Land Abandonment in the Rice Sector: An Economic Analysis

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ABSTRACT

Land abandonment is a serious problem to the agricultural sector, especially that of the rubber and rice sectors. In the rice sector, the problem persists not only in the traditional rice growing areas but also in the highly irrigated schemes. Logit analysis was conducted to identify the major causes for rice farming abandonment in the MUDA and KEMUBU irrigation schemes. In the MUDA scheme, farm size, lack of labour, competition from imported rice and cost of production are highly correlated to rice farming abandonment; while for the KEMUBU scheme, the major causes seemed to be farm size, age of farm operators, off-farm income, level of education, competition from imported rice and soil suitability. Measures toward minimizing or eradicating rice farm abandonment problem would not be effective unless farmers are offered a reasonably high farm-gate price for their padi harvest. In view of better offers from the off-farm employments, it is therefore important that rice farmers are assured of incomes that are comparable to those of other sectors.

ABSTRAK

Tanah terbiar merupakan satu masalah yang serius dalam sektor pertanian, terutama sekali dalam sektor getah dan padi. Dalam sektor padi, masalah ini berlaku bukan sahaja di kawasan tanaman padi tradisional, tetapi juga di projek-projek pengairan yang serba maju. Analisis logit telah digunakan untuk mengenalpasti sebab-sebab utama yang mengakibatkan tanah terbiar di projek-projek pengairan MUDA dan KEMUBU. Bagi projek MUDA, saiz sawah, kekurangan tenaga buruh, persaingan daripada beras import dan kos pengeluaran telah didapati mempunyai korelasi yang tinggi dengan tanah sawah terbiar; manakala bagi projek KEMUBU, sebab-sebab utama yang telah mengakibatkan tanah sawah terbiar didapati terdiri dari saiz sawah, umur pesawah, pendapatan bukan pertanian, tahap

*pendidikan, persaingan daripada beras import dan kesesuaian tanah
sawah. Langkah-langkah ke arah meminimumkan atau membasmi-
kan tanah terbiar tidak akan berkesan sekiranya pesawah tidak
diberikan harga padi yang berpatutan. Memandangkan bahawa
terdapat pendapatan yang lebih tinggi dari pekerjaan bukan-
pertanian. maka adalah amat penting sekali jika pesawah-pesawah
padi diberi jaminan supaya pendapatan mereka menjadi setanding
dengan pendapatan yang diperolehi dari sektor-sektor lain.*

INTRODUCTION

Land abandonment has been identified as one of the major
problems in the agricultural sector in West Malaysia. Mostly
affected are the rubber and rice sectors. This came about despite
enormous effort that has been directed towards the development
and advancement of both sectors since Malaysia gained her
independence from the British in 1957. Latest reports showed
that the total abandoned lands in West Malaysia by the end of 1980
has reached almost one million ha; the rubber sector alone accounts
for 729,137 ha (82 percent) while the rice sector accounts for the
remaining 160,863 ha or 18 percent of the total (Malaysia 1980).

Earlier studies conclude that land abandonment is a result of at
least three major factors: physical, economic and social factors (Ely
and Wehrwein 1940; Hart 1964, 1968 and 1976; Chamhuri 1985;
Courtenay 1986; Tempelman 1982; Hitam 1984). Common
characteristics often associated with the following factors are: soil
suitability, diseases and distant farms (physical factors); small farm
size, low net returns, off-farm employment, labour shortage and
competition from imported rice (economic factors); and land
fragmentation, aging farmers and land market structure (social
factors). These three factors operate, either singly or in combina-
tion, resulting in low farm incomes which consequently lead to
lands being utilized at the submarginal level or otherwise left in idle
conditions.

This paper offers an empirical study on the existence of
abandoned rice farms in the MUDA and KEMUBU irrigation
schemes, the largest two of the eight rice granary regions in the
country. A multinomial logit is used to estimate the major reasons

leading farmers to abandon their rice farms. Explanatory variables include farm size, labour availability, age of farm operators, off-farm incomes, level of education, credit availability, competition from imported rice, soil conditions, production cost and farm yield. Price, the main economic determinant is not considered in the model as the buying price for padi (unprocessed rice) is being controlled by the government. Farmers across the country are offered the same price for their padi harvest. Slight variations, if any, are mainly due to the differences in the quality of padi grains and transportation cost.

The model provides some interesting results. Labour shortage, small farm size, labour competition from imported rice and increasing production cost form the central problems to farmers in the MUDA irrigation scheme. On the contrary, farmers in the KEMUBU irrigation scheme abandoned their farms mainly as a result of small farm size, aging farm operators, better off-farm incomes, low level of education, competition from imported rice and soil problems.

