	3.4

* less than 0.05%

and 45 km west of the village respectively about 80 years ago. At that time the area around M12 was covered with shrubs, which the early settlers had to clear. They also had to dig ponds to raise the ground level for house building and to grow floating rice by broadcasting because of the frequent flooding at the end of rainy season.

b. Village Agrarian Structure and Village Economy

In this section I will discuss the agrarian structure and economy of the survey villages based on the results of my survey. Table 4 lists the major average indicators of the sample farms.

The second column of the table shows the distribution of the sample farms by the types of land ownership, which represents the agrarian structure of the survey villages. In M6 the various types of farm are quite evenly distributed. In M12 tenant farming is the dominant type: eleven of the fifteen sample farms are those of tenants who own no crop land. According to the village headman, about half of total paddy land in M12 is cultivated under tenancy agreement, and about 95 percent of the rented land is owned by people living outside the village. Landless laborers were found in both villages.

The seventh column indicates that landlord households in the villages own extremely large holdings while the owner-farmers possess only small holdings in both villages. The average acreage owned per farm is similar in the two villages, but the landholding per farm is much larger in M12 than M6, as shown in the eighth column. This shows that a large amount of agricultural land is leased out to the M12 villagers by absentee landlords, which coincides with the statement of the village headman. This per farm landholding is relatively evenly distributed among the farm types other than landless laborers and pig farmers in M6 but not in M12. It is noteworthy that the large tenants have very large landholdings in M12.

The last five columns show total and seasonal planted areas of paddy, the most important crop in both villages. The per farm total planted area of paddy in M12 is about double that in M6. In M6, traditional varieties (TVs) and HYVs are both planted and HYV's is double cropped, whereas in M12 single cropping of HYVs in the off season is practiced. In M6 TVs are dominant in the main season because of their varietal characteristics. Because of double cropping, the total per farm planted area of paddy is considerably larger than the per farm landholding in M6.

The third to fifth columns indicate that on the average farms in M12 have a larger family size, a larger number of economically fully active persons, and a larger agricultural labor force than farms in M6. This coincides with the larger per farm landholding and larger planted area of paddy in M12 than M6. The large tenants in M12, who have the largest landholding and the largest planted area of paddy per farm of all types of farms in both M12 and M6, have the largest family size, the largest number of economically active persons, and the largest agricultural labor force. All these reflect the fact that labor-intensive paddy production methods are current in Thailand.

Table 5 is a summary of the 1975/76 farm household economy by farm type from my

Table 4 Average Indicators Per Sample Farm

Type of Farm		Number of House-holds	Family Size	Economically Fully Active Persons	Agr. Labor Force[1]	Average Age of Family Members	Area of Land Owned	Total Holding	Paddy Planted Area				
									Main (*rai*)		Off (*rai*)		Total (*rai*)
			(persons)	(persons)	(persons)	(years)	(*rai*)	(*rai*)	HYV	TV	HYV	TV	
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
M6	Whole Sample	18	4.9	2.8	3.0	29.9	20.4	12.5	1.5	8.6	8.9	0.0	19.0
	Landlord[2]	5	5.2	2.0	2.2	25.7	58.1	12.2	2.8	7.2	8.4	0.0	18.4
	Owner	3	4.0	3.3	3.3	38.2	12.7	16.3	0.0	12.3	10.3	0.0	22.6
	Tenant[3]	6	5.8	3.5	3.8	24.0	6.4	18.3	2.2	13.5	14.5	0.0	30.2
	Landless Laborer	2	5.5	2.5	3.0	18.9	0.0	0.8	0.0	0.0	0.0	0.0	0.0
	Pig Farmer	2	2.5	2.0	2.0	56.9	0.0	2.1	0.0	0.0	0.0	0.0	0.0
M12	Whole Sample	15	6.4	3.9	4.3	26.3	17.2	42.5	0.0	0.0	37.3	0.0	37.3
	Landlord	2	4.0	3.0	3.0	35.1	114.1	41.0	0.0	0.0	27.5	0.0	27.5
	Owner	1	5.0	2.0	4.0	23.0	6.0	6.3	0.0	0.0	0.0	0.0	0.0
	Tenant[3]	11	7.0	4.5	4.8	24.9	2.1	49.8	0.0	0.0	45.9	0.0	45.9
	Large[4]	7	8.0	5.1	5.7	24.8	3.4	68.4	0.0	0.0	62.7	0.0	62.7
	Small	4	5.3	3.3	3.3	25.0	0.0	17.2	0.0	0.0	16.5	0.0	16.5
	Landless Laborer	1	6.0	2.0	1.0	27.16	0.0	2.0	0.0	0.0	0.0	0.0	0.0

Note: 1) Includes part-time labor force
2) Includes cultivating landlord
3) Includes owner-tenants
4) Planted paddy area of 25 *rai* or more

