Prediction of Future Situation of Rice Farming in the Muda Area, Malaysia

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Abstract

Purpose of this study was to analyze the farming conditions in terms of farming population and farmland in the largest paddy farming area of Malaysia. Based on the farmers' answers to a questionnaire (88 items), simulatims were made for a period of 20 years and the outcome represents the situation in the year 2013. The data were collected from all the residents (42 rice farmers) of a village in the Muda Irrigation Scheme area. Model building, which is an essential part of this kind of simulation, was carried out based on both survey data and previous related studies. The results of the simulation showed that if other conditions remained the same, the number of family members and people engaged in farm labors (hereafter referred to as "number of farm labor") at the survey site would decrease by 14% and 38%, respectively. As for farmland, it is forecasted that the size of owned land would decrease, while that of rent-in and rent-out land would moderately increase. It is also estimated that the size of operational land would slightly increase. The total population engaged in agriculture (rice farming) will

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decrease drastically in the year 2013. With the decreasing farming population, farm size (operational land per farm) will increase in the future. The simulation results also suggested that small-scale farmers were likely to rent-in land to increase their operation scale. Probability of the emergence of large-scale farmers will be high if the heads of farm households are young and wish to rent-in land to continue farming. However, if they decide to work in the nearby city, it is likely that they will not enlarge the size of operational land or will carry out farming on a part-time basis.

Additional key words: farmer's opinion, simulation of agricultural population, simulation of farmland

Introduction

Double cropping was launched in the Muda area in 1970 when the irrigation project which had started in 1960 was completed. Rice cultivation was, at that time, performed by transplanting. In the beginning of the 1980s, direct seeding method was introduced. Due to the diffusion of both direct seeding method and farm mechanization, farming system changed from traditional system which was labor-intensive to machine-operated system which is mainly controlled by contractors.

The changes have led to 1) the increase of the number of part-time farmers, 2) the increase of the size of unused land especially fields with drainage problems[1)], 3) difficulty of getting hired workers[4)] and 4) emergence of large-scale farmers and group farming[6)]. According to the National Agricultural Policy of Malaysia which was enacted in 1984 and revised in 1993, the authorities planned to encourage large-scale farming and group farming to prevent the decline of the agricultural sector.

In this paper, our concern or purpose of study is to estimate, based on farmers' data and opinions, the orientation of rice cultivation in the Muda area. We developed a model for forecasting the future situation of regional agriculture using individual farm data. By using this model, we assessed the future trend of the regional agricultural structure, that is, whether large-scale farming will continue to emerge and become dominant or whether the present situation of part-time farming and contract system will persist in the future.

Methodology

1) Questionnaire and method of analysis

One village called Kampong Sala Kechil was selected as the survey site. We interviewed all the farmers (42 farms) in March 1994. Interview sessions required two Malaysian enumerators who visited individual farmhouses. The questionnaire consisted of the following 3 parts; 1) family composition and occupation of family members, 2) land holding condition and 3) opinions of the farmers.

The part on the opinions of the farmers covered seven aspects; 1) relationship among parents, children and relatives (15 questions), 2) family property (16 questions), 3) economic sense (20 questions), 4) farming concern (7 questions), 5) farm land (19 questions), 6) farm organization and 7) farming technology (11 questions). All questions are statement forms, such as "I think education is necessary for managing farm." and the respondents were required to select one of the choices below; 1) strongly agree, 2) agree, 3) not sure, 4) disagree and 5) strongly disagree[3)].

A simulation for 20 years from now was made using the same set of data which were collected from interviews. Due to the shortage of official time series statistics in Malaysia, we could not use the parameters from trend data. Instead, we used the probability model, that is based on the assumption that farmer's decision making was influenced by farming resources and opinions. The model consisted of 4 parts; database,

evaluation of demographic movement, evaluation of operational land movement and analysis of simulation results (Fig. 1). In the first database part (A in Fig. 1), the information of all the respondents including farm family, farmers' opinions, farmland and other farming characteristics was stored individually as well as in the form of parameters. In the demographic procedure (B in Fig. 1), the numbers of family members and family members who reside together were simulated. In the land size change procedure (C in Fig. 1), based on the family members and farmers' opinions, decision making on farmland transaction was simulated. At the same time, in the case of the death of the farm household head, inheritance of farmland by a successor was simulated as well.