ANALYTICAL PROCEDURES

In this study, the decision model is a qualitative dependent variable, whether or not to abandon rice farming. Due to the different nature of the two study areas, a separate analysis for each is made. Factors associated with the abandonment of rice farming (dependent variable) are attributed to: price, holding-size, availability of labour, off-farm income, age of farm operators, level of education, access to cheap credits, availability of imported Thai rice, soil suitability, cost of production and yield (explanatory variables). The decision model for the MUDA scheme incorporates all the explanatory variables but for the KEMUBU scheme, all except the last two (cost of production and yield), are included in the decision model.

The standard approach in measuring the relative contributions of the variables contained in the X matrix toward Y is multiple regression analysis with the variables used in their linear form. However, various difficulties will be encountered in using the classical least squares technique in quantifying the relative

contributions of the various components of X toward a dichotomous dependent variable, Y.

Recall that Y can take only two possible values: 1 if farmers abandoned their rice farming, and 0 if otherwise. Therefore, the disturbance term, μ, can only take on two possible values. If,

$$Y_t = 1, \quad \mu_t = 1 - \beta'x_t$$

and if,

$$Y_t = 0, \quad \mu_t = -\beta'x_t$$
$$(t = 1, 2,..., N)$$

The assumption of homoskedasticity is, therefore, violated. Since variance (μ_t) depends upon t, the disturbance terms are heteroskedastic, and the use of ordinary least squares (OLS) will give inefficient estimators and imprecise predictions (Nerlove and Press 1973).

Goldberger (1964) and Zellner and Lee (1965) have suggested that generalized least squares (GLS) could be applied to overcome the problems relating to homoskedasticity but the GLS is good asymptotically (Nerlove and Press 1973). There is also no guarantee that Y_t will be within the unit interval for all t, so that some of the 'variances' may be negative.

Nerlove and Press (1973) and Judge et al. (1982) discuss two improved approaches in analyzing binary data: namely, probit and logit analysis. However, the choice of the technique in empirical work is quite arbitrary (Maddala and Nelson 1986). A more convenient one to use is the logistic function (Nerlove and Press 1973). Since some of the variables have discrete instead of continuous values, the logit model offers a better analysis than the multiple regression.

Let P_t be the probability that the tth farmer will abandon rice farming. Hence,

$$P_t = Pr(Y_t = 1)$$
$$= Pr(\mu_t < \beta'x_t)$$
$$= F(\beta'x_t)$$

where F is the cumulative distribution function (CDF) of the random variable μ_t. Thus,

$$1 - P_t = \text{Pr} \,(Y_t = 0)$$
$$= 1 - F \,(\beta' x_t)$$

With this specification, P_t will lie between 0 and 1, since $F(-\infty) = 0$ and $F\,(\infty) = 1$, being a property of the CDF.

The logistic function is given in equation [1]

$$P_t = [1 + \exp\{-\beta' x_t\}]^{-1} \qquad [1]$$

Solving for the argument results to

$$\exp\{-\beta' x_t\} = [(1 - P_t)/P_t] \qquad [2]$$

Taking the logs of both sides of [2] gives

$$-\beta' xt = \ln[(1 - P_t)/P_t] \qquad [3]$$

Hence,

$$\ln[P_t/(1 - P_t)] = \beta' x_t \qquad [4]$$

The left-hand side of [4] is known as the log-odds or logit of P_t, i.e., rice farming abandonment.

The computational procedures for obtaining the estimates of the β's are given in Nerlove and Press (1973). The procedure involves the setting up of a likelihood function, given observations on a dichotomous dependent variable and a set of independent variables. The maximum likelihood estimators have the desirable property of asymptotic efficiency (Theil 1971).

The hypothesis to be tested is that rice farms are abandoned because of physical, economic and social factors. We might expect that rice farms will be more likely to be abandoned if the net returns to rice farming is too low to support a decent living for the farm operators, other things are equal. It is therefore predicted that rice farmers with too low an income level would seek for other alternative jobs outside the rice farming activities.

THE DATA

The MUDA and KEMUBU irrigation schemes were chosen for this study (refer to Map 1 and Map 2 in the Appendix). The data for this study were collected in January 1990 through personal interviews with the farmers in both regions.

MUDA IRRIGATION SCHEME

The MUDA scheme, better known as the rice bowl of the country, is situated in the north-west of Peninsular Malaysia. Covering an area of 95,000 ha, the scheme stretches in the east-west direction for about 16 miles inland from the coastal front and for about 45 miles in the north-south. Alor Setar, the capital city of Kedah, acts as the focal point of the scheme. Besides its attraction for commercial and trade activities, it also serves as the administrative centre for MADA (Muda Agricultural and Development Authority). In addition, there are smaller towns within the scheme. In general, the scheme can be subdivided into 27 irrigation districts, with each district being placed under the control of the AFC (Area Farmers Cooperatives)

KEMUBU IRRIGATION SCHEME

The KEMUBU scheme is the biggest and most advanced irrigation scheme under the control of KADA (Kelantan Agricultural and Development Authority). Together with the relatively smaller schemes of Pasir Mas, Salor and Lemal, they occupy about 40,000 ha of rice farms capable of double-cropping. Before being absorbed into KADA's control, these three schemes were originally administered by the state agricultural department.