Table 5 Farm Economy 1975/76, Per Farm Figures

unit: baht

Type of Farm (No.)		Gross Agricultural Income											Agricultural Expenditures								Agricultural Income (G−E)	Nonagricultural Income				Household Income (G−E+O)	Gross Household Income (G+O)
		HYV	TV	Fruits	Water Chestnuts	Pigs	Eggs, Small Animals	Fish	Land Rent	Agricultural Wages	Other	Total (G)	Chemical Fertilizer	Other Chemicals	Animal Costs	Machine & Fuels	Hired Labor	Land Rent	Other	Total (E)		Salary	Wages	Others	Total (O)		
M6	Whole Sample (18)	17,841		61	3,555	3,738	72	44	2,425	1,769	236	31,742	2,296	661	2,319	1,669	3,932	1,213	594	12,685	19,057	0	394	2,495	2,889	21,946	34,631
	Landlord (5)	14,864	5,746	0	18,400	880	0	0	8,728	210	0	48,829	4,407	1,533	500	808	8,472	0	1,146	16,866	31,963	0	0	5,720	5,720	37,683	54,549
	Owner (3)	11,690	3,427	367	0	5,600	0	267	0	833	0	22,184	2,147	757	4,607	761	1,435	0	681	10,388	11,797	0	333	1,000	1,333	13,130	23,517
	Tenant (6)	28,788		0	1,333	0	217	0	0	2,117	33	32,488	2,143	328	0	2,371	4,019	3,640	353	12,853	19,636	0	437	200	637	20,271	33,125
	Landless Laborer (2)	0	0	0	0	0	0	0	0	7,800	0	7,800	0	0	125	0	0	0	400	525	7,275	0	1,740	0	1,740	9,015	9,540
	Pig Farmer (2)	0	0	0	0	23,045	0	0	0	0	2,028	25,073	0	0	12,585	4,750	0	0	0	17,335	7,738	0	0	6,050	6,050	13,788	31,123
M12	Whole Sample (15)	50,675	0	1,887	0	0	333	1,293	1,526	1,140	40	56,894	6,212	507	1,005	4,286	3,933	5,772	459	22,174	34,721	4,700	320	1,283	6,303	41,024	63,198
	Landlord (2)	39,000	0	9,300	0	0	0	3,000	11,146	0	250	63,346	3,878	1,019	0	2,530	3,000	0	1,634	12,061	51,285	0	0	0	0	51,285	63,346
	Owner (1)	0	0	6,500	0	0	0	1,500	0	0	0	8,000	380	500	0	490	0	0	550	1,920	6,080	0	0	18,250	18,250	24,330	26,250
	Tenant (11)	62,011	0	291	0	0	455	1,082	0	1,136	9	64,984	7,731	460	1,370	5,340	1,818	7,871	279	27,869	37,115	5,100	436	91	5,627	42,742	70,611
	Large (7)	86,057	0	457	0	0	714	1,700	0	357	14	89,300	10,686	623	2,153	7,284	7,000	10,526	353	38,624	50,676	8,014	0	143	8,157	58,833	97,457
	Small (4)	19,931	0	0	0	0	0	0	0	2,500	0	22,431	2,560	176	0	1,938	1,000	3,223	150	9,049	13,383	0	1,200	0	1,200	14,583	23,631
	Landless Laborer (1)	0	0	0	0	0	0	0	0	3,900	0	3,900	0	0	0	0	0	0	0	0	3,000	14,400	0	0	14,400	18,300	18,300

Table 6 Nonagricultural Households' Indicators

Household		Family Size (persons)	Economically Fully Active Persons	Average Age of Family Members	Area of Land Owned (*rai*)	Total Holding (*rai*)	Net Household Income (baht)					Amount Borrowed 1975/76 (baht)	Interest Rate (Weighted) (%)	Standing Debt (baht)
							Salary	Nonagricultural Wage	Trade & Small Activities	Other	Total			
M6	No. 1	3	2	34.3	0	0.3	0	200	38,325	0	38,525	11,000	0	11,000
	No. 2	7	4	23.6	0	2.8	0	0	78,250	0	78,250	100,000	22.2	10,300
	Average	5	3	28.9	0	1.5	0	100	58,288	0	58,388	55,500	20.0	10,650
M12	No. 1	5	2	18.8	0	0.3	0	0	15,000	0	15,000	0	—	0
	No. 2	7	2	28.4	0	1.0	19,200	0	0	2,400	21,600	150	0	NA
	Average	6	2	23.6	0	1.1	9,600	0	7,500	1,200	18,300	75	0	0
Overall Average		5.5	2.5	26.3	0	1.1	4,800	50	32,894	600	38,344	27,786	20.0	7,100

village surveys. The 1975/76 total per farm gross agricultural income of M12 is approximately double that of M6. This reflects the difference in per farm total planted area of paddy, the dominant crop, between the two villages. In M12 paddy contributes by far the largest share of the gross agricultural income, and fruits and fish caught in canals and backyard ponds contribute much less. In M6 paddy accounts for a smaller proportion of gross agricultural income than in M12. This difference in the importance of paddy arises partly because the large planted area of paddy per farm in M12, approximately double that in M6, provides sufficient income to the farmers in M12, whereas the per farm paddy income is not very high in M6, and partly because of topographical and hydrological differences between the areas in which the two surveyed villages are located. Therefore sources of agricultural income in M6 are more diversified than in M12, including water chestnuts, pigs, land rent, and agricultural wages. In M6, where both HYVs and TVs of paddy are grown, the gross revenue from HYVs is much larger than that from TVs because of the much higher yields of HYVs. Water chestnuts are considered by villagers of M6 to be the second most important commercial crop after paddy, and many villagers cultivate this crop. Pig farms in M6 are located on the levee of the Suphanburi River, which flows near the village. The relative importance of fruits in per farm gross agricultural income in M12 agrees with the market reputation of this village for good quality mangoes.

The highest per farm gross agricultural income for any type of farm in both survey villages is that of large tenants in M12, which averaged 89,300 baht, with a maximum of 144,500 baht. These large tenant farms can be regarded as commercial farms, since they are large by Thai standards and specialize in commercial rice production. Table 5 also indicates that except in pig farms agricultural wages tend to be higher on the types of farms owning less land in both villages.

