Southeast Asian Studies, Vol. 18, No. 4, March 1981

Ecology, New Technology and Rural Development: Impressions of Kampung Ulu Tiram Burok

L.J. FREDERICKS*

Introduction

The core of this small study is a survey carried out in 1976 among 39 Javanese village households cultivating two crops of paddy in the Sawah Sempadan area of Tanjung Karang, Selangor in Peninsular Malaysia. The questionnaires used in this survey were nearly identical to those administered in other villages in Malaysia and Thailand in a comparative project coordinated by the Center for Southeast Asian Studies, Kyoto University.

The major objective of this paper is to observe the broad processes of change in this particular locality, drawing data from previous studies and the present survey. The changes are particularly related to the ecology of the locality and the technological advancements that have been disseminated and adopted. These processes impinge upon rural development in Kampung Ulu Tiram Burok.

I The Survey Area

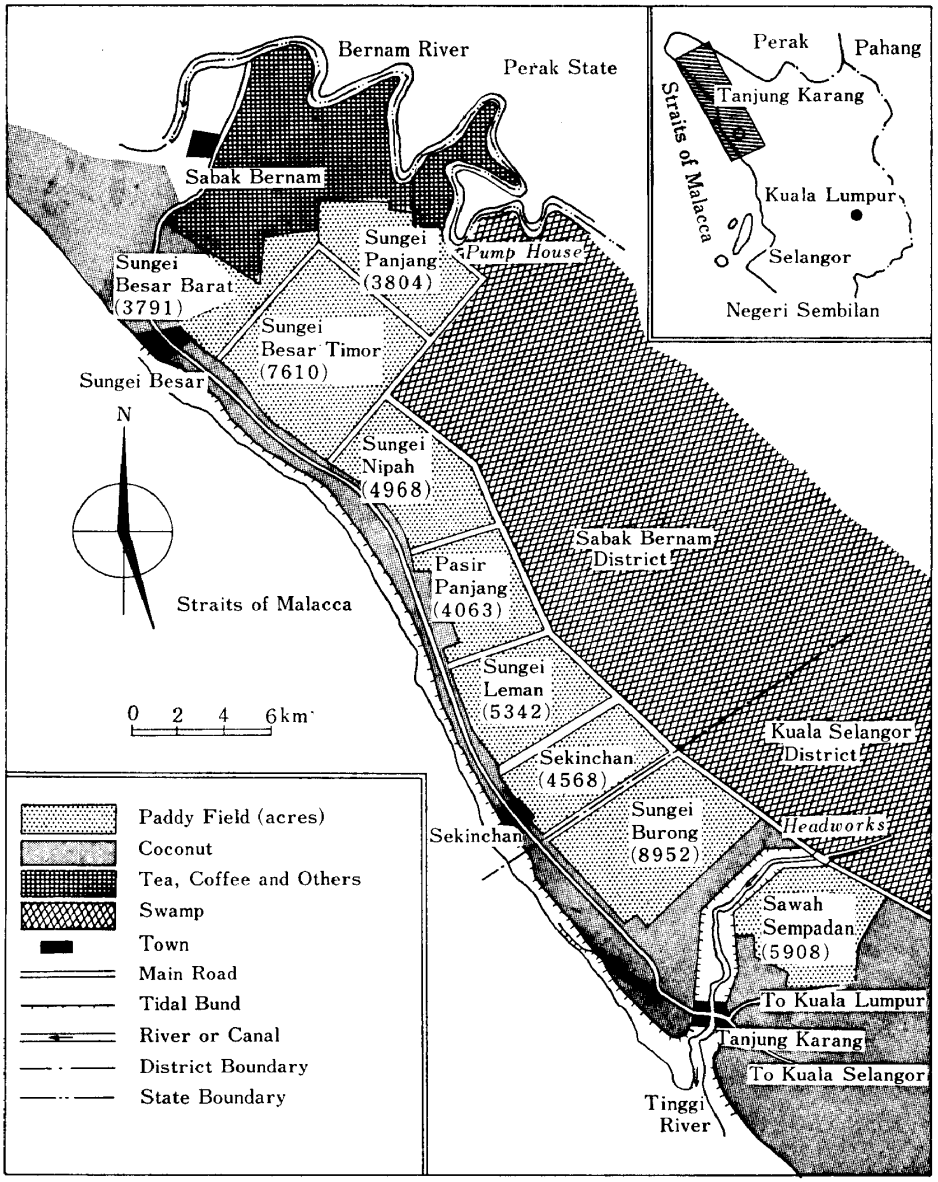
Kampung Ulu Tiram Burok is one of a cluster of kampungs located on the perimeter of the Sawah Sempadan paddy belt consisting of about 6,000 acres of paddy land. This kampung is a nucleated settlement whose boundaries, however, merge into other kampungs. Their inhabitants are primarily dependent on rice cultivation. Most farmers stay off-farm and only a minority reside on-farm in this locality.

Kampung Ulu Tiram Burok is easily accessible to Tanjung Karang which is not only an important market town but is the location of the Agriculture Department, Drainage and Irrigation Department, Farmers' Organization Office, hospital, etc. The district capital is Kuala Selangor, which is about 60 miles northwest of Kuala Lumpur and in which is located the District Office. Access to Kuala Selangor was formerly limited to ferries only but recently a bridge over the Selangor River was completed (Fig. 1).

Ecology and Its Adaptation

Sawah Sempadan is one of seven localities forming the Tanjung Karang Rice Belt which is the "rice bowl" of Selangor. The total area under paddy is 49,006 acres of which Sawah Sempadan accounts for 5,908 acres. As the area had to be adapted in order to facilitate

* Faculty of Economics and Administration, University of Malaya, Kuala Lumpur, Malaysia



Source: Funahashi [8]

Fig. 1 Tanjung Karang Paddy Area

irrigated rice cultivation, each locality is neatly subdivided into blocks and lots. For example, Sawah Sempadan consists of 23 blocks of about 250 acres each and 1,993 lots of an average size of 2.96 acres.