This study is strictly confined to the KEMUBU scheme because its level of development and achievement in rice double-cropping is relatively comparable to those of the MUDA scheme. Situated in the north-east of Peninsular Malaysia, the KEMUBU scheme has a total area of 19,000 ha. It runs in the east-west for almost 10 miles inland from the coastline and for about 40 miles in the nort-south direction. Kota Bharu, the capital city of Kelantan, is the major attraction for trade and commerce. The scheme covers three main districts, namely, Kota Bharu, Bachok and Pasir Putih.

Due to locational and seasonal differences, along with some variations in the socio-economic conditions, the results from the study would probably highlight some major similarities and differences between the two selected areas of study. In particular is in terms of the major causes for rice farming abandonment that each of them encounters. This would also provide some basis for making comparisons between the two areas. It is also expected that these differences would provide some diversity in the results.

SAMPLING PROCEDURES

The study uses the rice farms and their respective farm operators in trying to quantify the unit of analysis for the development of the model of the major causes for rice farming abandonment in the selected study areas. Each unit is considered the fundamental basic structure of a rice farm in operation. For instance, the decision for the methods to be used in each production stage and whether to continue rice farming or do otherwise will be determined at the unit level.

A total of 240 farmers (120 from each irrigation scheme) was randomly selected for the study. The selection was conducted based on the stratified, multi-stage random sampling procedures.

1. Each irrigation scheme was stratified according to the main available districts. The district in this context refers to the administrative units of both MADA and KADA; they are different from the administrative units used by the state and local governments. These districts were divided into three regions based on the distance from the city. Von Thunen's locational theory suggests that rent decreases as a piece of land increases in distance away from the city centre and that land use pattern varies with distance from the city centre (Hall 1966). Under this consideration, the three regions appeared as: a) close to the city centre (0-10 miles); b) intermediate distance to the city centre (10-20 miles); and c) furthest from the city centre (more than 20 miles).

2. Known cases of abandoned rice farms were identified from areas under the respective regions. Based on the definition of land abandonment (Malaysia 1980), abandoned rice farms belonged to two main categories: a) rice farms suitable for

double-cropping which have been abandoned or permanently left idle (completely unproductive); and b) rice farms which are sufficiently equipped for double-cropping activities but have instead been utilized for single-cropping during the main season, hence giving way for other better income-generating crops (particularly tobacco) in the off-season. Preliminary findings revealed that permanently abandoned rice farms in the MUDA scheme were not concentrated in any particular region but were actually scattered within the entire scheme, with no areas more significant than others. On the contrary, abandoned rice farms in the KEMUBU scheme were more temporary in nature. Rice farmers in this scheme utilize some proprtions of their rice farms for growing tobacco in the off-season and planting the rest with rice.

A village is the smallest unit area in each mukim. A mukim, the smallest administrative unit, usually comprises of several small villages. Similarly, several mukims jointly made up a district, the assigned category mentioned earlier. Any village with at least 20 percent cases of abandoned rice farms were considered for selection. This choice, though seemed arbitrary, would be expected to provide results which are representative to the area in which rice farming abandonment occurs.

3. Farmers with and without abandoned rice farms from each village under the assigned categories were randomly selected for the interview. A total of 240 respondents, with 120 from each scheme, was selected for the study. To further simplify the process of selection, a total of 40 respondents were randomly selected from each category.

MEASUREMENT FOR MULTIVARIATE ANALYSIS

Price: The price level, *ceteris paribus*, is one of the most important factors in determining the supply of and demand for a product. In the rice sector, farmers are more concerned with the farm-gate price for padi at harvest than an increase in the yield per acre. A reasonably high price would increase their returns and profit margins, hence encourages them to be more committed to their farms. Despite its great importance, price has not been included in

the model because the farm-gate price for padi is totally fixed by the government via the Guaranteed Minimum Price (GMP). Thus, all rice farmers in the country are assured of similar farm-gate price for their padi upon delivery at LPN (National Padi and Rice Authority) complexes or at any licensed rice mills. Slight variations in the buying price may however occur as a result of differences in the quality of padi grains and tranportation costs.

The buying price of padi including the price subsidy has not changed much over the last two decades; it has remained almost static since 1974. But after taking into account the inflation rate, the rice growers in the country are actually getting less for each Kg of padi that they delivered for sale (Table 1).

Holding-size: This is a continuous variable which takes any positive value greater than zero. Holding-size for both the MUDA and KEMUBU irrigation schemes was measured in acres, the standard unit of measurement. The variable is transformed into a dichotomy: up to 3.5 acres and above 3.5 acres. It was recorded as 1 and 0 respectively. The critical size is based on the minimum farm size required to effectively increase the income level of a rice owner-operator farmer above the current 'poverty line', expressed as an estimated total monthly income of RM350 for a family of six people (EIU 1989).