Agricultural expenditures for 1975/76 listed in Table 5 include heavy expenditures in almost all categories. Expenditure on compound chemical fertilizer is high because HYVs are planted, and agricultural machinery and hired labor are widely used because of the family labor shortages in the peak seasons. The larger average size of farms in M12 than M6 leads to larger expenditures on maintenance and repair of machines and on fuel, and this size factor together with the dominance of tenants in M12 leads to larger expenditures on land rent in M12. Most of the tenants surveyed are renting in paddy land, and land rent as a proportion of total paddy production is low, 13 percent in M6 and 12 percent in M12. For the small tenants in M12 the proportion is 16 percent, reflecting the weaker bargaining position of these farmers with their landlords. The average total per farm agricultural expenditures in M12 are about 1.75 times as large as those in M6. Agricultural income, that is, gross agricultural income minus agricultural expenditure (G—E) is highest in the landlord farms and second highest in the tenant farms in both villages. Although the large tenants in M12 have a far higher gross agricultural income than all other types of farm in either village, their high land rents and other input expenditures depresses their agricultural income below that of the

landlord farms in M12.

There is a sharp difference in the nonagricultural income sources between M6 and M12. In M6, nonagricultural income from sources other than salary or wages, that is, from small-scale trade and other small-scale economic activities is dominant, while in M12 salary (fixed monthly payment) from the jute bag factories, the rice mill, and the machine repair factory and ironworks is dominant. Since M12 is much closer to Bangkok than M6 the villagers have a greater opportunity to earn nonagricultural income in and near M12. There are two large jute bag factories near M12 which employ considerable number of young villagers, and a large rice mill and a large ironworks in the village. Many villagers of M12 consider the jute bag factories beneficial to the village because they provide job opportunities and income. The average per farm nonagricultural income in M12 is much greater (more than double) than in M6.

The sum of nonagricultural income and agricultural income gives the agricultural household income, which is shown in the second column from the right. The figures clearly indicate that nonagricultural income tends to offset the unequal distribution of agricultural income by types of farm. In other words, farms have been allocating their labor force so as to supplement a low agricultural income with an increased nonagricultural income, and have been succeeding in this to some extent. Farmers' efforts to raise their incomes have been facilitated recently by the rapid introduction of double cropping of paddy in M6 (where there is no modern rural industry) and by the increased number of rural factories in and around M12, both of which resulted in a considerable increase in job opportunities. My data indicate, however, that the income of the poorest classes in the survey villages, the small tenants and landless laborers, have not risen greatly. Of all types of sample farm in both M6 and M12, the highest per farm agricultural household income is that of the large tenants in M12, and the lowest that of the landless laborers in M6. The per capita income of the latter farms is only US $82, which is near the relative poverty level (one-third of the village average per capita income, US $75, according to the World Bank).

To be an owner-farmer is not to be assured of a high agricultural income in M6 and M12 in the Central Plain of Thailand. In my survey the farms with a high agricultural income are those which are able to rent in and manage a large paddy acreage, or which are larger non-cultivating or cultivating landlords. The prerequisite for high agricultural income is the ability to control a large paddy area in the village, whether it is rented in or owned.

Table 6 shows some indicators of randomly sampled nonagricultural households in M6 and M12. All but No. 2 household in M12 are grocery shops. Some are middlemen dealing in agricultural inputs and products and/or sell snack such as sweets, coffee, noodles, and cold drinks. The head of No. 2 household in M12 happens to be a guard at the Thai Teijin (a Japanese joint venture company) factory at Rangsit near Bangkok. The nonagricultural households in my sample own no agricultural land but they lease in limited areas of land for their house compounds.

The sample nonagricultural households in M6 borrowed considerable amounts of money during the crop year 1975/76. No. 2 household in particular borrowed a large sum, which was used for commercial activities.

c. Social Characteristics of the Survey Villages

In family life, the male household head is more dominant in the sample farms of M12 than M6. This tendency emerges from the answers to a question in the survey regarding who initiates and decides various farming, educational, and children's matters in the family. In M12, 44.4 percent of these decisions are made by male household heads alone, while in M6 the figure is only 18.0 percent. This dominance of the male household head in the farm families of M12 is probably related to the considerably larger size of the farms there than in M6, since agricultural operations in M12 depend more on physical strength and on entrepreneurship based on decisions involving risk, both of which are more characteristics of males than females. On the other hand the smaller farm size, greater diversification of agriculture, and the double cropping of paddy in M6 are better suited to female labor. Thus I believe the greater contribution made by females to agricultural production in M6 enhances their status in the farm families.

Cohesiveness of kinship is stronger in M6 than in M12. This is shown in the answers to two questions. In one, household heads were asked "Whom do you turn to first when you need help in family matters?" In M6, 54.1 percent of total answers to this question were parents, siblings, or other kinsmen and the remainder were for neighbors or other people. These percentages for M12 were 44.3 percent and 55.7 percent respectively. The other question asked was "What is the village to you?" The answers are presented in Table 7. These results clearly show the greater strength of kinship ties in M6 than in M12. Unlike in M6, the major portion of the total paddy production in M12 derives from large-scale, capitalistic tenant farms. And this area is also strongly influenced by the industrialization and urbanization in and around Bangkok, as described earlier. The villages also differ in the racial origin of their early settlers. These differences, I think, account for the lower degree of kinship cohesiveness in M12.

Table 7 What Is the Village to You?