The Tanjung Karang Rice Belt stretches over two districts (Kuala Selangor and Sabak Bernam) in a strip 2–4 miles wide, stretching 27 miles along the coast of Selangor. The area is ecologically swampy and low lying and is subject to frequent tidal inundations. Attempts to develop the swampy coast between the Selangor and Bernam Rivers began as early as 1895 but the first settlers, from Sumatra and Java, opened the coastal strip north of Kuala Selangor only in 1918. Initial attempts to adapt the coastal ecology to human habitation and cultivation were undertaken by these settlers using open

ditches to drain the swamps. However, sea-water inundation could not be effectively controlled by these primitive means, and agriculture (primarily coconut cultivation) remained in a precarious state. The setting up of the Drainage and Irrigation Department in 1932 led to the construction of a 50-mile long coastal bund with tidal gates and internal drains.

To promote paddy agriculture, an area of 15,000 acres was drained using a controlled drainage scheme in the Pancang Bedana area to the north of Tanjung Karang. This scheme was completed in 1937. In the meanwhile, intensive investigations were begun in 1933 to tap the paddy growing potential of the Tanjung Karang swamp. These investigations revealed that the arable land was limited by the depth of peat and consisted of a belt of 2–4 miles covering about 50,000 acres. In 1936, project proposals were submitted involving the construction of headworks on the Sungei Tinggi, a 2 1/2 mile canal to irrigate the Sawah Sempadan area, another 17-mile canal running north to Pancang Bedena and a perimeter bund with control gates on the western side to retain water in the paddy belt and separate it from the kampung belt earlier developed. The impending crisis of the Second World War accelerated the pace of development and construction began in September 1939.

In 1952, construction work was completed but with the reduction in the catchment area as a result of the development of the paddy belt, and to facilitate double cropping, a 9-mile-long diversionary canal was constructed supplying water from the Bernam River to the Tinggi River. This work was completed in 1957. In 1961/62, a pump house was constructed on the Bernam River to supply extra water to the Pancang Bedena area.[1] Thus by this date, investments in drainage and irrigation in the area ensured sufficient water for an area of 50,000 acres to double crop with rice. Currently, therefore, the drainage-irrigation system in the area utilizes water drawn into the main canal from the Tinggi and Bernam Rivers through the Tinggi River headworks. From the main canal, water flows by gravity into the secondary irrigation canals and finally into individual paddy lots on a field-to-field flooding basis. Excess water is drained by secondary drainage canals into the sea via drainage gates located on the tidal bunds which also serves to prevent tidal inundation.

Since 1961/62, no major adaptations to the existing irrigation system have been undertaken although two pilot schemes in the Sekinchan and Sawah Sempadan areas were started to provide on-farm control of water flows using concrete and fibre glass canals. The pilot project in Sawah Sempadan was a prelude to the Northwest Selangor Integrated Agricultural Development Project financed by the World Bank and currently in progress. This project, costing US$60 million of which US$26 million is financed by the World Bank, aims at improving

1) I have drawn heavily on Narkswasdi and Selvadurai [11: 18–21] for this section.

the existing headworks, feeder and main canal, construction of tertiary irrigation and drainage networks to serve individual farm lots. It also aims at improving the drainage and flood control systems serving about 200,000 acres under tree crop agriculture in the area.

As noted by the World Bank [15: 7]:

> The existing irrigation system has fulfilled its original purpose of permitting wet-season *padi* production and dry-season cropping of an average of 70% of the scheme area but still suffers from several deficiencies. The capacity of some reaches of the main canal is inadequate and the gates of the old Tinggi headworks now leak badly and waste water. Command head of the existing distributary canals is inadequate, causing slow inundation of fields and late transplanting, a problem exacerbated by the fact that water must travel one-half mile across farm lots with the present density of distributaries. Since the micro-topography is undulating, the water must often fill depressions to undesirable depths (30 cm. and above) before its flow continues. Much of the area can only be inundated by back-flooding from drains which are kept full for this purpose, thereby wasting substantial amounts of both water and fertilizers. These inadequacies have led to a situation where large areas of *padi* are continuously out of phase and drainage for drying and harvesting earlier planted fields is impossible if the water needs of the less mature crops are to be met.

II Productivity, Costs and Incomes

Table 1 provides data on acreage, output and marketed surplus based on the Kampung Ulu Tiram Burok and other surveys [4; 10; 11]. Given an average cultivated area of 2.44 acres, the average physical productivity is only 35.4 pickuls per acre, the largest deviation from which is shown in the smallest farms. This productivity is low compared to the average for Sawah Sempadan in 1966 (38.2 pickuls/ac.) or for the 1966 average for the Tanjung Karang area as a whole (47.6 pickuls/ac.). Again, in contrast to another survey undertaken in 1975/76 of farmers resident on-farm in Sawah Sempadan, the productivity of our 39 farm sample appears below average. Bearing in mind the different bases upon which the three surveys were undertaken, it would appear that while certain farmers in Sawah Sempadan (which records one of the lowest productivities in the Tanjung Karang belt) have increased their productivity, other farmers still produce at levels of output and technology which have changed little or marginally over the years. Secondly, while the third survey above shows that certain farmers have reached the average levels for the whole belt in 1966, it is certain that the farmers who were highly productive then (especially in Sekinchan, a Chinese area) have increased output at the same, if not higher, rate. Thirdly, given the scope and quality of ecological adaptation obtained in 1961/62 (when construction work

Table 1 Acreage Farmed, Output and Marketed Surplus by Different Farm Size Groups, Two Crop Seasons, Sawah Sempadan and Tanjung Karang, 1966–1975/76

Farm Size (ac.)	Total Acreage (ac.)	Total Output (pi.)	Avg. Output (pi./ac.)	Total Output Sold (pi.)	Total Output Retained (pi.)	Marketed Surplus
1½	24	776.4	32.4	649.8	126.6	83.7
2	4	127.0	31.8	107.0	20.0	84.3
2½	2½	98.5	39.4	79.6	18.9	80.8
3	54	1987.9	36.8	1587.1	400.8	79.4
4½	4½	165.0	36.7	140.0	25.0	84.4
6	6	208.0	34.7	170.2	37.8	81.8
Total	95	3362.8				
Avg. All Farms[1]	2.44		35.4	2733.7	629.1	81.3
Narkswasdi & Selvadurai[2]						
Sawah Sempadan			38.2	n.a.	n.a.	n.a.
Tanjung Karang			47.6	n.a.	n.a.	68
Fredericks[3]						
0–1.99	19.2		47.4	n.a.	n.a.	63.3
2–3.99	53.4		43.4	n.a.	n.a.	75.3
4–9.00	27.4		41.5	n.a.	n.a.	81.4

1 1975/76 survey of Kg. Ulu Tiram Burok
2 [11]
3 [4]
n.a.=not available

was completed and double cropping begun), as indicated by the World Bank Report quoted above, that further increases in productivity can only be of a marginal nature, unless the irrigation and drainage infrastructure is made more sophisticated and on-farm water controls made possible.