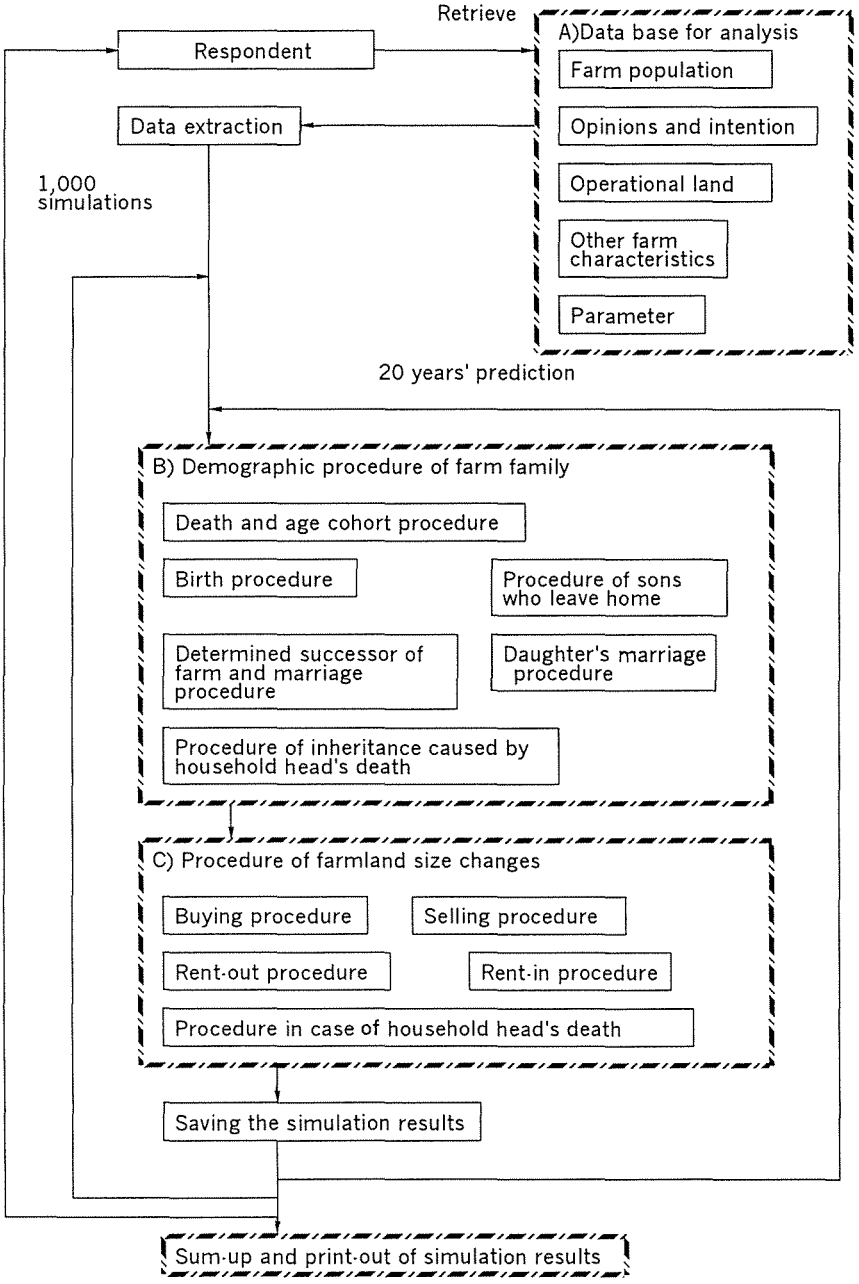

Fig. 1. Flowchart of procedure for whole simulation of farmland and farm population in Kg. Sala Kechil, Muda area, Malaysia

In obtaining the prediction of the future situation of farming, 1,000 simulations for every individual farm were made. Four types of simulations were produced (Table 1). For the first two types of simulation analyses, namely Basic and A, the conditions of job opportunities remained the same as presently. In the case of the death of the farm household head, Basic simulation assumed that fifty percent of his rent-in and rent-out agreements would be terminated and the other 50% of the agreements would be continued by his successor, while A type simulation assumed the termination of all (100%) of his rent-in and rent-out agreements. In addition, both Basic and A assumed that the probability that children who inherited the farmland but do not operate the farm and rent-out to one child who will become the farm successor is 80% for sons and 50% for daughters. The remaining two types (B and C types) of the simulation analyses dealt with the probability of the increase of job opportunities in the rural area in the future. Children who have non-farm job opportunities can operate the farm as a side-work. B type is based on the assumption that 50% of the land rental agreement continues, and that 30% of both sons and daughters will rent-out their inherited land. C is based on the assumption that 100% of farmland rental transactions will be terminated and that 30% of sons and daughters will rent out their inherited farmland to the farm successor. This assumption is based on the fact that the inheritance of farmland used to be divided equally among all children in the Muda area.

2) Outline of the survey site: Kampong Sala Kechil

Prior to the description of the model in the following section, we must consider whether the model assumptions are appropriate. However, we have only limited information on the present mechanisms controlling the changes of the farm family and farm size. The assumptions which we used in the model, are based on the results of interviews with the farmers and other empirical knowledge, such as our understanding of the inheritance custom prevailing in Malaysia and farmer's consideration and so on. Therefore further information is needed to confirm the validity of the model and to refine it. The survey sites will be outlined to back up our empirical knowledge.

Kg. Sala Kechil is a village with a linear form as often seen in the Muda area[2] and is located about 19 km southeast of Alor Setar, the state capital of Kedah. This village was one of the villages surveyed in 1974 by TARC (Tropical Agriculture Research Center). There were 64 households at that time but the number decreased to 62 by 1993[5]. The number of households in the village did not change appreciably in the past 20 years. However, the number of farm households decreased from 63 in 1974 to 46 in 1993. Sixteen farmers or 35% of the 46 farmers are full-time farmers: 5 are small-scale farmers, normally aged couples. Other economic activities or jobs here include fishing, drivers and factory workers. Twenty-four farmers (52%) are landowners, 14 (31%) are owner-cum-tenants and 8 (17%) are tenants.