	M6		M12	
	Number	(%)	Number	(%)
Just a Place to Reside	0	(0)	1	(6.7)
An Administrative Unit	0	(0)	2	(13.3)
A Place for Mutual Dependence among Families, Kin, and Friends	17	(94.4)	10	(66.7)
A Place for a Group of People to Cooperate	1	(5.6)	2	(13.3)
Total	18	(100.0)	15	(100.0)

What is the role of village headman in the solidarity of village society? To the question "What do you think are the main works of village headman?" the single answer most frequently selected from the nine alternatives was: "to protect and look after the village." This was chosen by eleven farms in M6 and ten farms in M12, which seems to show that the Thai villagers expect the headman to be a paternalistic guardian of the village. One of three other possible roles of the headman, which involve the functions of organizing the villagers for building or maintaining public facilities or for dealing with the local government, was selected more frequently in M6 (ten farms) than in M12 (six farms). This indicates that the village headman's function in organizing the villagers is greater in M6 than in M12. A further question revealed more frequent contact between the headman and the villagers in M6 than M12.

The household heads were also asked about their affiliations with such organizations as agricultural cooperatives, farmers' associations, and the Bank for Agriculture and Cooperatives. More sample household heads gave positive answers in M6 (twelve) than in M12 (nine). In summary, in M6 village society is more tightly knit by kinship ties, the organizational role of the village headman, and farmers' organizations; in M12 village society is less tightly knit and more individualistic behavior coupled with male dominance seem to be considered to be the norm.

II Consequences of Introduction of New Rice Technology

The HYVs of rice and the complementary modern technology have been adopted by all the sample rice-growing farms in both M6 and M12, whereas ten years ago all reported they were growing only one crop of TVs. The HYVs grown are RD (Rice Department) 1, RD3, and C4-63 in M12, and RD5, RD7, RD9, WPI53, C4-63, and C4-63(G) in M6. This widespread adoption of the HYVs in M6 and M12 must have influenced village agriculture, the economic conditions of the farms, and the agrarian structure of the villages.

Table 8 shows the number of sample farms adopting HYVs in a given year. The distribution indicates that in M6 HYVs were adopted over a much longer period (eleven years) than in M12, where adoption took place mainly in the early 1970s. This difference is due to the cropping pattern at the time of HYV introduction, the intensity of effort by the government to introduce the HYVs into the village, the size of the village, and probably the farmers' attitude to change. In M12 villagers reported that TVs had been planted in the dry season before HYVs were introduced. The HYVs perform especially well in the dry season if water is available. In M6, however, a single crop of TVs had been planted in the rainy season before HYVs were introduced. My interviews indicated that the government's effort to introduce HYVs into the villages was more intensive in M12 than M6. In M12 five of the thirteen sample farms answered that the extension service had been the most influencial source of information on the adoption of HYVs, while only two of the eleven sample farms in M6

Table 8 Year of Adoption of HYVs

unit: No. of Sample Farms

Year	M6	M12
1964	1	0
1965	1	0
1966	1	0
1967	1	2
1968	0	0
1969	2	0
1970	0	2
1971	1	4
1972	1	2
1973	2	2
1974	0	0
1975	1	1
1976	0	0
Total	11	13

Table 9 Year of Adoption of HYVs (by type of farm)

M6	(No.)	Year	M12	(No.)	Year
Whole Sample	(11)	1969.5	Whole Sample	(13)	1971.0
Landlord	(2)	1969.5	Landlord	(2)	1970.0
Owner	(3)	1966.7	Owner	(0)	—
Tenant	(6)	1970.8	Tenant	(11)	1971.2
Large*	(3)	1970.7	Large*	(7)	1970.6
Small	(3)	1971.0	Small	(4)	1972.3

* planted paddy area of 25 *rai* or more

answered so. M12 is much smaller than M6 in area and in the number of farms. *Ceteris paribus*, new technology can be spread faster in smaller villages than in larger ones. In connection with this, it should be noted that adoption of HYVs and probably of other new technology by farmers is facilitated by their seeing neighbors succeed in adopting the new technology. Eight of the eleven sample farms in M6 and nine of the thirteen in M12 answered that neighbors, kinsmen, and friends were the most influencial source of information in their adoption of HYVs. Finally, the more individualistic and entrepreneurial farmers in M12, as described above, are faster in their adoption of the HYVs of paddy.

Table 9 shows the year of adoption of HYVs by the survey farms, averaged for each type of farm listed. From this table the order of adoption is (1) owners (in M6 only), (2) cultivating landlords, (3) large tenants, and (4) small tenants. The owner-farmers in my definition do not lease in or lease out land, and in this sense they are independent. Although their incomes are not among the highest in the village, as discussed in connection with Table 5, this independ-

ence allows them greater flexibility to adopt a risky new technology. This may be why the owner-farmers were the first to adopt the HYVs in M6. The cultivating landlords and large tenants, as shown in Table 5, had the highest incomes of the farm types surveyed, which probably allowed them to adopt the HYVs earlier than the poorer small tenants. My observations and the agricultural household income data presented in Table 5 support the assertion that the small tenants are too poor to bear the risk of adopting HYVs in the early stages of their introduction into the villages.