Assuming that the farmer derives his total income only from rice farming, a 3.5 acre farm, yielding about 2500 Kg rice per acre, would be just sufficient to drive him above the poverty line. This category of farm-size in the rice sector is considered too small to be mechanized economically. There is no doubt that the farm can utilize all the family labour available, but mechanization is indispensable when the farmer has to double-crop; timeliness in all planting operations is a very important requirement in the double-cropping of rice.

However, the cut-off point in holding size for this analysis is still relatively large considering the average size of farms owned by farmers in the entire schemes. Malaysia (1977) reveals that 62.1 percent of the farms are 2.5 acres and below for the entire MUDA Scheme (Kedah) and 78.4 percent of this category in KEMUBU Scheme (Kelantan). The hypothesized relationship is negative: the

TABLE 1. Average buying price for padi in MUDA and KEMUBU Schemes, 1972-90 (RM/100kg)

Growing Season	Current Year Average Price	Current Year Total Price[1]	Contant Total Price[2] (1980 = 100)
I/72	26.30	26.30	24.76
II/72	27.58	27.58	25.89
I/73	34.17	34.17	29.11
II/73	42.42	42.42	36.13
I/74	47.38	63.92	46.37
II/74	46.43	62.97	45.70
I/75	43.58	60.12	41.75
II/75	44.33	60.87	42.27
I/76	44.97	61.51	41.65
II/76	45.58	62.12	42.06
I/77	45.23	61.77	39.90
II/77	46.88	63.42	40.97
I/78[3]	–	–	–
II/78	46.65	63.19	38.91
I/79	47.72	64.26	38.18
II/79	46.28	62.82	37.33
I/80	46.92	63.46	63.46
II/80	46.90	63.44	63.44
I/81	47.02	63.56	57.93
II/81	47.18	63.72	58.09
I/82	46.92	63.46	54.66
II/82	46.78	63.32	54.54
I/83	46.78	63.32	52.59
II/83	46.81	63.35	52.62
I/84	46.61	63.15	50.48
II/84	46.94	63.48	50.74
I/85	46.93	63.47	50.45
II/85	46.92	63.46	50.45
I/86	46.71	63.25	50.28
II/86	47.30	63.84	49.45
I/87	46.33	62.87	47.34

TABLE 1 *(continued)*

II/87	46.54	63.08	47.50
I/88	46.43	62.97	46.43
II/88	46.54	63.08	48.52
I/89	46.69	63.23	47.19
II/89	47.54	64.08	47.82
I/90[4]	47.58	72.39	52.46
II/90[5]	46.30	71.11	51.53

Note:

1. Total price includes price subsidy of RM16.54 per 100 Kg padi delivered for sale, effective from planting season 1/74.
2. Data up to 1979 refer to Consumer Price Index (1967 = 100).
3. Planting for this season was cancelled due ro severe drought.
4 Effective July 1990 price subsidy was increased to RM24.81 per 100 Kg.
5. Minimum price recommended by LPN.

Source: MADA, Alor Setar, Kedah.
　　　Quarterly Economic Bulletin, Bank Negara Malaysia (1975-1990).

smaller the rice farms, the higher the probability of rice farming being abandoned.

Availability of Labour: In the field survey, this variable was measured in terms of the number of working members in the household which referred to the number of household members available for undertaking the rice farming activities. This variable was continuous and transformed into a dichotomy: up to two working members versus more than two. This was correspondingly recorded as 1 and 0 respectively. As far as rice farming is concerned, active involvement of the household members on the farm jobs, both in terms of their readiness and timeliness, is critically important. Hiring workers for all the activities would not only drive up a farmer's total production costs but also affect his farming schedule. Due to exceptionally high demand for labour which peaked during planting and harvesting seasons, locally hired and immigrated workers may not be timely and sufficiently available. Hence, the failure of household members to undertake some, if not all, of the major farming activities would probably

result in unnecessary delay in the farming operations. Whatever methods of rice farming are to be adopted, a farmer has to adhere to the timing constraints within the planting schedule as closely as possible. In the case of traditional rice planting method, the rice seedlings should be ready by a certain date, plowing must be completed by a certain date and transplanting of the young seedlings by another. A delay in any of these operations would eventually lead to an adverse chain-effect on the farmer; a bad crop harvest is expected as a result. This would mean a disruption of the entire farming operations. The hypothesized relationship is negative: the chances of rice farming being abandoned increase with labour scarcity.

Age of Farm Operator: This is a continuous variable which was transformed into a dichotomy: up to 60 years versus above 60 years. The variable was recorded as 0 for farmers of age up to 60 years and 1, if otherwise. This age level was used in the recent 1980 Population Census and in several population censuses in the past to represent the oldest category of the population. In the field survey. the age of a farmer was counted from his last birthday. The hypothesized relationship is positive: as a farmer gets above 60 years of age the possibility that he would abandon his rice farming is greater.

Off-farm Income: This represents a continuous variable, measured in Malaysian Ringgit (RM). It was transformed into a dichotomy: 1 for off-farm incomes greater than incomes from rice farming and 0. if otherwise. The hypothesized relationship is positive: the higher the off-farm incomes that the farmer gets, the higher the possibility of rice farms being abandoned.

