FARM MANAGEMENT ANALYSIS OF MALAY AND CHINESE RICE FARMING IN PROVINCE WELLESLEY, MALAYSIA

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INTRODUCTION

RICE cultivation was limited to Malays for a long time by the colonial government, and only after 1939 were non-Malays permitted to grow rice.[1] This restriction, however, did not apply to the Straits Settlements of Penang, Malacca, and Singapore. In fact, in the Northern District of Province Wellesley (hereafter abbreviated as P.W.) in Penang State, Chinese farmers began to cultivate rice as early as the nineteenth century. Even today, this area is unique in Malaysia in that two main ethnic groups, Malay and Chinese, cultivate rice side by side, whereas the general pattern is still for rice to be grown almost exclusively by Malays [22, p. 28].[2] Thus, P.W. seems to be an ideal area in which to study rice farming by the two ethnic groups under the same natural conditions and farm environment.[3]

The aim of the paper is to present a comparative analysis of the rice-farm management and production behavior of both ethnic groups. While an earlier survey conducted in Tanjong Karang revealed that Chinese farmers are more efficient in resource allocation and attained a higher level of productivity than Malays [9], other studies have pointed out the relatively inferior position of the Malays as entrepreneurs [15] [18] [19]. It may therefore be surmised that the Chinese are better farm managers than the Malays.

To test this hypothesis, this paper will analyze farm management by looking closely at input-output and cost-and-return relationships. The results of a regression analysis of yield determination will also be presented to delineate the cultivation practices of both groups of farmers. The survey will show that type

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1 The fear of food shortage envisaged in the coming war forced the colonial government to lift the ban on non-Malays cultivating rice. See [7] and [10, p. 188].

2 Tanjong Karang in Selangor is perhaps the only other area in Malaysia where the two ethnic groups can be seen to engage in rice growing in the same neighborhood, but this area was reclaimed and settled only in the 1950s. Probably the only study on Chinese rice farmers ever conducted in Malaysia is that of Huang [9], who made his survey in Tanjong Karang in 1966, only one or two years after the introduction of double-cropping.

3 For past studies of rice farming in P.W., see Purcal [20] and Wilson [26]. A recent publication on the Malaysian rice farming is Taylor [23].

of farm management and cultivation practices differ for the two groups and suggest that even though Malays and Chinese cultivate rice in the same environment, different approaches are needed to increase the level of productivity for each. One important implication of this finding is that ethnic characteristics appear to affect the performance of farm management and should therefore be taken into account in future analyses of rice-farm management.

Data used in this study were gathered in the course of the author's fieldwork conducted in 1978 in two Malay villages and one Chinese village in the Northern District of P.W. A complete survey was conducted in the two Malay villages, while a sampling survey was conducted in the Chinese village, which was located adjacent to the Malay villages studied. Pre-tested questionnaires were used to interview the head of each household. Farm management data were collected for the 1977/78 main season cropping.

I. CHARACTERISTICS OF THE AREA UNDER STUDY

The Malay villages surveyed were Kampung Guar Tok Said (GTS) and Kampung Guar Kepah (GK), which consist of sixty-one and fifty-two households respectively and are situated in Mukim 5 and Mukim 2 of the Northern District. The rice-farm management of fifty and thirty-five households, respectively, growing rice in the 1977/78 main season were studied intensively. The Chinese village studied was Kampung Paya Guar Kepah Cina, from which a total of twenty-five farm households were selected at random for interview purposes. The location of these villages is shown in Figure 1, which also shows irrigation canals and drains constructed or improved under the Sungei Muda Irrigation Scheme.

The Malay term *paya* literally means swamp or swampy area. According to local farmers, when the Chinese first arrived in the area, all the best land had been occupied by Malays, so that they were forced to settle the swampy areas. The Chinese settled separately and lived on their own farm land, forming a scattered village. Although the swamp was gradually improved through the construction of drains, the name of the village serves as a reminder of the swamp.