Before HYVs were introduced, the farmers in the survey area must have been very poor, because their major source of income was paddy and the TVs gave very low yields (1.1 ton per ha, as shown in Table 12). If the average farm size and the paddy price are assumed to be the same as at the time of the survey, the values of paddy production per farm before the introduction of HYVs can be calculated to be 7,671 and 15,045 baht in M6 and M12 respectively, while the corresponding values in 1975/76 are 17,841 and 42,538 baht. These values indicate that the monetary income of the farmers in M6 and M12 was very low before 1964, even though they were not then using such modern purchased inputs as fertilizers or other agricultural chemicals.[6)]

With increased production afforded by the HYVs, agricultural household income rose sharply in the survey area. This increase in income on the average must have shifted farmers' demand toward commodities with higher income elasticities and raised their standard of living.[7)]

The adoption of HYVs in the survey villages resulted in very different cropping patterns in the two villages. In M6 double cropping of paddy is now prevalent, while in M12 only a single crop of HYVs is planted in the dry season. In M6 both TVs and HYVs are planted in the rainy season, with TVs' dominance, and in dry season only HYVs are planted. The conditions that allowed double cropping to become prevalent in M6 are as follows: 1) The irrigation system is well developed. 2) Labor is available in sufficient quantity and at sufficiently low opportunity cost. 3) The farmers' need to increase the intensity of paddy production was probably very great before the HYVs were introduced, because of the smallness of the farm size. 4) Capital, materials, and technological inputs necessary for the adoption of HYVS were available from private and public sources. 5) The land tenancy institution was not so exploitative as to stifle the tenants' incentive to adopt HYVs.

In M12, the first, fourth and fifth of these conditions were fulfilled. But the lack of the second and third conditions, the high probability of flood damage at the end of rainy season, and rat and bird damage led to only the single, dry-season cropping of HYVs being

6) Farmers in M6 told me that they did not know of chemical fertilizer when they were growing the TVs, and that they were hesitant to use fertilizers when HYVs were first introduced into the villages, but that later fertilizer use spread rapidly.

7) Farmers in M6 previously drank cheaper liquors like coconut wine, but now they often drink more expensive rice whisky.

established in M12. The villagers of M12 told me that they practiced double cropping when HYVs were first introduced, but found it difficult to meet the peak labor demand for the two crops with the available labor force. The cultivation of HYVs in the dry season gives much higher output and higher farm income than the cultivation of TVs or HYVs in the main season, since the HYVs perform better in the dry (off) season than in the rainy (main) season, for physiological reasons. Because of the considerable flood risk in the rainy season, the number of farms planting paddy in that season declined. Some farmers tried to continue rainy-season cultivation, and even now some farmers would like to, but the concentrated attack of rats and birds on the few paddy fields planted would make cultivation absolutely impossible. The reasons the TVs are dominant in the rainy season in M6 are 1) the villagers prefer these varieties for consumption, and 2) only these varieties can be grown in the deeply flooded fields.

Because of the high fertilizer response of the HYVs a considerable amount of compound chemical fertilizer, far above the average fertilizer application level to rice in Thailand, is applied to paddy fields in both villages.[8] Table 10 shows the percentage of paddy farmers who used chemical fertilizer in the sample farms in the survey villages and in all the farms in the corresponding provinces in the 1963 agricultural census. In M6, most sample farms applied compound fertilizer to HYVs in the dry season but considerably fewer used fertilizer in the rainy season for either HYVs or TVs. This is due to the better fertilizer response of HYVs in the dry season. The 1963 agricultural census revealed that only 9 percent of farms in Suphanburi Province used fertilizer at that time, which agrees with the statement by villagers of M6 that they did not know of chemical fertilizer ten years ago. The corresponding percentage for Phathumthani Province is quite high, which indicates that fertilizer was popular among farmers in this province even in 1963. This table and the information I gathered in interviews show that the use of chemical fertilizer in M6 has expanded very rapidly in the past decade.

Table 10 Percentage of Paddy Farmers Using Chemical Fertilizer

		M6	M12
Main Season	HYV	67	—
	TV	50	—
Off Season	HYV	91	100
	TV	—	—
1963 Census Provincial Data for All Farms		9	66

8) The chemical fertilizer used for rice in M6 and M12 is mostly of two kinds, 16-20-0 and 18-22-0. In calculating fertilizer application I add the quantities of these two fertilizers.

Table 11 Average Inputs of Compound Fertilizer (kg/ha planted)

		M6	M12
Main Season	HYV	132	—
	TV	62	—
Off Season	HYV	191	282
	TV	—	—

Table 12 Average Paddy Yields (ton/ha planted)

		M6	M12
Main Season	HYV	3.2	—
	TV	2.3	—
Off Season	HYV	3.3	3.8
	TV	—	—
Provincial Average, 1963 Agricultural Census		1.1	1.1

Table 11 shows average inputs of compound fertilizer in kilograms per hectare of planted paddy area. Sample farms in M12 apply a very large amount (282 kg/ha) of fertilizer, while sample farms in M6 use a smaller amount (191 kg/ha) for off-season HYVs. In M6, the main-season fertilizer input is smaller than the off-season input, and in the main season the input to HYVs is more than double that to TVs. These differences correspond with the differences in the fertilizer response of paddy between traditional and high-yielding varieties and between the two seasons. The fertilizer input in the survey villages is far above average for the whole of Thailand.[9] This is reflected in the heavy expenditure on fertilizer in the sample farms, as presented in Table 5.