The marketed surpluses have clearly risen, showing a need to obtain cash incomes to meet the past and forthcoming season's cash expenses which are high because of the double cropping regime.

Table 2 provides data on output, production costs and net incomes aggregated over two seasons using the three different surveys. It should first be emphasized that the different data bases, while not completely uncomparable, have to be treated with some caution. Nonetheless, attention can be drawn to several facts. A comparison of gross paddy incomes clearly shows that despite the inconclusive evidence on productivity gains, per unit paddy prices have increased by nearly 100% (Guaranteed Minimum Prices set by government), while production costs have also risen steeply. The relationship between production costs and revenue is clouded because of technological changes (e.g., changes in intensities of input use), inflationary trends (labour wages, tractor services, etc.) and the spread of the sample over different farms sizes (greater labour intensities on smaller farms as compared to larger sized

Table 2 Output, Expenditure and Net Incomes per Acre, Aggregated over Two Crop Seasons, 1966–1975/76

Survey	Avg. Output (pi./ac.)	Gross Paddy Income $	Production Costs								Net Paddy Income $	Imputed Costs $		Net Returns $
			Fertilizer & Insecticides	Seeds	Hired Labour	Land Rent	Irrigation & Other Fees	Maintenance & Repair	Other	Total Costs $				
Ulu Tiram Burok (1975/76)	35.4	942	161	40	169	23	30	43	18	484	458	n.a.	n.a.	?
Narkswasdi & Selvadurai (1966)														
1. Sawah Sempadan	37.2	328	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	320	8	n.a.	n.a.	-ve
2. Tanjung Karang	47.6	422	5	4.4	79.2[1]	24.4	6.6	14.8	6.8	141.2	280.8	20.4[2]	147.4[3]	113
Fredericks (1975/76)	44.1	1181	105	22	86	26	24	—	69	332	849	337.3[3]	15.4[4]	496

1 Including hired labour and tractor costs 2 Depreciation on farm capital 3 Family labour 4 Tractor services
n.a.=not available, -ve=negative

Table 3 Sources of Income on a Per Farm Basis, Aggregated over Two Seasons, 1966–1975/76

Farm Size Class ac.	Total Paddy Output Pickuls	Gross Value $	Input Costs $	Net Paddy Income $	% of Total Income	Income from				Non-paddy Income $	% of Total Income	Off-farm Income				Off-farm Income $	% of Total Income	Total Farm Income $
						Permanent Crops $	Temporary Crops $	Poultry, etc. $	Other $			Small Business $	Agric. Labour $	Non-agric. Work $	Rentals $			
1½	48.5	1229	696	533	21	576	9	116	—	701	28	—	931	366	—	1297	51	2531
2	63.5	1709	1104	605	36	100	20	115	—	235	14	—	850	—	—	850	50	1690
2½	98.5	2646	1750	896	26	575	—	190	—	765	22	600	1200	—	—	1800	52	3461
3	110.4	2926	1029	1897	45	723	1	88	11	823	20	40	835	577	—	1452	35	4172
4½	165.0	4551	873	3678	47	600	—	260	—	860	11	—	3300	—	—	3300	42	7838
6	280.0	5440	4032[2]	1408	22	1000	—	70	—	1070	16	—	4030	—	—	4030	62	6508
Avg. All Farms				1502	34	596	5	140	2	743	17	107	1858	157	—	2122	49	4367
Narkswasdi & Selvadurai (1966)	167.3	1478	474	1004	61	93	12	65	—	170	10	←	222	→ 244	—	466	29	1640
Fredericks (1975/76) 3.34	142.8	3850	1048	2802	63	← 25	———	→ 127	—	152	4	—	347	579	541[3]	1467	33	4421

1 Excluding imputed costs 2 Including high repair costs 3 On tractor services and land

farms). Net paddy incomes have increased since 1966, although inflation has been of the order of greater than 60% since then. If we relate the 1966 survey data for Sawah Sempadan with the other two surveys, we could tentatively conclude that significant gains have been made, probably by technological advances and innovations adopted by this group of farmers as compared to others who were more innovative-minded in 1966. As indicated by various researchers [1; 4], the major determinants of paddy income are size of farm and land productivity. A detailed investigation on the latter factor by Bhati [1: 218] shows that while inputs such as fertilizers, weedkillers, pesticides, seed variety, etc., are important explanatory variables, cultivation practices also affect paddy yield per acre. This is discussed elsewhere in this paper.

Regarding imputed costs (particularly for family labour, depreciation, tractor services on farms using their own tractors), net returns are reduced significantly for all farms although one can expect negative returns particularly for small paddy farms. This is indicated for the Sawah Sempadan farmers in 1966.

One significant factor in paddy farming operations in the two periods seems to be a decline in the use of in-kind payments particularly for rents, wages and *zakat* or religious tax. Narkswasdi and Selvadurai [11: 99] indicate that 14.1% of total paddy production costs were met in-kind. This percentage actually increases to 45% when imputed costs for family labour and depreciation are excluded. Currently, in-kind payments are seldom made in testimony to the widespread monetization of relationships in the area. Furthermore, with double cropping, constant demands are made on the cash reserves of the farmer, although cases of deferred payments (e.g., for tractor services) are quite common.

