TARC Notes

Impact of double cropping of rice on farm management in the Muda Irrigation Project Area of Malaysia

Since the completion of the Muda Irrigation Project in 1970, the double cropping of rice has rapidly spread in the Project area under the guidance and support of the Muda Agricultural Development Authority (MADA), a governmental organization responsible for the over-all agricultural development based on double cropping of rice in that area.

The author carried out a study on the economic and technical impact of rice double cropping on farm management in the area. The study consisted of (1) to investigate variations in farm income among farmers and locations, (2) to identify changes in traditional farming practices caused by the introduction of double cropping of rice, (3) to analyse changes in farm household accounts caused by the development of double cropping, and (4) to investigate relationships between paddy output and productive factors in the double cropping of rice.

The farm management survey was carried out during the period from February 1974 to March 1975 at six villages selected from three different soil class areas. A total of 100 farmers was selected at random from the above mentioned areas. The survey was conducted in cooperation with MADA.

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1. As the yield of rice is an end-product of farm management activities, differences in yields among farmers must involve differences in farm management. The coefficient of variation in yields among the sample farmers was 20% for the year 1974/75. This variation, however, was not caused by the difference in farm management alone, but must be affected by the local difference in physical environments such as soil and water conditions. The coefficient of variation in paddy yield among villages which can be considered as expressing local differences was 15%. Therefore, it seems that the variation among farmers was primarily caused by the local difference in physical environments in those areas.

Farm management activities can be reflected by farm expenditures per unit farm area. The coefficient of variation in farm expenditures of sample farmers was 34%. This variation was due to the remarkable difference in labor input among farmers, and labor input was found to be related to local differences in physical conditions. Thus, it is suggested that the improvement of water control, realignment of farm holdings, and soil improvement could reduce the variation in paddy yields among farmers.

2. Seasonal peaks in labor demand in rice cultivation evolved the *derau* (mutual exchange of labor) and *gotong royong* (cooperative farm operation) systems for particular farm works such as transplanting and harvesting even at the past time of single cropping. With the development of double cropping, dependence on outside labor has increased, but *derau* and *gotong royong* systems have been on the decline, because they were substituted by *upah* (cash wage labor) system reflecting the increasing currency economy and expanding labor market.

About 60% of the total labor input of average-sized farms consisted of hired labor and *derau* labor. Majority of the labor was supplied by small holders, who wanted to get any additional income by taking advantage of these employment opportunities. However, labor shortage during the peak season was becoming more serious, and accordingly farmers were enforced to mechanize farm operations, particularly harvesting. In pro-

moting farm mechanization, problem of wage income for small holders should be taken into consideration.

3. It was difficult to trace up directly the improvement of farm economy induced by double cropping of rice, because comparable data before the introduction of double cropping were not available. An attempt, however, was made to compare the data obtained from the present study with the FAO/IBRD's data[1], as a proxy of the single cropping income. Results were as follows:

1) Agricultural receipt of farmers increased by 4.6 times in nominal terms and 2.5 times in real terms after the introduction of double cropping of rice. This increase was born from an increased paddy production and increased farm labor wage receipt.

2) Paddy receipt increased by 2.3 times in real terms, mainly due to an increased cropping intensity and partly due to an increased paddy yield, especially in the off season.

3) Farm labor wage receipt contributed not only to increase the income of small holders, but also to reduce the income disparity between large holders and small holders.

4) Agricultural expenditures increased by 5.2 times in nominal terms and 2.8 times in real terms after the introduction of double cropping of rice. The rate of increase was greater than that of agricultural receipt.

5) Thus, the net farm income increased by 4.3 times in nominal terms and 2.3 times in real terms.

6) The farm household income increased by 4.2 times in nominal terms and 2.3 times in real terms after the adoption of double cropping of rice.

4. Farm income is a function of a number of variables. In the present case, the farm income was found to be primarily a function of paddy production, and, to a lesser degree, of farm labor wage receipt.

Paddy production itself is a function of a number of independent variables. A production function was formulated by using a simple model with four independent variables; area cropped to rice, labor input, total fertilizer used and the capital used, based on Cobb Douglas function method.

Table 1. Regression analysis on paddy production

		Off season crop	Main season crop
Number of sample farmers		91	94
Log. A		1. 496	2. 031
Regression coefficient:	Sum	1. 118	1. 013
	Area	0. 612	0. 696
	Labor	0. 358	0. 123
	Fertilizer	0. 028	0. 038
	Capital	0. 120	0. 156
R^2		0. 901	0. 950
F		98. 3	219. 7

The result of the regression analysis (Table 1) indicates that:

1) Sum of regression coefficients in the formula was greater than 1.0 showing the law of increasing return with respect to the size of farming.

2) The most important factor for increasing paddy production was the area cropped to rice under the present level of agricultural technology. Labor input showed a relatively high correlation with paddy production, but the regression coefficient was small.

3) A small positive regression coefficient for fertilizer use implies that the fertilizer use under the existing farming condition was not a significant determinant for paddy yields.

4) Relationships between paddy production and each productive factor showed a considerable dissimilarity between off season crop and main season crop.

1) FAO/IBRD: The Muda Study (1975).