Level of Education: This is a categorical variable grouped into: (1) no formal education; (2) primary education; (3) lower secondary education; (4) higher secondary education; and (5) college education. By collapsing the groups, the variable was transformed into a dichotomy: up to primary versus secondary education and above. The corresponding values are 1 and 0 respectively. With better education the chances of getting a more rewarding job outside the rice sector is greater. The hypothesized relationship is

negative: as a farmer is more educated the tendency to abandon the rice farming is greater.

Access to Cheap Credits: This variable was a dichotomy as the farmers in the sample were basically asked whether they have any difficulty of getting access to cheap credits from farmers cooperatives. The variable was given a value of 1 for farmers with difficulty in getting access to cheap credits and 0, if otherwise. The hypothesized relationship is negative: a farmer without cheap credits would face problems of having insufficient cash to readily cope with the production costs; production costs would also increase because of higher informal credit market interest payments by the farmer – he therefore has a higher possibility of abandoning his rice farming.

Availability of Thai Rice: This is a categorical variable grouped into five consuming groups based on the percentage of Thai rice consumed by the household members: (1) 0 percent; (2) 25 percent; (3) 50 percent; (4) 75 percent; and (5) 100 percent. By collapsing the groups the variable was transformed into a dichotomy: 25 percent and below versus above 25 percent. The corresponding values are 0 and 1 respectively. The choice for this critical level is based on the response from farmers in the selected sample. All farmers in the sample, regardless of their income level, reported to have included at least 25 percent of Thai rice in their own daily total rice consumption. This is basically due to the farmers' established traditional diet contents in which a certain proportion of their rice intake has to be of Thai rice. This established type of diet, very common to those residing in the northern states of Malaysia, was mainly brought about by the availability of cheap, good quality Thai rice in the market. The hypothesized relationship is positive: the greater the availability of Thai rice, the greater the chances of farmers reducing their working time in their rice farms which would eventually lead to the abandonment of rice farming.

Soil Suitability: This variable was recorded in a dichotomy as the farmers were asked whether their farms were associated with any soil problems. The variable was given the values of 1 if the abandoned farms have soil problems and 0, if otherwise. The

hypothesized relationship is positive: rice farms with soil problems have greater tendency towards abandonment.

Cost of Production: This variable is only used in the model for the MUDA scheme. It measures the total production costs, including reclamation costs, incurred by farmers in the year just prior to the abandonment of their rice farming. This continuous variable was transformed into a dichotomy: total production costs of up to RM750 per acre versus more than RM750 per acre. The corresponding values are 0 and 1 respectively. The choice for this critical amount is based on the average production cost incurred by farmers in the sample and that of the entire scheme. It was recorded that farmers in the MUDA scheme who used extra fertilizers and those with farms away from accessible roads have to spend as high as RM750 per acre from planting to harvest (MADA 1988). This includes expenses on additional fertilizers and transportation costs. The hypothesized relationship is positive: the higher the total production costs the greater the tendency for rice farming to be abandoned.

Yield: Similar to the preceding variable (cost of production), the yield per acre is only applicable to the model for the MUDA scheme. It refers to the yield per acre of farms in the year just prior to their abandonment. This continuous variable was transformed into a dichotomy: yield of less than 1100 Kg per acre versus more than 1100 Kg per acre. The corresponding values are 1 and 0 respectively. The hypothesized relationship is positive: given the relatively high cost of production, the lower the yield the higher the probability of the abandonment of rice farming as farmers would be squeezed by heavy losses.

THE EMPIRICAL RESULTS

To evaluate the final research phase, it is helpful to examine the results for each of the logistic function variables in the land-abandonment model. The two models, based on the maximum likelihood, will be examined separately, one for the MUDA scheme and another for the KEMUBU scheme. Descriptive statistics of both the MUDA and KEMUBU schemes are shown in Table 2.

TABLE 2. Descriptive Statistics

Explanatory Variables	MUDA Scheme				KEMUBU Scheme			
	Mean	Std. Dev.	Minimum	Maximum	Mean	Std. Dev.	Minimum	Maximum
ACRE	4.170	1.944	1.420	10.670	2.277	1.132	1.000	6.000
NFRM	2.240	0.900	1.000	5.000	1.570	0.742	1.000	4.000
LABOUR	1.408	0.527	1.000	3.000	1.608	0.626	1.000	3.000
HMBS	5.633	1.107	2.000	9.000	6.383	0.980	4.000	9.000
HMG	2.292	0.653	1.000	4.000	3.325	0.862	2.000	5.020
AGE	55.117	6.373	41.000	68.000	56.192	5.823	42.000	69.000
OFINC	136.33	205.37	0	1000.00	303.09	270.14	0	1420.00
RINC	310.56	197.49	85.00	975.00	135.35	81.88	40.00	459.00
TRICE	43.958	16.525	25.000	75.000	50.833	13.725	25.000	75.000
SOIL	2.543	3.001	1.42	10.670	1.185	1.497	0.75	6.00
AYLD	2089.00	161.11	1800.00	2350.00	1917.00	150.06	1650.00	2125.00