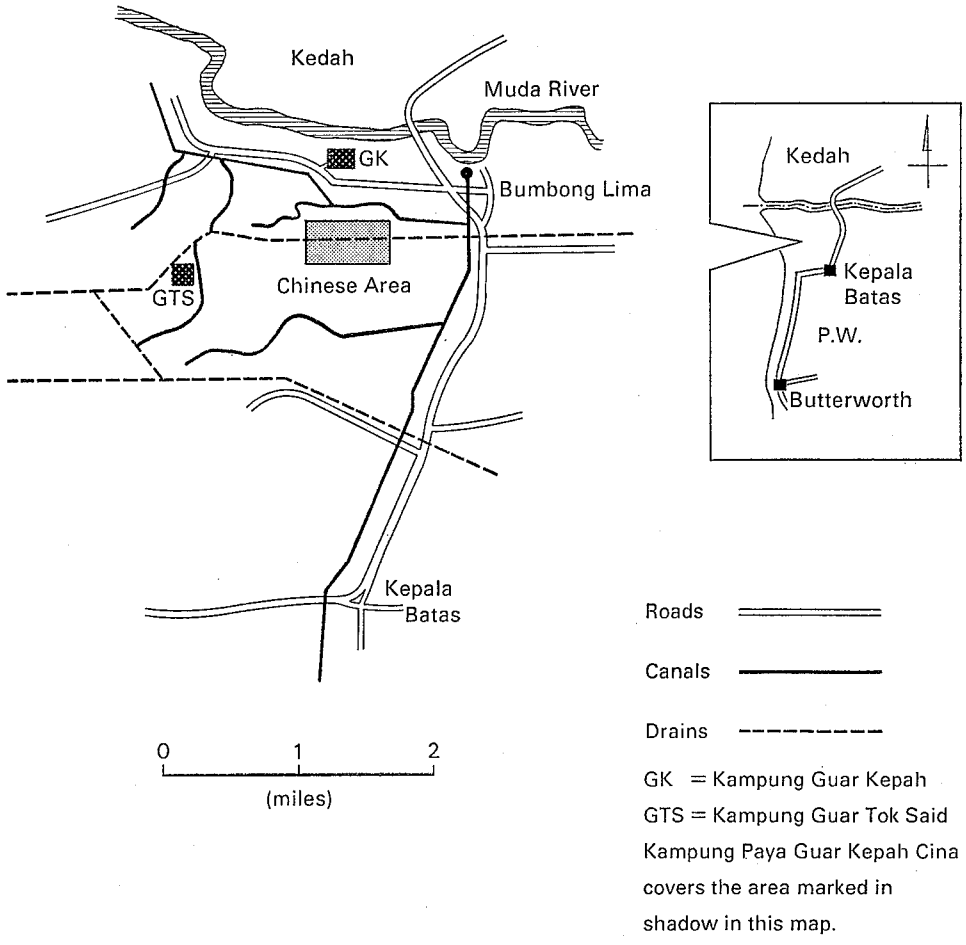
Most of the land settled by both Malay and Chinese farmers was legally owned by the Bertam Estate Company. A large number of settlers were either tenant farmers or rubber tappers employed by the company. In 1959, however, a program unique in Malaysia was launched by the Province Wellesley Cooperative Banking Union (Bank Persatuan). The Bertam Land Scheme was set up to redistribute 5,595 acres previously owned by the company to tenant farmers, who were allowed to purchase, on installment, only the land they were cultivating at the time of redistribution.[4] In the three villages studied, a number of farmers participated in the scheme and became landowners.

The Northern District of P.W. has an area of 67,200 acres, of which 36 per cent are estimated to be rice land. The total population was 161,317 in 1970, but in 1978, it was estimated to be around 200,000.[5] Perhaps the most important

[4] For a preliminary analysis of the scheme, which may be the only program of landownership redistribution in Malaysian rice farming, see [4].

[5] District Office, Northern District, Butterworth.

Fig. 1. Location of the Villages Studied



feature of the area is that it was here that rice double-cropping was first introduced to Malaysia during the Japanese Occupation [1] [21] [24]. This was achieved through the farmers' own efforts, i.e., by irrigating fields during the dry season.[6] The progressive nature of farming in this area has been preserved, and today it is one of the most mechanized rice-growing regions in the country [5]. As seen in Table I, although its cultivated acreage is rather small, P.W. as a whole is one of Malaysia's most productive rice areas.

In the district are five government-constructed irrigation projects, of which the oldest and largest is the Sungei Muda Irrigation Scheme. This covers 17,580 acres of rice land stretching from the north to the south of Kepala Batas. Full-scale rice double-cropping began here in 1958. All three villages studied are situated in the area covered by this project.

[6] It was the Malay farmers who began double-cropping under the guidance of the Japanese army. Whether or not the Chinese in the area also participated in the first double-cropping could not be ascertained from interviews with farmers.

TABLE I

RICE ACREAGE AND YIELD PER ACRE BY STATE
(1977/78 MAIN SEASON CROPPING)

	Area Planted		Yield per Acre	
	Acres	%	Gantang	Index
Johore	5,090	0.6	522	120
Kedah	296,940	35.9	514	118
Kelantan	170,630	20.6	353	81
Malacca	20,600	2.5	342	79
N. Sembilan	11,480	1.4	371	85
Pahang	14,590	1.8	199	46
Penang & P.W.	33,770	4.1	528	121
Perak	93,500	11.3	402	92
Perlis	65,630	7.9	392	90
Selangor	44,620	5.4	574	132
Trengganu	71,130	8.6	337	77
Total	827,980	100.0	435	100

Source: [14].
Note: Data refer only to Peninsular Malaysia. One gantang is equivalent to one gallon, and 400 gantang of *padi* ("unhusked rice") is approximately one ton.