Table 3 provides some perspectives on the composition of total farm income derived by paddy farmers. Three major sources can be identified: net paddy income (less realized production costs but not taking into account imputed costs); income from other farm-based agricultural activities (crops, poultry, livestock); and off-farm income from small businesses, agricultural labour, non-agricultural labour (fixed wage employment) and rentals from farm equipment and land. In comparing the Ulu Tiram Burok survey with the survey of 1975/76, one attribute to be noted is that the latter covered on-farm cultivators who derive little income from permanent crops while the former group consists of farmers who live off-farm where the possibility of non-paddy cultivation is greater. This accounts for the large difference in the percentage of non-paddy income and the relative significance of paddy cultivation in contributing to total farm income.

A comparison of the sources of farm income between Fredericks' and Narkswasdi and Selvadurai's surveys shows that the relative significance of the three sources have changed little over ten years, although the magnitudes of income earned differ significantly (up to 300%). For all

three surveys, off-farm income sources are more important than income from non-paddy cultivation and within the former category, agricultural labour appears a very important source, particularly for small farms [4: 36].

Taking the 1970 national mean monthly income of $264.00, there are significant gains made between 1966 ($137.00) and 1975/76 ($364.00 and $368.00) even if the post-1970 inflation factor is taken into account. The comparison is even more favourable when the rural household mean monthly income of $200.00 or the mean monthly income of $172.00 for rural Malay households is used as the standard. If only net paddy incomes are used, the mean monthly figures for the three data sets are $84.00 (1966), $125.00 (Ulu Tiram Burok) and $233.00 (1975/76). Other important dimensions that require consideration (but for which comparable data are unavailable) are the measure of income disparity and the distribution of income by different farm size groups.

Two other changes are noteworthy in relation to farm incomes in the area over the last decade or so. Generally, with rising incomes, levels of living have increased materially, and this is indicated by the more widespread consumption of consumer goods (bicycles, motorcycles, new houses, television and radio, piped-water, electricity) by farmers. Obviously, there are poor farmers who have not been affected by these changes, although their expectations have surely sharpened over the years.

Secondly, there have been some general feeling that, as in the Muda area, the number of pure owner-farmers have declined while owner-tenants and tenants have increased in numbers. Funahashi's [8: 10] research in the Sungei Burong area covering 48 farmers shows that ten years ago, 20 households were owner-farmers working 78 acres. In 1978, this group had been reduced to 11 households farming only 32 acres. The number of owner-tenant farmers had increased to 13 and their cultivated paddy acreage was 76.6 acres or half of the total worked by the sample farmers. Somewhat the same position was recorded for the tenants. Consistent with this trend, the area rented-in and rented-out had also increased sharply. Narkswasdi and Selvadurai [11: 64] reported in 1966 that of all farmers were full owners while owner-tenants and pure 62.3% tenants consisted of 23.2% and 14.5% respectively for the whole area. For Sungei Burong, the corresponding figures were 46.4%, 32.2% and 21.4% respectively. Such a structural change in ownership indicates two possibilities: 1. that certain owners have extended their cultivation margins which would imply some degree of skewedness in farm sizes, and 2. that some other paddy land owners have moved out of farming and rented their land to farmers who had never farmed before or owned any paddy land hitherto.

III Technological Change and Adaptation

In assessing the quantum and direction of change related to technological ad-

vancements and its adoption by farmers, the basic hypothesis is that the different components of the modern rice technology (water availability, inputs and cultivation practices) must be fully adopted in order to realize optimum yields. A comparison between 1966 and 1975/76 can be made because this particular aspect was extensively investigated by Narkswasdi and Selvadurai [*ibid.*] and Fredericks [4]. An analysis of the adoption of the different components of the new rice technology is given below.

Cultivation Practices

Prior to 1961, the Tanjung Karang area cultivated only one crop and, as noted by Narkswasdi and Selvadurai [11], the growing period lasted six months (October–March) while harvesting spread over February–May. Such an extended growing/harvesting season merely reflected the uncoordinated planting schedules typical of the traditional rice cultivation regime, although it should be noted that the area was already serviced by an irrigation system. With the introduction of double cropping in 1961, farmers were forced to adapt to a new cultivation cycle requiring a greater degree of discipline than hitherto shown. In order to ensure this, optimum planting and harvesting schedules determined by the Department of Agriculture in consultation with the Drainage and Irrigation Department are disseminated to the farmers. These rigid schedules, determined to ensure optimum water supplies and minimization of crops losses by birds, insects, rats, etc., have, however,

Table 4 Deviations from Planting and Harvesting Recommended Schedules, 1966–1975/76

Field Operation	*Main Season* 1966[1]		*Off Season* 1966[1]		*Main Season* 1975/76[2]		*Off Season* 1975/76[2]	
	Recommended	*Actual*	*Recommended*	*Actual*	*Recommended*	*Actual*	*Recommended*	*Actual*
Preparation of Paddy Fields	10/10 1965	Oct.-Dec.	20/5 1966	various	14/9 1975	Sept.-Oct. 1975	14/3 1976	Mar.-Apr. 1976
Flooding Water in Fields	11/10 1965	follows above	25/5 1966	various	15/9 1975	Sept.-Oct. 1975	15/3 1976	Mar.-Apr. 1976
Nursery Sowing	18/10 1965	Oct.-Dec.	1/6 1966	June–July	23/9 1975	Sept.-Oct. 1975	23/3 1976	Mar.-Apr. 1976
Transplanting	25/11–5/12 '65	Dec.-Jan.	25/6 1966	June–Sept.	10–20/10 '75	Nov.-Dec. 1975	10–20/4 '76	Apr.-May 1976
Harvesting	not later than March 1966	May–July	Oct. 1966	Oct.-Jan. 1967				

Source: 1 [11: 33–34]
2 [4: 45]

been difficult to impose as indicated by the deviations recorded by Narkswasdi and Selvadurai [*ibid.*: 33–34]. Over time (1966–1975/76), it appears that farmers still face considerable difficulties in adjusting to the crop schedules thus affecting the productivity of land in the area (see Table 4). Such reluctance or inability is remarkable when compared to the disciplined behaviour of the Chinese rice farmers of Sekinchan (in Tanjung Karang) or the Malay paddy growers of Muda in Kedah. It is, of course, to be noted that not all farmers are unable to adjust to the recommended activity schedules and, after ten years experience, it is possible that deviations from these schedules are getting less and less. It is relevant, however, that Narkswasdi and Selvadurai [*ibid.*: 34] felt that the non-uniformity of planting and harvesting schedules was due to the fact that 1966 was the first year that double cropping was undertaken on a wide scale and that farmers had yet to adapt themselves to the new schedules. It would appear that reasons other than experience are cogent. They are related to the influence of tradition, rational adjustments by individual farmers to the actual on-farm water situation or delay in cultivation schedules on individual farms in order to release farmers to seek work in other paddy growing areas.