Referring to Table 2, the respective values are ACRE (size of rice farms in acres); LABOUR (availability of family labour); HMBS (household members); HMG (household members which have migrated); AGE (age of farm operators in years); OFINC (off-farm income); RINC (incomes derived from rice farming); TRICE (competition from imported Thai rice measured by the percentage of Thai rice consumed daily); SOIL (soil conditions); AYLD (padi yield per acre in Kg); and NFRM (number of farm plots owned by the farmers - this indicates that farms are getting smaller in size due to land fragmentation and subdivision processes).

MAXIMUM LIKELIHOOD LOGISTIC RESULTS

The logistic estimates as described earlier serve as the analytical tool in the investigation of the existence of land-abandonment in both the MUDA and KEMUBU irrigation schemes. Results of the respective logistic estimates are shown in Tables 3 and 4.

The significance of each independent variable towards rice farming abandonment can be illustrated by examining both the relative significance and the level (degree) of significance: (a) the relationship between the estimated standard error and the estimated coefficient shows the relative significance. If the estimated standard error is smaller than the estimated coefficient, then the variable is considered to be significant. This standard error-coefficient relationship however only shows the relative significance; it does not indicate the level of significance; (b) the Z-value of each independent variable indicates the level of significance. A variable with a Z-value of 1.645 is considered to be significant at the 0.05 level; thus any variable with a Z-value of 1.645 or more is considered to be highly significant. However, as the Z-value of a variable indicates a specific level of significance, it is therefore a better way of testing the hypothesis than using the standard error-coefficient relationship.

MUDA **Scheme**: Results of the logistic analysis of the choice of rice farming abandonment by farmers in the MUDA scheme are presented in Table 3.

TABLE 3. Logistic Relations for Rice Farming Abandonment in
MUDA Scheme

Explanatory Variables	Coefficient	Standard Error	Z-Value
CONSTANT	− 5.15245	1.76459	− 2.920
ACRE	2.98240	1.42922	2.087**
LABOUR	1.99809	1.00456	1.989**
AGE	− 0.17565	0.82641	− 0.213
OFINC	1.38465	1.54780	0.895
EDUC	− 0.47078	0.85876	− 0.548
CHCRD	− 1.26760	1.50975	− 0.840
TRICE	2.28339	1.38466	1.649*
SOIL	17.01640	2159.70	0.008
PCOST	4.18780	1.35903	3.081***
AYLD	16.5295	2094.63	0.008

Goodness of Fit Statistics

Log-Likelihood = −11.463577
Chi-squared   = 151.251976

*   Siginificant at 0.05
**   Significant at 0.025
*** Significant at 0.005

As evident from Table 3, the results were more consistent with
the hypothesized signs but with the exception of variables, AGE,
ACRE, LABOUR and AYLD. Variables which are highly significant at
the 0.05 level include ACRE, LABOUR, TRICE and PCOST. The
variables, AGE, OFINC, EDUC, CHCRD, SOIL and AYLD, are not
significant at the 0.05 level.

The estimated standard errors are smaller than their respective
estimated coefficients for the variables – holding-size in acre
(ACRE), availability of labour (LABOUR), availability of Thai rice
(TRICE), and production cost (PCOST). The results suggest that these
variables contribute significantly toward farmers' tendency to
abandon their rice farming. The signs of the estimated coeffi-
cients, with the exception of PCOST are not as generally
hypothesized earlier.

The coefficients for variables – age of farm operator (AGE), off-
farm incomes (OFINC), level of education (EDUC), access to cheap
credits (CHCRD). soil suitability (SOIL), and yield per acre (AYLD)
had large standard errors, suggesting that these variables

contributed very little to the farmers' decision to abandon the rice farming.

KEMUBU **Scheme**: Similar to the above, the results of the logistic analysis of choice of rice farming abandonment by farmers in the KEMUBU scheme are illustrated in Table 4.

TABLE 4. Logistic Relations for Rice Farming Abandonment in KEMUBU Scheme

Explanatory Variables	Coefficient	Standard Error	Z-Value
CONSTANT	− 5.79348	2.06190	− 2.810
ACRE	− 1.77230	1.24503	− 1.423*
LABOUR	− 0.67789	0.77776	−0.087
AGE	3.23703	0.90649	3.571****
OFINC	3.04271	1.33055	2.287***
EDUC	− 0.40851	0.81276	− 1.733**
CHCRD	0.48537	0.89129	0.545
TRICE	2.35089	1.32949	1.768**
SOIL	4.96100	1.77930	4.207****

Goodness of Fit Statistics

Log-Likelihood = −17.284400
Chi-squared   = 138.774088

* Siginificant at 0.10
** Significant at 0.05
*** Significant at 0.01
**** Significant at 0.005