II. RICE-FARM MANAGEMENT

A. *Production Factors*

The area under study consists of low-lying land and villages surrounded by rice fields. None of the farmers interviewed, Malay or Chinese, owned land planted to rubber trees, and the cultivation of vegetables and fruits was limited to the home compound: it was mainly for home consumption.[7] Neither was livestock raising significant, except for some farmers who raised one or two buffaloes for use as draft animals or to be sold for meat. In other words, farm management in the area surveyed was rather straightforward and limited to the cultivation of rice twice a year.

The possession of production factors by farmers is summarized in Table II. With respect to the land factor, the average farm size of the Chinese farmer (6.86 acres) is nearly three times that of his Malay counterpart (2.46 acres), the difference being statistically significant at the 1 per cent level. Those farmers who cultivated rented land consitituted 62 per cent of all Malays but only 20 per cent of Chinese, presumably because the landholdings of Chinese farmers were already extensive, and they did not therefore seek to acquire additional land through tenancy.

In view of the marked difference in farm size, one may speculate that the Chinese expanded the size of their holding through money-lending activities, as was often the case in Malaysia [6]. However, this was not true of the Chinese

[7] In the southern and central districts of P.W., there exist Chinese farmers who are engaged in commercial vegetable growing. For a study of Chinese farmers there, see [16].

TABLE II

THE POSSESSION OF PRODUCTION FACTORS BY MALAY AND CHINESE FARMERS

	Malays	Chinese	Significant Level of the Difference
Total number of farmers	85	25	
Average rice-land area operated (acres)	2.46 (1.73)	6.86 (3.17)	1%
% of farmers cultivating rented land	62.4	20.0	
Average family size (persons)	5.35 (2.16)	7.48 (2.53)	1%
Average number of family rice workers (persons)	2.33 (0.87)	4.24 (1.57)	1%
Average age of the farmers (years old)	42.88 (11.87)	52.20 (11.81)	1%
Average length of school education (years)	4.68 (2.41)	4.32 (1.57)	10%
% of farmers owning:			
tractor	10.6	88.0	
buffalo	23.5	64.0	
irrigation pump	8.2	28.0	
motorbike	58.8	84.0	
TV set	37.6	32.0	

Note: Figures in parentheses show the standard deviations.

farmers in the sample: they happened to be cultivating more land than the Malays at the time of Bertam land redistribution. Another important factor related to the difference in landholding is the system of inheritance. Among the Malays, the inheritance of landed property is governed either by Islamic or customary law. All children, regardless of sex, are entitled to a share, which naturally results in the extensive subdivision of landholdings [25]. In contrast, the inheritance of land among the Chinese is limited to male children, and this prevents the initial holding from being too excessively subdivided [16]. In fact, the subdivision of land clearly seemed to be much more serious among Malays than among Chinese in the area studied [4].

Concerning the labor factor, the number of workers who could be engaged in rice farming on a full-time basis was much larger for the Chinese, reflecting their larger family size. Family rice workers were defined as those older than sixteen years who did not have a fixed job or were not in school. However, if the actual area of cultivated rice land is taken into account, the availability of family labor would show the reverse tendency. The number of family workers per acre of land under cultivation was 0.95 person for the Malays but only 0.62 person for the Chinese. Thus, the actual amount of family labor available for rice cultivation per given farm size was larger for Malays than for Chinese.

With regard to capital assets, there appears to exist a clear difference between the two groups. As many as 88 per cent of Chinese farmers owned a tractor (in all cases, pedestrian tractor or power tiller) at the time of the study, whereas only 11 per cent of Malays owned one. This does not necessarily mean that the

majority of Malay farmers still depended on draft animals for ploughing; in fact, they hired tractor and operator on a contract basis [5]. This point is also supported by the fact that only 24 per cent of Malays owned a buffalo as compared to 64 per cent of Chinese.

Even though under the government irrigation scheme the area was generally well supplied with irrigation water, water could not easily reach some fields, due to undulation of the field. A much higher proportion (28 per cent) of Chinese farmers than Malays (8 per cent) invested in irrigation pumps in order to overcome this problem on their own initiative. It appears that the Chinese generally tended to own more farm assets, such as land, tractor, and irrigation pump, than Malay farmers. On the other hand, a higher proportion (38 per cent) of Malays than Chinese (32 per cent) owned a television set, a typical durable consumer good and often a status symbol for better-off villagers. The Malays thus appear to show a stronger orientation toward consumption than toward investment in rice production.

Further, there exists a significant difference in the average age of Malay and Chinese farmers. The difference is probably due to a more extensive emigration of Chinese youth to nonagricultural sectors. More Malay youths tended to remain in farming, which lowers the average age of the sample Malay farmers.[8] Yet, the difference in educational standards was very small between the two groups, indicating that older Chinese tended to be as well educated as younger Malays.