The importance of proper cultivation practices to optimum yields cannot be over-emphasized. In fact, as Bhati [1: 218] points out, the adoption of proper cultivation practices, avoidance of excessive flooding and other measures to improve land quality are crucial to the use of and response from modern inputs and seeds. Related to this factor is what Bhati terms the managerial factor (i.e., general experience as a paddy farmer, technical knowledge related to new inputs and paddy production methods, economic initiative and drive) as a key explanatory variable for variations in yields and incomes.

In order to facilitate double cropping, farmers have readily accepted the new seed varieties having a shorter maturation period, high yields and good eating quality.

Before double cropping began farmers planted a variety of seed (Radin Puteh, Radin China, Radin Siam, Radin India, Radin Kuning, Radin Nyonya, etc.), and in 1966 farmers used the newer varieties (Malinja and Mahsuri) recommended by the Department of Agriculture. By 1975/76, Mat Candu was the most popular variety in the area.

Nursery Preparation and Transplanting

With the availability of controlled water supplies, a wet nursery can be used, located either on field (*semaian tabur*) or on plots near the farm house or bund. The first method, which is practised in the Chinese area of Sekinchan, economizes on the use of both seed and labour, while the second, extensively used in Sawah Sempadan, involves two nurseries, the first called *semaian rakit* or floating nurseries and the second involving a transfer to the field itself. This second method is used because of the inability of some farmers to follow the pre-

scribed crop schedules. This situation prevailed in 1966 (Narkswasdi and Selvadurai noted that 90% of all Malay farmers used this method of nursery preparation) and was largely unchanged when the 1975/76 surveys were carried out.

Transplanting rather than broadcasting of seed is favoured as weeding can be more easily facilitated. Transplanting is done manually using family, hired or communal labour. The last source has never been used in Sekinchan and over the last ten years, its popularity is waning because of the monetization of traditional relationships. The *kuku kambing* is used in transplanting although, where the ground is soft enough, bare hands will suffice. Mechanical transplanters have not appeared in this locality although in Muda experiments have already begun to adapt these machines to its topography.

Field Preparation

In the paddy single cropping system, field preparation was done manually and not by using animal drawn ploughs. Even in 1966, manual preparation was popular and involved the cutting of weeds and stubble, raking and removal rather than actual ploughing and turning over of the soil. As with transplanting, hired, family and communal labour were used in field preparation. Although small tractors were available for hire in Tanjung Karang in 1966, the Sekinchan farmers were the main group who used them.

By the time of Fredericks' survey in 1975/76, all farmers were using tractors to plough their fields thus displacing labour input altogether. This substitution was as much a result of the availability of tractor services as the rising cost of farm labour and the pressure of time involved in double cropping. Two other points are relevant. The recommended practice of two ploughings is, by and large, followed by all farmers (more than 90% of all farmers surveyed by Fredericks [4] in 1975/76). A lack of financial resources and access to institutional credit are the major reasons why small farmers in particular plough their land only once. Secondly, tractor service costs were $20.00–$28.00 per acre for one round of ploughing or $30.00–$41.00 per acre for two rounds of ploughing in 1966. In 1975/76, two rounds of ploughing cost $125.00 for a 3 acre-field, thus showing then that the cost of mechanical ploughing has largely been unchanged in absolute terms. However, given that inflation has been considerable over 1966–1975 and that labour costs have about doubled, the factor price ratios have definitely turned in favour of tractor ploughing. In fact, the incidence of tractor ownership is very high and instances of farmers owning more than one tractor have been identified in the 1975/76 survey. Incomes of these tractor owners far exceed their incomes from paddy cultivation: access to capital resources have led to the creation of a new class of tractor capitalists.

Intensity of Fertilizer and Other Chemical Applications

Input of chemical fertilizers is an important part of the new rice technologies

Table 5 Use of Recommended Inputs and Tractor Services in Different Farm Size Categories

Input/Service	Season	Small		Medium		Large	
		No.	%	No.	%	No.	%
Nursery Fertilizer	—1st	8	40	20	51	4	29
	—2nd	13	65	21	51.2	6	50
Field Fertilizer (basal mix)	—1st	18	90	37	95	13	93
	—2nd	19	95	35	85	12	100
Field Fertilizer (urea)	—1st	18	90	34	87	13	93
	—2nd	17	85	40	98	12	100
Insecticides	—1st	17	85	37	95	14	100
	—2nd	15	75	34	83	11	92
Weedicides	—1st	9	45	24	62	11	79
	—2nd	6	30	18	44	10	83
Herbicides	—1st	1	5	—	—	—	—
	—2nd	—	—	—	—	—	—
Tractor Ploughing[1]	—1st	18	90	35	90	14	100
	—2nd	18	90	36	88	12	100

Source: Fredericks [4: Table 19]
1 Number of farmers undertaking two ploughings

as the fertility of the soil has to be maintained under a double cropping cycle. The 1966 survey reported that nearly all the Sekinchan rice farmers who double-cropped applied chemical fertilizers while only 23% of all other paddy lands were so treated. No animal or organic fertilizers were used at all. Despite a fertilizer subsidy offered then by the government, Narkswasdi and Selvadurai [11: 40–41] reported that, on the whole, farmers did not apply fertilizers at the recommended levels for the nursery (ammophos), pre-transplanting (mixed fertilizer) or after transplanting (urea). In dollar terms, application of fertilizers at the recommended levels would have cost $18.34 per acre at subsidized prices while on average only $2.51 per acre was actually spent. Furthermore, the type and quantity of fertilizer used and methods (timing) of application deviated from the government recommendations.