Table 12 allows investigation of whether higher fertilizer input is rewarded by higher paddy yield. The average paddy yield data from my survey indicate that higher fertilizer input leads to yields which are higher, but less than proportionately so. The law of diminishing returns operates. In the same table average paddy yields in the 1963 agricultural census for the corresponding provinces are listed. These yields are very low (1.1 ton/ha), representing the rainy-season yield of TVs with very low or no fertilizer application. The TVs grown in M6 in the rainy season with compound fertilizer application of 62 kg/ha yield 2.3 ton/ha, more than double the census average yield. Consequently it can be said in general that with a high level of water control as in M6 and M12, fertilizer application will increase paddy yield

9) There is no comparable fertilizer input data for the whole of Thailand. D. B. Lee estimated that the average fertilizer use in agriculture in Thailand was 12.9 kg/ha of plant nutrients in his *Economic Survey of Fertilizer Situation in the Asian and Pacific Region*, Food and Fertilizer Technology Center, Taiwan, p. 169, Dec. 1973.

Table 13 Some Indicators of Mechanization

M6					Suphanburi Province, Agricultural Census 1963		M12					Phathumthani Province, Agricultural Census 1963	
Type of Farm	Number of Farms	Number Per Farm			% of Farms Using Tractor	No. of Buffalos Per Farm	Type of Farm	Number of Farms	Number Per Farm			% of Farms Using Tractor	No. of Buffalos Per Farm
		Hand Tractors (1)	Pumps (2)	Buffalos (3)	(4)	(5)			Hand Tractors (1)	Pumps (2)	Buffalos (3)	(4)	(5)
Whole Sample	18	0.33	0.44	0.33	15.3	2.2	Whole Sample	15	0.67	0.80	0	27.3	2.1
Landlord	5	0.40	0.40	0	—	—	Landlord	2	0.50	1	0	—	—
Owner	3	0.33	0.67	0.33	15.9	2.4	Owner	1	0	1	0	22.4	2.2
Tenant	6	0.33	0.60	0.83	11.8	1.4	Tenant	11	0.82	0.82	0	30.8	2.0
Large	3	0.67	1	1.67	—	—	Large	7	1	1.14	0	—	—
Small	3	0	0	0	—	—	Small	4	0.50	0.25	0	—	—
Landless Laborer	2	0	0	0	—	—	Landless Laborer	1	0	0	0	—	—
Pig Farmer	2	0.50	0.50	0	—	—	Pig Farmer	0	—	—	—	—	—

tremendously, particularly if TVs are replaced with HYVs. It is interesting that in a country like Thailand which has a low average paddy yield of 1.8 ton/ha there is a considerable number of farms like those in M6 and M12 where HYVs give very high average yields of more than 3.2 ton/ha (maximum, 3.8 ton/ha). The high cost of fertilizer input in these villages is more than offset by the high yield of the HYVs, as shown in Table 5.

Mechanization of paddy production in both survey villages is more developed than in other parts of Thailand. Hand tractors and pumps are much in evidence in M6 and M12. Table 13 shows some indicators of agricultural mechanization in these villages. In the whole sample, the average numbers of hand tractors (column 1) and pumps (column 2) per farm in M12 are about twice those in M6. This is because of the differences between the villages in the average size of farms, in the agricultural wage rates and in the need for pump irrigation. As mentioned above regarding Table 5 agricultural income is larger, and farm mechanization is easier for financial reasons the larger the farm is. The average paddy planted area per farm in M12, as mentioned in connection with Table 4, is about double that in M6. There are also differences in the agricultural wage rates between M6 and M12: the most frequently reported wage rates for M6 and M12 were respectively B20/man·day and B25/man·day for transplanting and B20/man·day and B50/man·day for harvesting. Providing no such large disparity exists in the price of agricultural machines, mechanization must be more highly developed in M12 than in M6. Because of the flat topography pump irrigation is indispensable for the single, dry-season cropping of HYVs in M12. Pump density is thus very high in this village (0.8 per farm). The 1963 Agricultural Census data in column 4 show that the proportion of farms using tractors in Phathumthani Province was about double that in Suphanburi Province. This ratio is consistent with the relative density of tractors in M12 and M6, and appears to reflect the difference in the provincial average farm size, which is shown in Table 1. The distribution of machine density by types of farms shown in columns 1 and 2 for each village is more or less even in M6 but not so in M12. This reflects the very uneven distribution of farm landholdings in M12, shown in Tables 1 and 4. The large tenants in M12, which have more than 10 hectares of land per farm, each own on the average one hand tractor and more than one pump. Most of the farms which do not own a hand tractor, in both M6 and M12, borrow or hire one or employ a villager who owns a machine to till their land. Landless village laborers, who are among the poorest farmers in M6 and M12, own no hand tractor and pump.

Buffalos, once the most important nonhuman power source in the paddy-growing lowland of Thailand, are now rapidly being replaced by tractors and engines. In the areas around M6 and M12 this replacement is almost complete. As Table 13 shows, some of the sample ownerfarms and tenants in M6 own buffalos, but none in M12 do. Buffalos in M6 are used for threshing, by trampling the piled up harvested paddy. This practice is becoming increasingly rare, however, threshing now being commonly done by tractor and other machines. The village headman of M6 keeps one buffalo, not because he uses it for agricultural work, but

because he likes the buffalo and is used to keeping it. In M12 the villagers informed me that there had been hundreds of buffalos in the village until not long ago but there was now only one left in the village. The average number of buffalos owned per farm in the corresponding provinces (column 5 in Table 13) was calculated from 1963 Agricultural Census to be little more than two. Thus agricultural mechanization rapidly displaced buffalos from agricultural work in these provinces. (1) The economy of labor in using hand tractors rather than baffalos for paddy land preparation, (2) the labor shortage and the high wage rates at the peak seasons of labor demand in paddy production caused mainly by rural and urban industrialization near M12 and by the introduction of double cropping of paddy with HYVs in M6, and (3) the general increase in agricultural labor demand caused by the adoption of HYVs, all contributed to this shift from buffalo to hand tractor.