B. *Input and Output*

Input and output data in rice production for the 1977/78 main season are presented in Table III. The average amount of labor input per acre was forty-one man-days for the Malays and thirty man-days for the Chinese, the difference being statistically significant at the 5 per cent level. Breakdown of labor input according to source indicates that the Chinese used much more hired labor than the Malays on a per-acre basis, while the use of family labor was more intensive among Malays than Chinese. *Gotong-royong* or exchange labor, which did not require wage payment, was found only among the Malays, mainly in the operations of transplanting, reaping, and threshing. For these operations, the Chinese largely employed hired labor which consisted of Malay women (for transplanting and reaping) and Malay men (for threshing). Wages were paid on a per-relong (1.3 acres) basis.

The Chinese used much larger amounts of cash inputs, such as fertilizer and pesticide, on a per-acre basis. The use of pesticide, in particular, among the Chinese was three times that of the Malays. Farm management, then, was generally more capital-intensive among the Chinese and labor-intensive among the Malays.

According to the farmers, the cultivation of rice in the 1977/78 main season

[8] Those Malay youths who remained in the village normally became tenant farmers, as was discussed in the "life-cycle hypothesis" [11] [3]. In most cases, they rented land from close relatives. For comprehensive studies of land tenure systems among Malay rice farmers, see [4] [8] [11] [26].

TABLE III

INPUT AND OUTPUT FOR THE 1977/78 MAIN SEASON CROPPING

	Malays	Chinese	Significant Level of the Difference
Land area operated (acres)	2.46(1.73)	6.86(3.17)	1%
Labor input per acre (man-days):			
family labor	17.0 (11.2)	11.7 (4.4)	5%
hired labor	11.0 (12.1)	18.4 (6.2)	1%
gotong-royong labor	12.9 (8.8)	0.0	
total	40.9 (12.8)	30.1 (7.5)	5%
Nitrogen per acre (kg)	33.8 (12.6)	41.1 (13.9)	1%
Pesticide per acre (M$)	4.8 (3.9)	12.4 (6.2)	1%
Yield per acre (gantang):			
mean	523.5 (151.6)	572.0 (103.5)	10%
maximum	862.0	814.0	
minimum	121.0	385.0	

Note: Figures in parentheses are the standard deviations. The currency unit used in this paper is the Malaysian dollar. At the time of the study, 1 U.S. dollar was approximately 2.35 Malaysian dollars.

was typical.[9] The average yield per acre was 524 gantang for the Malays and 572 gantang for the Chinese. The difference of 48 gantang is statistically significant at the 10 per cent level. The range of yield variation and the magnitude of standard deviation of the mean value are much smaller among Chinese farmers than among Malays, which suggests that their level of rice technology and farm management might be relatively more uniform than that of the Malays.

In short, there existed marked differences between the two groups in terms of type of farm management and the resulting average yield per acre. It is now necessary to examine the cost-and-return structure of the two groups in order to further clarify differences in farm management.

C. *The Cost-and-Return Structure of Rice Farming*

Costs of rice production were calculated for nine components based on the following assumptions. Cost of seeds and seedlings was estimated at M$1.10 per gantang, which was the average rice price in the season studied.[10] Cost of fertilizer and pesticide was the actual expense incurred by farmers, including transportation costs and interest charges for purchases on credit. Although they may be an unusual cost component, ploughing costs refer to the cost of field preparation undertaken by one's own tractor or by a tractor hired on a contract basis [5]. The use of one's own buffalo for ploughing or paddling was included under the heading of family labor cost. The cost of family labor was imputed on the

[9] Although a serious drought caused extensive crop damage in the previous few seasons and forced farmers to abandon the planting of the 1978 off-season crop in Kedah, this did not affect the area under study in P.W. where irrigation water was pumped up from the Muda River.

[10] There was very little change in rice price from 1974 to 1980. One U.S. dollar was approximately 2.35 Malaysian dollars at this time.

TABLE IV

COST OF RICE PRODUCTION PER 100 GANTANG (1977/78 MAIN SEASON CROPPING)

	Malays		Chinese	
	M$	%	M$	%
Seeds & seedlings	1.30	1.0	1.05	1.0
Fertilizer & pesticide	12.12	9.7	12.58	11.0
Ploughing	8.71	7.0	5.22	4.6
Family labor	16.85	13.5	12.83	11.2
Hired labor	14.65	11.7	22.92	20.1
Gotong-royong labor	15.84	12.7	0.0	0.0
Rent	9.64	7.7	1.63	1.4
Interest on farm assets	45.17	36.1	56.99	49.9
Tax & rate	0.74	0.6	0.92	0.8
Total	125.02	100.0	114.14	100.0

basis of M$7 per day (eight man-hours), and no distinction was made as to sex or age of the worker.[11] While the cost of *gotong-royong* labor was imputed in the same manner as family labor, it also included the cost of food, drink, and cigarettes supplied to the workers. Hired labor costs were the actual expenses incurred by the farmers. Rent was also the actual amount paid by tenants to their landlords. Rental in kind (*padi*) was converted into monetary terms at M$1.10 per gantang. Annual interest on farm assets was estimated at 10 per cent (5 per cent for the season studied) charged on the current value of farm assets, including owner-cultivated rice land, farm buildings, machines, and draft animals.[12] Since farm assets were evaluated according to the values given by the owners in interviews, the direction of bias was probably toward overestimation. Tax and rate refer to the land tax and water rate paid by the farmer.