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Yield components and related characters of floating rice in Thailand

Floating rice, or deep water rice, is an ecotype of the cultivated rice, *Oryza sativa L.*, that is adapted to inundated conditions by expressing its remarkable elongation ability as the water level increases[5]. Improvement of floating rice has been intensified recently by breeding work through international cooperation[1].

The present paper describes briefly some of the results of a field survey which was conducted to know yield components of floating rice growing in farmers' fields as a basis of breeding for yield potential.

The field survey was carried out in the Central Plain of Thailand on the 13th and 14th of January, 1976, by selecting three locations for sampling: Bang Pa In district and Maharaj district in Ayuthaya province, and Angthong district of Angthong province. Floating rice is usually harvested after the water subsides and plants lodge completely. In this survey, the sampling was done under such a condition. Plant samples taken from 1 m^2 each were brought to the laboratory and examined after drying for 2 days under the sunshine. Results are summarized in Table 1.

Grain weights at three locations were 329, 231 and 223 g/m^2. These are equivalent to grain yields of 3.29, 2.31 and 2.23 t/ha respectively, which exceed the national average of rice yields in Thailand, 1.8 t/ha in 1970[6]. Although the number of grains/m^2 indicated in the table is much less as compared to that generally observed in Japan, that averages around 30,000 grains/m^2, it may be enough for the yield levels of 2–3 t/ha.

For tall traditional varieties in Thailand Fukui[2] suggested that one easy method to obtain yields of 3–4 t/ha is to apply 10 to 20 kg/ha each of N and P_2O_5. With the tall traditional varieties in Malaysia, Moriya[4] stated that grain yields were proportional to number of panicles and hence number of spike-

Table 1. Yield components and related characters of floating rice sampled from farmers' fields at three locations in Central Thailand in 1976

Items	Location		
	Bang Pa In	Maharaj	Angthong
Maximum water depth (cm)	120–130	150–170	220–250
Name of variety	Kwian Hak	Pin Gaew 56	Hin Hoy
Length of plant (cm)	315	398	450
Length of submerged part (cm)	180	300	320
Number of elongated internodes	13	17	17
Straw weight (g/m^2)	1, 298	987	2, 096
Panicle number per m^2	212	101	130
Grain number per panicle	77	120	93
Fertile grains per panicle	67	89	70
Percentage of ripened grains (%)	87	74	75
Grain number per m^2	16, 303	12, 100	12, 116
Grain weight (g/m^2)	329	231	223
Weight of 1, 000 grains (g)	24. 83	25. 97	27. 41
Grain length (mm)	6. 5	7. 6	7. 5
Grain/straw ratio	0. 25	0. 23	0. 11

Note: Information of water depths and variety name was obtained from farmers. Length of submerged part was judged from brown-colored stems. Fertile grain and grain number/panicle were means of 30 panicles randomly selected. Weight of 1, 000 grains was determined with 3 samples 20 g each of fertile grains.

lets per unit area up to a yield level of 5 t/ha. Nitrogen application to traditional tall varieties was not very effective in increasing the number of spikelets because it promoted plant height, but not increased number of panicles effectively. Therefore, he believed that dense planting might be a practical approach to produce more spikelets. Yamada[7] noted that transplanting culture usually ensured greater production than broadcasting culture, but in cases when the broadcasting culture produced more panicles than the transplanting culture, the former outyielded the latter.

In Thailand, the floating rice is generally broadcast with heavy seeding rates (about 100 kg/ha). Since the yield of floating rice seems to be closely related to the number of panicles produced per unit area, the practice of broadcasting with heavy seeding rates can be regarded as a measure for increasing number of panicles. In addition, it was observed that fertilizer application is practiced by some farmers in the Bang Pa In district before the inundation takes place. Fertilizer and insecticide application seemed to be gaining popularity in this area. The sample taken from that district was fertilized rice, and the grain yield was highest among three locations.

The growth duration of floating rice ranges from 210 to 240 days. Such a long growth duration and a deep water submergence cause a continued vegetative growth resulting in the extremely low grain/straw ratio as shown in the table. At present, it is a general practice to burn most of the straw in February and March prior to ploughing instead of utilizing it as an organic manure.

Most of the traditional floating rice varieties have short grains. Short grains of rice in Thailand are parboiled for the export to Middle East, Pakistan, India, Bangladesh and parts of Africa. As long and transparent grains are exported as the world famous Thai white rice, the government recommends to grow long grain varieties with grain length of 7 mm or longer after milling such as Pin Gaew 56 (Table 1). At present, long grain types are estimated to constitute about 30% of the total acreage of floating rice (Thawee Kupkanchanakul, personal communication).

At the time of the survey, it was found that the floating rice was completely destroyed in areas in the Pah Mawk and Maharaj districts in Ayuthaya province. This was caused by an extremely deep flooding occurred during October–November 1975, reportedly the worst in 33 years. Rice plants were not only killed by the overhead submergence but also uprooted by rapid flowing water. Such unusual flood caused the delayed maturity in many floating rice areas.

Finally it must be added that a new attempt to incorporate the elongation ability of floating rice into semi-dwarf high yielding varieties with an aim of breeding high yielding varieties adaptable to deep water conditions is now in progress in Thailand with successful results[3,8].

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