Mechanization involves high per farm expenditures for the operation and maintenance of agricultural machines in the survey villages, as shown in Table 5. These expenditures per farm are much higher in M12 than in M6 because of the difference in the per farm number of tractors and pumps owned. In addition, calculation from Tables 4 and 5 indicates that the average expenditure on hired labor per *rai* of planted paddy area is about half as much in M12 as in M6. These data support again the hypothesis that villagers in M12 have mechanized more than those in M6 in order to reduce the input of more expensive hired labor. The high machine-related expenditures in both villages are, however, more than offset by the higher yields gained from the HYVs.

The susceptibility of the HYVs of paddy to disease and insects is greater than that of the TVs, and is increased further by fertilizer application. This high susceptibility is a source of uncertainty about HYV production to the farmers who adopted the new rice. In order to quantify this uncertainty, I asked each of the sample farmers about his past experiences, that is, the number of seasons when he had good crop, normal crop, bad crop, or total failure during the past ten years of growing HYVs or TVs. From this, I determined the distribution of the number of seasons by good, normal, and bad crops, and total failure for each variety, each season, and each sample farm. By normalizing this distribution and averaging the normalized distribution over the sample farms, I determined the distribution of seasons by good, normal, and bad crops, and total failure for each variety of rice, each season, and each village.[10] Then, by assigning the values of 1, 2, and 3 for bad, normal, good crops respectively (no case of total failure was reported), I calculated the means and variances of the farmers' assessments of their past paddy harvests for each type of rice variety, each season, and each survey village. The calculation results are shown in Table 14. The means indicate the average assessment made by the farmers of the production performance of each type of rice variety, and the variances are estimates of the production uncertainty which farmers face. Only a few sample farms reported off-season TV production, and none reported main-season

10) In this averaging-out process, I omitted sample farms which had grown HYV or TV rice for only one season during past 10 years, since I was interested in the uncertainty which regular rice-growing farms faced.

Table 14 Uncertainty of New Rice Technology —Mean and Variance of Reported Harvest

Variety and Season	M6			M12		
	No. of Farms	Mean	Variance	No. of Frams	Mean	Variance
HYV Off Season	11	2.286	0.372	12	2.552	0.369
TV Main Season	10	2.169	0.282	11	1.708	0.325

HYV production. Thus I could not calculate means and variances for these two cases.

Table 14 shows that the farmers of M6 assess the past production performance of the off-season HYVs only slightly higher than that of the main-season TVs, while uncertainty of paddy harvest, indicated by the variance, is considerably higher for the off-season HYVs than for the main-season TVs. In M12, the farmers assessment of the situation differs: production is assessed considerably higher while uncertainty is only slightly higher for the off-season HYV crop than for the main-season TV crop. These results indicate that the farmers' assessment of the production and its uncertainty differs for HYVs and TVs and varies with geographical area and season. This difference can be ascribed to topographical and hydrological conditions and the physiological properties of the rice varieties. The environmental conditions for the off-season HYV crop in M6 and M12 can be considered similar, judging from the fact that irrigation levels and the variances of the off-season HYV production in M6 and M12 are similar. But for the main-season TV production the variance is considerably higher in M12 than in M6, which accords with the reported high probability of flood damage in the main season in M12. This probability is low in M6. These probabilities depend on the regional topographical and hydrological conditions. Thus the difference in the two variances in M6 represents the varietal difference in the production uncertainty, while the difference in M12 is small since the varietal uncertainty is offset by the environmental uncertainty in paddy production.

Farmers in the survey villages clearly recognize that large amounts of modern inputs like fertilizer and other agricultural chemicals are necessary if the high yield potentials of the HYVs are to be realized. As mentioned earlier, very large amounts of these inputs are used by farmers in the survey villages. Also mentioned earlier was the fact that industrialization in M12 and double cropping of paddy in M6 caused wage rates to rise in the peak labor-demand seasons, raising hired labor expenditures, and resulting in greater machine-related expenditures because of the progress of mechanization. These factors raised the cash expenditures neccessary for paddy production above the levels necessary when only the TVs were grown, and led the farmers into greater indebtedness. And the farmers incurred debts at very high interest rates. Table 15 shows my survey results on the average amounts borrowed per sample farm during the crop year 1975/76, the average annual interest rates at which they borrowed weighted by amounts of loans, and the standing debts per farm in summer 1976 by the types of farms. In the samples as a whole, farms in M6 borrowed more

Table 15 Per Farm Indebtedness and Interest Rates

	Type of Farm	No. of Farms	Amount Borrowed, 1975/76 (baht)	Weighted Average Annual Interest Rate (%)	Standing Debt, 1976 (baht)
M6	Whole Sample	18	12,056	14.2	12,467
	Landlord	5	15,400	14.2	13,800
	Owner	3	13,500	16.4	12,267
	Tenant	6	16,200	15.1	16,817
	Landless Laborer	2	400	15.0	725
	Pig Farmer	2	7,500	4.0	8,125
M12	Whole Sample	15	7,857	19.0	13,295
	Landlord	2	0	—	0
	Owner	1	25,000	18.0	38,000
	Tenant	11	8,000	19.8	13,766
	Large	7	10,143	20.6	19,383
	Small	4	4,250	16.9	8,283
	Landless Laborer	1	7,000	12.0	5,000