The average cost of production per 100 gantang of *padi* is presented in Table IV for both groups of farmers. The production costs appeared to be lower for the Chinese than for Malays, the main differences being the labor cost, rent, and interest on farm assets. The major cost component was the interest on farm assets, which constituted 36 per cent of total costs among Malays and 50 per cent among Chinese. The high level of capital costs was clearly due to high land values, averaging M$7,700 per acre, which accounted for a major part of total farm assets.

The labor cost constituted 38 per cent of total costs among Malays and 31 per

[11] The use of M$7 per day was based on the following facts. The government research institute located in Bumbong Lima employed more than two hundred casual workers from the survey area and paid M$6.50 per day. Construction workers in nearby towns could earn M$8 to M$12 per day.

[12] The use of 10 per cent interest rate was based on the following facts. Farmers' Association, from which most of the farmers purchased fertilizer and pesticide, charged 4 per cent interest per season (8 per cent per year) on credit and paid 10 per cent dividend on shares. Shops in nearby towns charged 10 per cent interest per year for purchases on credit. Thus, it appeared that 10 per cent was a reasonable rate for the opportunity cost for capital assets used in rice farming.

TABLE V

NUMBER OF FARMERS ACCORDING TO THE AVERAGE RICE INCOME PER MONTH (1977/78 MAIN SEASON CROPPING)

Income (M$)	Malays	Chinese
0	3 (3.5)	0 (0.0)
1– 49	19 (22.4)	0 (0.0)
50– 99	17 (20.0)	0 (0.0)
100–149	21 (24.7)	3 (12.0)
150–199	11 (12.9)	2 (8.0)
200–299	5 (5.9)	3 (12.0)
300–399	4 (4.7)	8 (32.0)
400–499	3 (3.5)	2 (8.0)
500 or more	2 (2.4)	7 (28.0)
Total	85 (100.0)	25 (100.0)

Note: Figures in parentheses show the percentages.

cent among Chinese. Estimated cost of family labor and *gotong-royong* constituted 26 per cent of total costs for Malays, while hired labor cost was 20 per cent of the total expenses for Chinese. The average rent was higher for Malays, among whom the incidence of tenancy was higher than for Chinese.

While the average production cost was M$125 for Malays and M$114 for Chinese, the gross revenue from 100 gantang of *padi* was M$110. Since no by-products of rice farming were effectively utilized or sold, they were excluded from the analysis. In other words, both groups of farmers recorded on average a negative net revenue. This does not necessarily mean, however, that they should stop growing rice, as the payment to capital and family labor was regarded as part of costs in the above calculation. Should we exclude these two items from the calculation, the remaining cost would be M$44.32 for the Chinese and M$47.16 for the Malays. The balance between this cost and gross revenues is considered to be the return to capital and family labor. For those farmers who did not actually impute unpaid costs, this return probably meant income from rice farming. That is to say, the farmers received a positive income from rice cultivation, amounting to M$62 for Malays and M$66 for Chinese per 100 gantang of *padi* harvested. On a per-acre basis, this income level would be equivalent to M$328 for the former and M$371 for the latter.

Even though the difference in rice income was not particularly large on a per-acre basis, the difference in farm size obviously affected the total income from rice for both groups. Table V shows the number of farmers according to the average rice income per month measured in terms of the return to capital and family labor. Among Malay farmers, 46 per cent earned less than M$100 per month, and as many as 84 per cent of the total earned less than M$200. Three farmers could not obtain a positive income from rice farming in the season studied due to severe crop damage. In contrast, 80 per cent of Chinese farmers earned more than M$200 per month, 28 per cent obtaining M$500 or more from rice cultivation.

A question arises as to where these farmers stand in relation to the average

standard of living in Malaysia. According to the Malaysian government, the poverty line was M$267 per month per household in 1979. This level of income was defined as necessary to cover minimum food requirements and the basic outlays for clothing, housing, durable consumer goods, and transport services needed to sustain a decent standard of living [12, p. 5]. The average rice income of the great majority of Malay farmers clearly was so low that they could not sustain a decent level of living. This means that they either had to remain in poverty or search for other sources of income. A number of farmers certainly engaged in off-farm employment, such as wage labor in agricultural and non-agricultural sectors and trading. However, even if all sources of income are taken into account, 56 per cent of Malay farmers still earned less than M$200 per month and lived in poverty.[13]

It follows that increasing the level of income is vitally important, especially for Malays. There may be a number of ways of raising the level of farm-household income, including price policies and the provision of off-farm employment opportunities offering higher wage rates. Within the sphere of farm management, however, it is essential for farmers to either reduce production costs or increase the level of productivity under the given prices. Our analysis so far has revealed some significant differences between the two groups of farmers in terms of farm management and the resulting average yield per acre. Since the determination of productivity was probably affected by cultivation techniques, it is necessary to analyze rice technology in order to suggest possible ways of improving current farm management practices.