The results were more consistent with the hypothesized signs with the only exception of variable, CHCRD – access to cheap credits, which has a positive sign. Variables AGE, OFINC, EDUC, TRICE and SOIL have relatively large Z-values which are significant at the 0.05 level. Their estimated standard errors are also smaller than their estimated coefficients; this further confirms their relative significance to rice farming abandonment. Although the standard error-coefficient relationship for variable, ACRE, suggests that the variable contributes significantly toward the farmers' decision to abandon their rice farming, its Z-value are however too low to be considered significance at the 0.05 level. In addition, the Z-value for other variables, LABOUR and CHCRD are not large enough to be

considered as attaining the 0.05 significance level. The signs of the estimated coefficients are generally as hypothesized earlier.

A further evaluation of the individual explanatory variables is important in understanding their significance to the land-abandonment model. Explanations are based on the logistic results shown in Tables 3 and 4.

ACRE – holding-size in acres. Referring to the logistic results for the MUDA scheme, ACRE was positively correlated to the dependent variable. In the logistic equation, ACRE has a standard error smaller than the estimated coefficient, suggesting that this variable has contributed significantly toward the abandonment of rice farming. The Z-value for the variable was reasonably high to be accepted at the 0.05 level of significance. The 'wrong' sign attached to ACRE was probably due to the fact that only a certain proportion of the entire farms has been abandoned. For instance, only 0.71 acres from a total of 3.56 acres was abandoned. Referring to the local measurement, the abandoned plot would only be 1 relong out of 5 relong. Throughout the field study, there has not been a single case where a farmer, due to any compelling reasons, abandoned all his rice farming. However, those with relatively more land apparently find it easier to stop raising rice on some of it, than farmers with less available land.

From the logistic results for the KEMUBU scheme, ACRE has a smaller standard error than its coefficient, suggesting that the variable had contributed significantly toward the abandonment of rice farming in the area. Despite having the hypothesized sign, the Z-value was however too small to be significant at the 0.05 level.

LABOUR – availability of labour. This variable was positively correlated to the dependent variable. LABOUR has a standard error smaller than the estimated coefficient, suggesting that the variable has contributed significantly towards the abandonment of rice farming in the MUDA scheme. The Z-value for the variable was large enough to be significant at the 0.05 level. The 'wrong' sign on LABOUR suggests that the more the labour is available, the more likely for the farmers to abandon their farms. This could probably be attributed to a relatively high level of mechanization services covering from planting to harvesting, which has been made available in the entire MUDA scheme. Hence, farmers are more

'mechanized oriented' than before, such that machines could be, in many cases, easily substituted for scarce labour.

For the KEMUBU scheme, the variable, LABOUR, was negatively correlated to the dependent variable. It has a larger standard error than the estimated coefficient. In addition, its Z-value was also not significant at 0.05 level. Hence, these indicate that the availability of labour which helps to explain the degree of labour shortage has very little effect on the abandonment of rice farming in the KEMUBU scheme. For the KEMUBU scheme, the logistic results for LABOUR were quite disappointing.

AGE – age of farm operator. For the MUDA scheme, this variable has a larger standard error than the estimated coefficient, suggesting that it has contributed very little towards the abandonment of rice farming in the MUDA scheme. This was further supported by the Z-value which was too low to be significant at the 0.05 level. The logistic results for KEMUBU scheme show that AGE is more consistent with hypothesized sign. It has a smaller standard error than the estimated coefficient, suggesting that the variable has contributed significantly to the abandonment of rice farming. This was further supported by the fact that its Z-value is significant at 0.05 level.

OFINC – off-farm incomes. In both the MUDA and KEMUBU models, the logistic results have the correct signs as had been hypothesized. For the MUDA scheme, OFINC has a larger standard error than its estimated coefficient. In addition, the Z-value is also too small to be significant at 0.05 level. Quite unexpectedly, the results indicate that OFINC has very little effect on the abandonment of rice farming in the sample from the MUDA scheme. Disappointing though, the results also contradict to earlier findings by Courtenay (1986) through his study of an irrigation scheme in Terengganu where the attraction of higher off-farm incomes had driven rice farmers out of double-cropping. resulting in a big failure to the project.

In the model for the KEMUBU scheme, the logistic results show that OFINC has a smaller standard error than the estimated coefficient, suggesting that this variable has contributed significantly toward the abandonment of rice farming in the area. In this study, income from tobacco is also considered an off-farm income; a source of income other than what farmers get from rice farming.

As expected, the Z-value for OFINC is large enough to be significant at 0.05 level.

EDUC – level of education. The logistic results for both models show that the variable, EDUC, has the correct sign as being hypothesized. In the MUDA model, EDUC has a larger standard error than the estimated coefficient. Its Z-value is also not significant at 0.05 level. These emphasized that the level of education has very little effect on the abandonment of rice farming in the MUDA scheme.