than those in M12 and had relatively heavier outstanding debts in that the per farm paddy planted area in M6 was about a half of that in M12. The weighted annual average interest rates are very high by Japanese standards. The rate is lower in M6 than M12. These intervillage differences arise from the following: (1) Although the sample farms borrowed money on similar numbers of occasions from the Government Bank for Agriculture and Cooperatives (BAC) and from private noninstitutional sources like relatives, friends, and merchants, the sample farms in M6 obtained about 62.7 percent of their total loans from the BAC while those in M12 obtained only 39.0 percent, and the interest rates charged by the BAC ranged 8–12 percent per year while the rates of private noninstitutional loans were in the main two to three times higher. (2) The noninstitutional loan rates ranged 0–24 percent for M6 and 18–36 percent for M12. (3) The larger farms in M12 could finance a large part of their cash demand themselves since they have very large agricultural household incomes, as shown in Tables 4 and 5.

Table 15 indicates that the farms of higher status in the villages, represented mainly by the area of paddy land under their control, tend to borrow more than those of lower status. Closer inspection of the average per farm borrowings in 1975/76 by size of farm reveals that in both survey villages the large farms (which plant 25 *rai* or more of paddy per year) borrow much more than the small ones. The per farm borrowings for the large and small farms are 179,000 vs. 38,000 baht in M6, and 11,500 vs. 8,167 baht in M12. An important finding is that the large farms can secure bigger low-interest loans from the government bank (BAC) than the small ones. The large farms in M6 secure up to 73.2 percent of their total borrow-

ings from the BAC, while in M12 the figure is 42 percent. On the other hand, the small farms in M6 can secure from the BAC only 13.2 percent of their total borrowings, and in M12 they obtain 34.7 percent. Of the total sum borrowed from the BAC by the sample farms in each village, 96.3 percent and 63.0 percent goes to the large farms in M6 and M12 respectively. During my survey I observed that the smaller and poorer farmers had virtually nothing to offer as security for their loans; in other words, they could not borrow very much even if they wanted to. The larger and richer farmers in M6 and M12, on the other hand, have readier access socially and politically to the low-interest government loans.

According to my survey the farmers borrowed money mainly for purposes relating to farming; loans were so used in 65 percent of cases in M6 and 84 percent in M12. The standing debts virtually equals the annual borrowing in M6, but is about 1.7 times higher in M12, possibly indicating that the farmers are accumulating debt in M12. If this is the case, one factor must be the higher interest rate which farmers have to pay and the lower availability of BAC loans in M12 than in M6.

III Conclusion

The last decade has seen adoption of HYVs of paddy by all the farmers in both survey villages, and a steep rise in agricultural wage rates caused by rural and urban industrialization near M12 and the introduction of double cropping in M6. This led to larger inputs of chemical fertilizer and considerably higher paddy yields, an increased level of mechanization, heavier paddy-growing expenditures, and higher average agricultural household incomes, because of the higher paddy income and higher agricultural and nonagricultural labor incomes. The large increase in paddy-growing expenditures raised the demand for cash among the farmers of M6 and M12, many of whom borrowed considerable sums of money. The amount of money the farmers borrow depends not only on the size of the farm but also on the availability of the low-interest government agricultural loans. Since the interest rate of the government (BAC) loan is about one-half to one-third of that charged for private noninstitutional loans, the farms in M6, where government loans are much more readily available, borrowed 53 percent more at a 25 percent lower overall average interest rate than the farms in M12, even though the per farm planted area of paddy is only about half of that in M12.

An important problem regarding the low-interest government agricultural loans is that the larger and richer and thus politically and socially more powerful farmers in the village tend to secure a larger share of the loan. This is may be an extreme case, but in M6, 96.3 percent of the total government agricultural loan went to the large farms which plant 25 *rai* or more of paddy per year (and which make up 50 percent of the total sample in M6). The small farms in M6 and in M12 (where government loans are less readily available and interest rates paid by the villagers consequently much higher) showed a tendency to accumu-

late debts, in that annual borrowing exceeded standing debts by a considerable margin. This tendency, together with the privileges enjoyed by the large farmers in securing government loans, and the greater uncertainty in production of HYVs in comparison with TVs, is likely to produce polarization of the agrarian structure in the survey villages in the near future.

Such polarization, if it occurs, will heighten the inequality in the village income distribution. The small farms, those which plant less than 25 *rai* of paddy and are, in the main, small tenants, landless laborers, and small owner-farmers, will face harsher living conditions in the villages. Some of these farms already fall into the World Bank's category of absolute poverty (annual per capita income equal to or less than US $50 in 1969 prices). This injustice is contrary to the aims of rural development and may well lead to political instability in the rural areas.

Given that land reform in Thailand has made little progress and faces many difficulties, two feasible policies to stop or reverse the polarization can be proposed on the basis of my survey results. The first policy is to institute measures to assure the equal distribution or the small-farm-oriented distribution of the low-interest government agricultural loans, in order that unequal distribution such as I found in M6 will not continue to prevail. The second policy concerns agricultural mechanization. The household income of small farms depends considerably on agricultural labor. If the large farms mechanize too rapidly, the small farms will loose their income from agricultural labor and some of the small farmers may be forced to leave the villages for urban areas. But in urban areas it is very difficult for a farmer to find a proper job because he is not equipped to supply labor of the quality demanded there. The small farmers displaced from the villages will probably just add to the already large numbers of underemployed in the urban areas. Thus a policy must be instituted that will regulate the speed of agricultural mechanization in Thailand to a level at which the agricultural labor income of the small farms will not decline but may even increase slowly over time.