III. RICE CULTIVATION TECHNIQUES

In order to clarify differences in rice cultivation techniques, it may be useful to look first into the rice varieties planted by the farmers. As is seen in Table VI, the majority (67 per cent) of Malays planted only one variety, while most Chinese (68 per cent) planted two or more concurrently. This was probably due to the farm size difference in that the Chinese, cultivating a much larger area of land, planted several varieties in order to spread the risk and to experiment with new seed types.

A breakdown of rice varieties by type, presented in Table VII, seems to suggest different production attitudes in each group. Although 42 per cent of Malays planted Ketek, which has high-yielding potential, an equal proportion of farmers planted Mahsuri for its good food quality rather than price or yield considerations. This indicates that this variety was grown mainly for home consumption by a large number of Malay farmers. In contrast, none of the Chinese farmers

[13] It is important to note that the area surveyed (P.W.) may be considered a relatively wealthy rural area in Malaysia in that the average rice yield is high and off-farm employment is readily available in nearby towns. Yet the incidence of poverty still appears to be high in the villages. According to the most recent estimate, 55 per cent of all rice-farming households in the country lived in poverty in 1980, while the incidence of poverty in Penang State was lower than the national average. See [13, pp. 34, 44].

TABLE VI

NUMBER OF FARMERS ACCORDING TO THE NUMBER OF RICE VARIETIES PLANTED

No. of Varieties	Malays (%)	Chinese (%)
1	57 (67.1)	8 (32.0)
2	25 (29.4)	12 (48.0)
3	3 (3.5)	4 (16.0)
4	0 (0.0)	1 (4.0)
Total	85 (100.0)	25 (100.0)

TABLE VII

NUMBER OF FARMERS ACCORDING TO RICE VARIETIES PLANTED

Variety	Malays (%)	Chinese (%)	Remarks
Ketek	36 (42.4)	7 (28.0)	High yield
Mahsuri	36 (42.4)	0 (0.0)	Good taste
Mat Candu Kawin	13 (15.3)	5 (20.0)	High price
Appolo	12 (14.1)	2 (8.0)	
Mat Candu	8 (9.4)	15 (60.0)	High price
RC 1	2 (2.4)	11 (44.0)	High yield
RC 7	2 (2.4)	2 (8.0)	
Sri Malaysia	0 (0.0)	3 (12.0)	
Others	3 (3.5)	3 (12.0)	
Total	85 (100.0)	25 (100.0)	

grew Mahsuri or any other varieties out of consideration for taste, but clearly preferred varieties such as Mat Candu, RC 1, and Ketek for their high-yielding or price potential. Thus, the Chinese appeared to be generally more market-oriented in their choice of rice varieties, while the Malays showed a clear preference for a particular variety which was grown for home consumption.

Since production attitudes are likely to affect the actual practice of rice farming, the question arises as to how the above difference between the two groups was reflected in rice technology. Table VIII compares Malay and Chinese farmers with respect to rice cultivation techniques, from which a number of points can be drawn. First, the use of chemical fertilizer has been well established in the area, and all farmers in both groups applied it to nursery beds as well as to main fields. However, a clear difference was found in the use of pesticides. A very high proportion of Chinese farmers applied both insecticides and raticides, while less than one-third of the Malays did so, in the main fields at any rate.

Second, about 30 per cent of the Malays prepared fields only once or twice, while all the Chinese did so at least three times. Since careful preparation of the main fields is likely to contribute to the smooth settling and growth of transplanted seedlings, the intensity of field preparation may be considered to have important implications for the size of the yield.

Third, the use of a combine harvester is a labor-saving innovation but may not have positive effects on yield levels. Its use was observed only among

TABLE VIII

A COMPARISON OF RICE OPERATIONS BETWEEN MALAY AND CHINESE FARMERS

	Malays	Chinese
% of farmers using fertilizer in nursery beds	100.0	100.0
% of farmers using insecticide in nursery beds	18.8	56.0
% of farmers ploughing and paddling:		
only once	3.5	0.0
twice	25.9	0.0
3 times	52.9	84.0
4 times	17.6	16.0
Age of seedlings at transplanting (days)*	34.3	35.5
% of farmers using fertilizer in field	100.0	100.0
% of farmers using insecticide in field	27.1	92.0
% of farmers using weedicide in field	76.5	80.0
% of farmers weeding by hand	83.5	56.0
% of farmers using raticide in field	30.6	80.0
% of farmers using a combine harvester	0.0	60.0

* The difference between the two mean values of the age of seedlings is not statistically significant at the 10 per cent level.