The 1975/76 [4: 5] survey (see Table 5) shows a large improvement in the incidence of fertilizer use by the non-Sekinchan paddy farmers although not at the recommended levels. However, a point worth noting is that the Department of Agriculture recommendations are not location specific and given the considerable variation in soil conditions, further research is required to provide dual or multiple recommendations.

Table 6 [*ibid.*: 48] provides details of the number and percentages of farmers using prescribed inputs. A marked reticence to use nursery fertilizers (ammo-

Table 6 Use of Recommended Inputs and Tractor Services

	1st Season		2nd Season	
	No.	%	No.	%
Nursery Fertilizer	32	44	41	56
Field Fertilizer (basal mix)	68	93	67	92
Field Fertilizer (urea)	65	89	70	96
Insecticides	68	93	60	82
Weedicides	44	60	34	47
Herbicides	1	1	1	1
1st Tractor Ploughing	72	99	73	100
2nd Tractor Ploughing	66	90	66	90

Source: Fredericks [4: Table 18]

phos) is shown despite its significance to the proper development of paddy roots. However, some farmers consider that its application makes subsequent transplanting difficult and, hence, use urea instead as a nursery fertilizer. For field fertilizers, urea and basal dressing, the acceptance rate is higher. The majority of farmers did not employ the quantities recommended, particularly of basal fertilizer mixtures. Other farmers used urea at above the recommended rates thus indicating its substitution for nursery and even basal mixtures. The timing of fertilizer applications was not strictly to specified schedules.

Although Narkswasdi and Selvadurai do not provide details of the use of other inputs, they reported that despite the supply of poison and sprayers to eradicate rats and other insects, few farmers used them. For the whole area, insignificant quantities were distributed although in Sekinchan, much labour time was spent and costs incurred to apply pesticides and insecticides. The 1975/76 survey (see Tables 5 and 6) indicated that while the level of use of such precautionary inputs as herbicides, weedicides and insecticides was less than for chemical fertilizers, nevertheless marked improvements since 1966 are shown. The less popular use of such relatively inexpensive inputs indicate a lack of confidence in their benefits rather than a lack of resources to purchase them.

As in 1966, however, manual weeding is extensively undertaken by the farmer and his family. A total of about 3 man-days were accounted by weeding and application of inputs out of about 19 man-days spent on each acre of paddy cultivated per season.

Some useful insights on the use of these inputs by different farm sizes is given in Table 5. Generally, with the exception of nursery fertilizers, larger farmers have higher utilization rates of input and undertake two rounds of ploughing their farms. It is to be expected that larger farms can finance input and tractor use without too much difficulty while the demands on cash reserves to meet the higher expenses of double cropping represent a great strain on small and medium-sized farms.

Harvesting and Threshing

The technical means to facilitate harvesting and threshing (*tajak, tuai, tong pukul padi*, etc.) have remained largely unchanged over the last ten years. The situation in Tanjung Karang contrasts sharply with Muda where combine harvesters are gaining popularity, due largely to the initiatives made by the Muda

Agricultural Development Authority which has been concerned with labour shortage at peak seasons in the rice cultivation cycle. The only tangible difference is institutional; i.e., the decline in the use of communal labour in harvesting and threshing and its substitution by hired labour working in groups or *"syarikat."*

IV Institutional Developments

At the time of the 1966 survey, farmers' institutions in the region consisted mainly of credit cooperatives, rice milling and marketing cooperative societies and two rice milling and marketing unions. The majority of these institutions had been formed between 1950–1960. Membership in the rural credit societies was largely determined by the availability of government agricultural loans and their operations were generally small and beset by repayment problems.

The cooperative marketing structure in 1966 was somewhat different in that the cooperative rice milling and marketing unions (in Kuala Selangor and Sabak Bernam) were paddy monopsonies which also undertook milling and marketing functions. It is noteworthy that as early as 1955 [2: 116–117], the Selangor government had authorized that marketing cooperatives be the sole paddy puchasing agents in Tanjung Karang. However, with the setting up of the Federal Agricultural Marketing Authority in 1965 (as a consequence of the relatively limited effectiveness of marketing cooperatives), a Padi and Rice Marketing Board was created in Tanjung Karang in 1968. The rice marketing cooperatives then became the buying agents of the Board while the cooperative rice milling and marketing unions were jointly operated with the Board. The rice marketing cooperatives still performed the function of milling paddy for home consumption.

Currently, that National Paddy and Rice Authority (LPN) is responsible for marketing and milling paddy, operating the Guaranteed Minimum Price of rice for the government, controlling import quotas and variable tariffs, stabilizing the rice buffer stock and supervising the compulsory sale of rice by millers to the Authority. Paddy cooperative marketing societies are now appointed agents of LPN. The cooperative union milling facilities are operated by LPN which itself has added to the local rice milling capacity by the establishment of huge integrated milling-drying complexes. The appropriateness of such technology to deal with the increased paddy output has been questioned by some researchers [13]. The small rice mills operated by the cooperative societies have themselves undergone upgrading in technology and mill paddy both for home consumption and for commercial purposes.

In 1973, the Farmers' Organization Authority (FOA) was formed to deal with the vexing problem of integrating farmers' cooperatives and farmers' associations. The latter were first formed in the area in 1969 as multi-purpose mutual help organizations which, to all intents and purposes, operated the same

functions and services as the agricultural cooperatives. However, various problems on the ground and at federal level prompted the creation of the FOA [3] which began operations in the Tanjung Karang area in 1973/74 by liquidating nearly all the agricultural credit societies because of their dormant or poor performance. A Farmers' Organization was set up in Tanjung Karang using the existing farmers' cooperatives and small agricultural units (of the farmers' associations) as field level organizations. The Farmers' Organization is staffed by FOA officers charged with the responsibility for farmer development in the area by the provision of various inputs (credit, fertilizer and chemical inputs, tractors) and services (accounting, extension, business development, etc.). However, as with the cooperatives and farmers' associations, the position of the Farmers' Organization *vis-a-vis* farmers raises the old problem of over-dependency. Some preliminary research done in the area [14] places the FOA third in importance in the perception of the farmer after the Drainage and Irrigation Department and Department of Agriculture. Another more substantial research project [9: 113], in which Tanjung Karang–Sabak Bernam was one of the areas studied, found that the affiliation with the cooperatives and farmers' associations was generally poor despite the attempts by the FOA to amalgamate these two organizations.