In the KEMUBU model, EDUC has a smaller standard error than the estimated coefficient. Its Z-value is significant at 0.05 level. In contrast to the logistic results for the MUDA scheme, the level of education could be considered as having significant contribution towards the abandonment of rice farming in the KEMUBU scheme.

CHCRD – access to cheap credits. In the MUDA model, the logistic results show that the variable, CHCRD, has a correct sign as had been hypothesized. Its standard error is larger than the estimated coefficient, suggesting that the access to cheap credits has very little effect on the abandonment of rice farming in the MUDA scheme. This is further reinforced by its small Z-value which is not significant at 0.05 level.

In the KEMUBU model, CHCRD is positively correlated to the dependent variable. Similar to the MUDA logistic results, CHCRD has larger standard error than the estimated coefficient but with a 'wrong' sign. The Z-value is also too small and therefore not significant at 0.05 level. These suggest that the access to cheap credits has very little effect on the farmers decision to abandon their rice farming.

TRICE – availability of Thai-rice. As expected, the variable, TRICE, in both the MUDA and KEMUBU logistic models. was positively correlated to the dependent variable; the standard errors were smaller than the estimated coefficients; and the Z-values were considerably large, and significant at 0.05 level. These indicate that the availability of Thai rice has a quite significant effect on farmers decision to abandon their rice farming.

SOIL – soil suitability. As expected, variable SOIL from both logistic models is positively correlated to the dependent variable. In the MUDA model, the logistic results show that SOIL has an

extraordinarily large standard error compared to the estimated coefficient. Its Z-value is also too small and not significant at 0.05 level. These indicate that soil problems have very little effect on the abandonment of rice farming in the MUDA scheme. This is quite disappointing as all the abandoned farms in the selected sample from the MUDA scheme were, in one form or another, associated with soil problems.

For the KEMUBU scheme, the logistic results were more promising and consistent with those of the hypothesized values. The standard error is smaller than the estimated coefficient and the Z-value is significant at 0.05 level. Together, these indicate that soil problems had a significant effect on the abandonment of rice farming in the KEMUBU scheme.

PCOST – cost of production. This variable is only applicable to the logistic model for the MUDA scheme. As expected, the logistic results show that: variable PCOST is positively correlated to the dependent variable; the standard error is smaller than the estimated coefficient; and the Z-value is significant at 0.05 level. The results were promising and consistent with the hypothesized, suggesting that the high cost of production associated with the abandoned rice plots had a very significant effect on the farmers' decision – to reclaim the plots or leave them out of production.

AYLD – padi yield per acre. Similar to the preceding variable, AYLD is only applicable to the logistic model for the MUDA scheme. As hypothesized, AYLD was positively correlated to the dependent variable. But the standard error for AYLD was unexpectedly too large compared to the estimated coefficient and the Z-value was too small and not significant at 0.05 level. These indicate that the yield per acre of the abandoned rice farms had very little effect on the farmers' decision – whether or not to abandon their farming. Again, the results seemed disappointing considering the fact that all the farmers who owned 'abandoned' rice farms in the MUDA sample reported that they had to abandon rice farming when the yields were unexpectedly too low to cover their costs of production.

CONCLUSION

Results of the logit, as summarized in Table 3 and Table 4, help to indicate the major factors leading to farm abandonment. It is evident that most of the explanatory variables used in the models for both MUDA and KEMUBU schemes, although with minor exceptions, have the expected signs.

It is evident from the logistic results that the variables, farm size (ACRE), the availability of labour (LABOUR), age of farm operators (AGE), off-farm incomes (OFINC), competition from imported Thai rice (TRICE), and cost of production (PCOST) have contributed significantly toward the abandonment of rice farming. Rationally, the farmers would not have abandoned their farms if the net returns from rice farming are relatively better than those obtained from alternative jobs. In short, all factors discussed would basically contribute towards low farm incomes, therefore indicating that continuing with rice farming activities would only incur a high opportunity cost to farmers.

The most important task that lies ahead is for the authority to evaluate the findings of this study with the view of proposing effective remedial measures towards minimizing the rice farming abandonment problem. Any measures proposed towards eradicating or minimizing the problems of abandoned farms would not be effective unless appropriate policies are implemented towards increasing the net income of rice farmers. Probably, the most important is the buying price of padi. A reasonably high farm-gate price for padi would directly increase farm incomes, hence giving more incentive to farmers to fully utilize their farms. Appropriate adjustment for the farm-gate prices of padi, not just the subsidy, is long overdue, although this might contradict with the government policy of maintaining low food prices in the country. This is important in reducing the income gap between various sectors in the country.

The abandoned land problem should be given due attention. What needs to be done is a continuous effort in rehabilitation programmes which have to be conducted with full commitment and responsibility. This would be more effective and meaningful than programmes conducted on an ad-hoc basis. In view of this problem, rice farmers should not only be provided with the latest

set of sophisticated technologies which are capable of increasing farm productivity levels, but more importantly, a better price for their harvests.

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