Chinese: 32 per cent of the total harvested all their fields by machine, while 28 per cent employed a machine on part of their holdings, the rest hiring traditional manual labor. In the area studied, there were three combine harvesters owned by Chinese cooperative societies, and farmers used the machines on a contract basis. Even though this contract service was available for Malays as well, they preferred to employ fellow villagers for harvesting in order to provide them with wage opportunities.[14]

Fourth, despite the fact that the Malays had a larger amount of family labor on a per-acre basis, weedicides were used equally extensively by both groups. Since weedicides are labor-saving rather than yield-increasing, the extensive use of these chemicals by the Malays is consistent with their consumption-oriented attitude.

It is clear from the above analysis that Chinese rice cultivation techniques were more capital-intensive and geared toward increasing the level of the average yield, while Malay techniques were less capital-intensive and more subsistence-oriented. This implies that different kinds of technological improvements may be needed to increase the level of productivity for each group even under the same natural conditions and farm environment.

IV. ANALYSIS OF YIELD DETERMINATION

The determination of average yield with respect to cultivation techniques may

[14] The contract charge for reaping, threshing, and winnowing by a combine harvester was M$110 per relong, whereas traditional harvesting by manual labor would cost M$130 to M$140 for the same area of land not including winnowing. The villagers were of course aware of the economic advantage of the combine harvesters over manual labor, but they felt obliged to provide job opportunities for poorer villagers who needed a wage income. For a detailed study of mutual assistance among the Malays in rice production, see [4].

TABLE IX

MULTIPLE LINEAR REGRESSION ESTIMATES

	Malays		Chinese	
	Regression Coefficients	Standard Errors	Regression Coefficients	Standard Errors
a: constant	355.26		286.24	
b_1: hired labor	0.76	1.34	4.94*	3.15
b_2: fertilizer	1.90*	1.30	−0.21	1.38
b_3: pesticide	8.61**	4.34	8.44***	3.11
b_4: education	11.54**	6.56	22.87**	11.38
R^2	0.41		0.63	
N	85		25	

*** Denotes significance at the 1 per cent level.
** Denotes significance at the 5 per cent level.
* Denotes significance at the 10 per cent level.

be quantitatively analyzed by the estimation of functional relationships between yield levels and the use of various inputs. For this purpose, regression equations were estimated for the samples of Malay and Chinese farmers. Data used were drawn from the 1977/78 main season, as presented earlier in Tables II and III. The following model was used for the estimation:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 ,$$

where the dependent variable, Y, is the average yield per acre expressed in physical terms, gantang. Of the four independent variables, X_1 is the amount of hired labor–input per acre expressed in man-days. No distinctions were made as to the sex and age of the workers, and the input of family and *gotong-royong* labor was not included in the analysis. X_2 is the amount of fertilizer used per acre and expressed in kilograms of nitrogen (N) used. Other fertilizer elements (P, K) were not included in the variable. X_3 is the amount of pesticide applied per acre and included insecticides and weedicides. This was expressed in Malaysian dollars. Since raticide was provided free of charge by the Farmers' Association, this chemical was excluded from the analysis. X_4 is the farmers' educational level expressed in the number of years of formal school education. It is hoped that this variable may correspond to farmers' managerial skills and the level of technical know-how. The regression coefficients of all four variables, b_1 through b_4, are expected to have a positive sign.

The model is certainly partial and does not attempt to cover all the variables which probably influenced the size of average yields. The results of the estimation are presented in Table IX. The coefficient of multiple determination (R^2) indicates that 41 per cent and 63 per cent of yield variations among the Malay and Chinese farmers, respectively, can be explained by the variables included in the regression equation. In view of the fact that the specification did not include natural fertility of land as an independent variable, these results appear to be reasonably good. In fact, three of the four independent variables have significant regression coefficients at the 10 per cent level. Overall, the results present a useful set of estimations for discussing the mechanism of yield determination.

First, education appears to play a most important role in the determination of

average yields for both groups. Theoretically, one extra year of school education for the farmer will result in a higher yield per acre by 12 gantang for Malays and by as much as 23 gantang for Chinese. The difference in the magnitude of the regression coefficient between the two groups is statistically significant at the 1 per cent level. If the educational standard is acceptable as an index of farmers' managerial skills, the results would suggest that the scope for increasing the level of average yeilds by improving farm management practices was wider among Chinese than among Malays. This is consistent with the earlier analysis which revealed that Chinese farm management was capital-intensive and relied on the intensive use of hired labor as well as on capital inputs. Furthermore, if the educational standard is taken as indicative of the level of technical know-how, the present result provides support for past studies emphasizing the importance of technical knowledge in the determination of rice income [2].