Since the onset of double cropping in Tanjung Karang, the number of government agencies involved in rural development has increased manifold. As noted by Fredericks [5: 191], two levels of relationship can be discerned between the political ideology of the State and the form of its participation in modernization processes. Rural institutions, like agricultural cooperatives and farmers' associations, manifest a committment to the institutionalization of the involvement of the farmer in rural development and an attempt to de-centralize the processes of government.

Up to 1969, FAMA (Federal Agricultural Marketing Authority) was the only public sector agency involved in rural development (apart from the Cooperative Department and traditional agencies like the Agriculture Department and the Drainage and Irrigation Department). After 1969, public sector expansion into the field of rural development began in earnest, largely to create bureaucracies imbued with the values of innovation, adaptation and change as compared to their traditional law-and-order and revenue-collecting functions.

In Tanjung Karang, the impact of these changes was an increase in the number of rural development agencies, each operating independently unlike MADA (the Muda Agricultural Development Authority) which operates as a river basin development authority. The Farmers' Organization Authority was charged with the function to coordinate rural development agencies in the areas where no overall authority existed but because of the lack of executive powers, linkages are forged more on a personal than on

formal bases. Thus, while farmers are being provided with a greater range of inputs and services, the lack of inter-agency coordination may create problems of confusion, overlapping of functions and misallocation of scarce resources.

V Ecology, New Technology and Rural Development: An Assessment

The adaptation of the Tanjung Karang rice producing belt clearly illustrates the problems associated with double cropping in an essentially humid and swampy environment. There is little doubt that changes to the ecology are pre-requisites not only to increase farm productivity but also to improve the socio-economic status of farmers in the area. From what was originally a virtually uninhabitable equatorial swamp has emerged a thriving community of paddy producers simply because of the pioneering efforts of the early settlers and the heavy public investments in drainage and irrigation infrastructure from 1932 onwards.

The adaptations brought by man on his environment are by no means a one-way relationship. The fact bears repeating that even when man initiates changes to the environment, productivity gains can be obtained only by the increased investment. This is indicated by the pioneering efforts to drain the swampy jungle of Tanjung Karang which resulted primarily in coconut cultivation. While some rice cultivation was possible in the early twentieth century, large scale cultivation was only possible with the intervention of the Drainage and Irrigation Department. Again, improvements on current productivity levels will only be feasible when the North West Selangor Irrigation Project makes on-farm water management a reality.

However, the influence of the environment on man and his productivity are equally, if not more, significant, and as a result the impact of environmental changes on rural development becomes more effective. In the first instance, while investments in infrastructure are pre-conditions to productivity gains, actual returns are predicated upon the micro-economic reactions of farmers to environmental and technological improvements. The cultivation practices of the Malay farmers in Tanjung Karang have affected productivity or delayed the full impact of the modern rice technologies. One major obstacle, as noted earlier, is the delay in adjusting to the planting and harvesting schedules determined by the Agriculture Department and the Drainage and Irrigation Department. In assessing this, Fukui and Takaya [7] and Takaya, Fukui and Yamada [12] have made some pertinent observations which may help in explaining the seemingly "irrational" behaviour of farmers. It is noted that the perhumid conditions in lowland Peninsular Malaysia have bred a strong trait of indifference to water control. This has resulted from the cultural adaptations of Malay farmers to an environment in which an abundance of rainfall was assured but not necessarily at definite periods during one year thus forcing farmers to be flexible in planting

and harvesting. The discipline required in double cropping is obviously difficult to adjust to overnight or over a period of ten years especially if farmers are unable individually to control the inflows and outflows of water required in paddy cultivation. In a sense then, the uncertainty of rainfall in a single cropping regime have been replaced, insofar as individual farmers are concerned, by the uncertainty of water flows under an irrigation-drainage system of the type available in Tanjung Karang.

Inability to adhere to the set schedules is compounded by the prevalent use of primary and secondary nurseries (or dry and wet nurseries) by Malay paddy farmers. The primary, dry or floating nursery (*semaian rakit*) is a cultural response to the swampy environment with high and unpredictable rainfall. Placing this nursery on high ground prevents inundation which would result especially if it were placed in the paddy field. Transplanting to the wet, secondary or field nursery is undertaken when seedlings are between 7–10 days old. Final transplanting is undertaken when seedlings are tall enough to meet the deep water conditions in the *sawah*.[2] Such a method of double transplanting (sometimes triple transplanting when fields are quite deeply flooded during the planting season) is wasteful of seed and labour as more than normal amounts of seed are used to off-set the poor conditions in the primary nursery. The continued use of the dry and wet nurseries in Tanjung Karang can thus be traced to the influence of the environment in the previous single cropping cycle. It is also influenced by the fact that farmers do not exercise sufficient control over water flows in their fields and are unsure about the ability of the authorities to deliver water into individual fields at the scheduled time.

The Chinese farmers in Sekinchan are more efficient in that labour and seed are saved by using only one nursery and transplanting seedlings directly into the fields 25–30 days after germination. However, whether the Chinese are more adaptable to changes in their environment in Tanjung Karang or themselves have been culturally influenced by the single transplanting method remains to be investigated. It is interesting to observe, however, that the Malay paddy growers in Muda have adjusted to new cropping schedules without substantial delays, although both double and single transplanting were common in the area during the single cropping era.

Secondly, the influence of the environment on the technology used in paddy cultivation has also been strong. Animal-drawn ploughs were never used in Tanjung Karang because they would have been hindered by the soft soil and the presence of sub-soil woody debris [*ibid.*: 155]. Thus, in the pre-double cropping period land preparation consisted primarily of slashing weeds with the *tajak* and tramping them into the ground. The use of tractors

2) Jackson reports that the double transplanting method was introduced to the West Coast of Peninsular Malaysia towards the end of the 19th century by Banjarese immigrants. See Takaya, Fukui and Yamada [12].

to prepare the soil for transplanting, while representing a technological advancement related to double-cropping, has been accelerated by economic factors and not necessarily by innovativeness alone. Thus, our surveys have shown that while a single ploughing of fields is widespread, a second ploughing is not as extensively undertaken especially by small farmers because of economic considerations. Weeding by hand or with the *tajak* is also extensively undertaken by farmers because the per-humid conditions facilitates vigorous weed growth.

The adoption of the other elements of the seed-fertilizer revolution appear to be mixed, although it is generally better than the adoption of the new planting schedules. This pertains to the use of the new seed varieties and chemical inputs (output-increasing inputs) although for the latter, despite a better performance over the last ten years, timing and rates of utilization are not according to the recommended rates. However, as indicated earlier, this experience may not be fully explained by the lack of innovation on the part of the farmers, because other factors like lack of cash resources or inappropriateness of the recommended levels are also important. For the latter, more research is obviously required before the extension machinery takes over.

Some aggregate effects of technological advancement in the area have been explored by Fredericks [3] and can be summarized here. Given that farms were of equal sizes when they were allocated to farmers, farm size ownership has become less equal partially because of the Islamic laws of inheritance and, to some extent, agglomerative tendencies among some farmers. Given that the size of the production unit is a major variable affecting productivity, the size distribution of incomes from paddy farming can be expected to be skewed although the Gini-coefficient of less than 0.3 is not large. However, in view of the scale of mechanization (or tractorization), one can postulate the economic need to lower its fixed capital costs by enlarging farm size through renting-in or evicting small tenants. The market for farm land can be expected to become very tight—already the capital improvements associated with irrigated paddy land has raised per acre costs to between $4,000 and $10,000—especially in a situation where widespread tractor ownership reduces the need to rent tractors. Under such conditions, the existence of a pool of landless labourers will become possible.

Other changes that are evident in the area relate to the effect of commercialization of farm production on two aspects of rural Malay society. One phenomenon that has been noted is the decline in the use of cultural labour or *derau* because of the commercialization of traditional relationships. The second relates to a decline in sex and and job-specific labour functions because of peak demand for labour at transplanting and harvesting seasons. Fredericks [6] notes that *syarikat* of Malay males and females are becoming common in the area in contrast to the traditional picture of the shy and with-

drawn village maiden.

Finally, in contrast to the technological developments taking place in Tanjung Karang, rural institutions (like the farmers' cooperatives, farmers' associations and farmers' organizations) are not being developed as dynamically to create a resilient and independent farming community. If at all, the flow of public sector resources into the area may well serve to undermine whatever seminal efforts towards the creation of a dynamic community have been made in the past. This, in the view of the author, poses a fundamental dilemma of rural development in Malaysia: change is being promoted and accelerated by external agents (the government) and standards of living are being raised, but little productive effort is being made to nuture rural organizations and institutions to ensure the integrity of rural Malay society. For a country which is committed to rural development and which possesses bountiful resources to make plans a reality, to expect the latter objective to be achieved may well be a wishful dream.

References

1. Bhati, U.N. 1971. Economic Determinants of Income on Irrigated Paddy Farms in Tanjung Karang, West Malaysia. Unpublished Ph. D. Thesis. Australian National University.
2. Fredericks, L.J. 1973. Cooperative Structure and Government Policy in Malaysia. Unpublished Agr. Dr. Thesis. Uppsala: Department of Economics and Statistics, Royal Agricultural College of Sweden.
3. ————. 1975. The Farmers' Organization Authority in Malaysia. *Journal of Administration Overseas* 14 (2).
4. ————. 1977a. Patterns of Labour Utilization and Income Distribution in Rice Double Cropping System: Policy Implications. *Occasional Papers on Malaysian Socio-economic Affairs*. No. 8. Kuala Lumpur: Faculty of Economics and Administration, University of Malaya.
5. ————. 1977b. Ideology and Organizations in Agricultural Development: The Case of Malaysia. *Sociologia Ruralis* 17 (3).
6. ————. 1977c. Some Socio-economic Characteristics of Rural Labour with Special Reference to a Rice Doublic Cropping Area in Selangor, West Malaysia. In *Hired Labour in Rural Asia*, edited by S. Hirashima. Tokyo: Institute of Developing Economies.
7. Fukui, H.; and Takaya, Y. 1978. Some Ecological Observations on Rice-Growing in Malaysia. *Southeast Asian Studies* 16 (2).
8. Funahashi, K. 1979. A Malay Padi Growing Community in Tanjung Karang, West Malaysia. In *A Comparative Study of Paddy-Growing Communities in Southeast Asia and Japan*, edited by M. Kuchiba and L.E. Bauzon. Kyoto.
9. Malaysian Centre for Development Studies. 1976. *Value Orientations of Farmers Towards Change in Peninsular Malaysia*. Final Report.
10. Mizuno, Koichi. 1977. Comparative Analysis of Rural Development——Rice-Growing Villages in Thailand and Malaysia——. *Southeast Asian Studies* 15 (3).
11. Narkswasdi, U.; and Selvadurai, S. 1968. *Economic Survey of Padi Production in West Malaysia*. Ministry of Agriculture and Cooperatives.
12. Takaya, Y.; and Fukui, H.; and Yamada, I. 1978. Ecology of Traditional Padi Farming in West Malaysia. *Southeast Asian Studies* 16 (2).
13. Wells, R.J.G.; Fredericks, L.J.; and Gul, F.A.K. 1978. A Study of Productivity in Padi Processing Plants in Tanjung Karang. Workshop on Productivity in Manufacturing Industry, Faculty of Engineering, University of Malaya.
14. Wolff, Paul. 1977. A Sociological Study of the Structure and Performance of the Farmers' Organizations in Tanjung Karang, (Selangor) Malaysia, A Preliminary Report. Unpublished mss.
15. World Bank. 1978. *Malaysia Appraisal of the Northwest Selangor Integrated Agricultural Development Project.*