Second, pesticide plays a significant role in the determination of the average yield for both groups. The magnitude of the regression coefficient is very similar for both groups, and the difference is not statistically significant at the 10 per cent level. The expected yield increase from an additional dollar of pesticide is eight to nine gantang on the average. Since this increment in yield is equivalent to about M$10, the increased use of pesticide can be economically justified. Even if price uncertainties and production risks are taken into account, the increase in pesticide application appears to be a highly desirable method of raising productivity among Malay as well as Chinese farmers.

Third, it is interesting to compare the contribution of fertilizer to yield determination for the two groups. For the Malays, the regression coefficient is significant at the 10 per cent level and has a positive sign. One additional kilogram of nitrogen can be expected to increase the yield by 1.9 gantang or M$2.09 on the average. Since the price of urea (20 kilograms, N=46 per cent) was M$9.50 at the local Farmers' Association, which charged 4 per cent interest on credit sales for one season, the marginal cost of nitrogen would be M$1.07 per kilogram. Again, the expected yield increase is much greater than the additional cost, justifying the increased use of this important input.

However, the regression coefficient of the fertilizer variable for Chinese farmers has a negative sign but is not statistically significant at the 10 per cent level. It appears that the already large amounts of fertilizer used by this group resulted in an insignificant coefficient. Given the current level of other inputs in use, the average Chinese farmer could not expect to increase his yield by using a larger quantity of fertilizer.

Fourth, the regression coefficient of hired labor is not statistically significant for the Malays at the 10 per cent level. This suggests that their use of labor, mainly in the form of family and *gotong-royong* labor, was already so intensive that additional employment of hired labor would have an insignificant effect on the yield level.

In contrast, this coefficient is significant for the Chinese and has a positive sign. Theoretically, the group can expect a yield increase of 4.94 gantang from an additional day of hired labor. As mentioned earlier, the Chinese farmers em-

ployed hired labor, consisting of Malay men and women, for transplanting, reaping, and threshing. Since wages were paid on a per-relong basis, the workers tended to complete the job as fast as possible in order to obtain further contracts from other farmers during the limited peak season. This naturally resulted in roughly performed, low-quality work. One typical example was seen in transplanting where the workers transplanted seedlings too sparsely, so that a group of seven or so women could complete the task of transplanting a whole relong in just one day. A similar agronomic problem was also reported by a study conducted in Kedah, which emphasized the necessity of dense transplanting as a measure for increasing yields [17]. The result of our regression analysis appears to suggest, then, the necessity among Chinese farmers of more careful and denser transplanting by employing additional hired labor. The same may be said of reaping and threshing. It may also be argued that yields may be increased by assuring better quality work rather than by simply hiring larger quantities of manpower.

Thus, our regression analysis quantitatively clarified differences in the process of yield determination with respect to cultivation techniques and confirmed that different technical improvements are needed to raise the level of yields for each group of farmers. It became clear that differences in production attitudes, farm management, and institutional arrangements were reflected in the actual process of farm operations and in the resulting average yields per acre.

CONCLUSION

This paper presented a comparative analysis of the rice-farm management of Malay and Chinese farmers who grew rice in adjacent areas of the Northern District of P.W. Data were obtained from the author's fieldwork in 1978, and the analysis of rice farming was carried out for the 1977/78 main season cropping. The area surveyed is one of the most progressive and productive rice-growing regions in Malaysia, double-cropping being first introduced here during the Japanese Occupation. It is also characterized by a long history of rice cultivation by the two ethnic groups. The analysis of different groups of farmers working in the same environment was undertaken to highlight the effects on farm management of production attitudes and other determinants which may reflect ethnic characteristics.

Marked differences were found between the two groups in the type of farm management employed and in the resulting levels of yield. Differences in farm size, which were originally caused by historical factors and maintained by different systems of inheritance, were clearly the most important factor responsible for the large income gap observed between Malays and Chinese. However, some indications of qualitative differences in farm management were also found. The Chinese farmers were seen to be essentially market-oriented, and their rice cultivation techniques were clearly geared toward increasing the level of productivity through the intensive use of capital inputs and hired labor. In contrast, the Malay farmers appeared to be more consumption-oriented, and their farm management was

relatively labor-intensive. Not only was the level of yield higher, but the production cost was also lower for Chinese than for Malays. This suggests that Chinese farmers had generally more advanced cultivation techniques and managed rice farming better than Malay farmers in the same area.

It follows that each group appears to require different approaches for the improvement of production practice. Even though the area surveyed is very progressive, a generalized view of the problems facing farmers could lead to unrealistic approaches and, ultimately, to wrong solutions. The policy implication is that future farm improvement should take into account not only regional conditions but also differences between individual farmers, including ethnic characteristics.

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