Table 1. Type of simulation

		After the household head death ratio of land rental agreement	
		Termination (50%)	Termination (100%)
Probability of rent-out land by children to a farm successor	Son 80% Daughter 50%	Basic	Type A
	Son 30% Daughter 30%	Type B	Type C

Table 2 shows the outline of the respondents and their farming characteristics. Firstly we found that Kg. Sala Kechil is a village with an aging population (64% of the people are more than 50 years old). The number of family members who reside together decreased as age increased from 6.3 for the age cohort of 30-39 to 2.6 for the age cohort of 60 and above. Rather surprisingly, the size of operational land is at a peak in the age cohort of 50-59 (7.1 relong: 1 relong = 0.29 ha) but decreases to 4.5 relong for the age cohort of 60 and above. The majority of the farmers are small-scale farmers with 81% of them operating between 0-9.99 relong of land. Only a small proportion (7%) is operating 15 relong and more.

Secondly, 51% of the farmers have rent-in land with 27% of them renting-in a land area between 2-4.99 relong. The average size of rent-in land is 4.5 relong for each farmer. During the period of 1991-1993, 11% of the farmers were found to have increased the size of rent-in land while 27% of the others had reduced the size of rent-in land.

Thirdly, approximately 58% of the farmers obtained 10-15 gunny (1 gunny = 80 to 90 kg) of paddy yield for the first season while 38% were able to obtain more than 15 gunny. However, for the second season yield, 96% of the farmers were able to obtain more than 15 gunny. In comparison, there were substantial differences among the farmers in terms of paddy yield in the first season but almost all of the farmers obtained the same level of yield in the second season.

3) Procedures of simulation

(1) Demographic procedure

In the demographic analysis, information on family composition, number of family members who reside together, farm labor, birth and death of family members, information on cohort analysis, marriages and inheritance were analyzed. Fig. 2 shows the procedure flow of the demographic analysis. Firstly an evaluation of the number of family members was performed based on the probability of each family member's survival for the next year. The procedure is determined using life expectancy ratio. With this, we will know whether each of the family members will still be alive or pass away in a period of 365 days. If the head of the household is still alive within the next years, 2 different procedures can be initiated as follows.

The first procedure will determine whether the number of family members will increase. Here, we considered the farmer and his wife, their sons and daughters, sons-in-law and daughters-in-law who reside together. According to the age cohort, for every woman in the family, fertility ratio was applied to determine her fertility probability. If any of them could still give birth, we assumed that the number of family members would increase, and if not, that the present family composition would remain constant. Second procedure determines whether sons or daughters will live with the farmer and his wife. Here, probability of age cohort was calculated and if it was assumed that the sons or daughters would move to some other places (leave home), the family composition would become smaller. If they still remained in the family (remain at home), succession of father's land would be determined and marriage ratio used to determine whether they may get married in the near future or not.

Now, if the farmer dies within the next 365 days, a successor to the land will be determined. If there is no successor, it was assumed that the farm operation would stop. If there is a successor, either spouse, son or daughter, a procedure using random numbers was used to determine the eligibility of other family members for renting-in the land if the successor does not want to operate the land.

Whether the son or daughter stays together with his/her parent when he gets a job (starts higher education) or she gets married is determined by the actual farm data. We assumed that the child who stays at the time when his/her father is 60 years old would remain in the village.

(2) Farm size procedure

To predict the outcome of the farm size, the data related to four elements; 1) purchase of land, 2) selling land, 3) renting-in of land and 4) renting-

Table 2. Characteristics of respondents

Characteristics		1 Age	2 No. of children	3 No. of family members residing together	4 Rent-in land	5 Changes in size of rent-in land	6 Operational land	7 Changes in size of operational land	8 Paddy yield 1st season	9 Paddy yield 2nt season
Ratio of return (%)		100.0	92.9	100.0	97.6	88.1	97.6	88.1	61.9	61.9
1. Age	30-39	9.5%	3.5	6.3	2.5	0.0	6.0	-0.3	10.0	16.0
	40-49	26.2%	4.7	6.5	3.0	-0.4	6.6	-0.1	14.4	16.9
	50-59	33.3%	4.1	3.9	2.4	-0.2	7.1	0.9	13.6	17.8
	60 above	31.0%	4.3	2.6	1.0	-0.2	4.5	0.7	12.4	16.5
2. No. of children	1-3	54.0	35.9%	3.8	1.9	0.1	6.2	1.6	12.8	16.5
	4-6	52.2	48.7%	5.1	2.7	-0.5	5.9	-0.6	13.7	17.3
	6 above	57.0	15.4%	5.0	1.4	-1.3	7.1	0.0	13.5	16.5
3. No. of family	1-3	64.7	4.3	42.9%	1.3	-0.2	4.4	0.5	13.0	16.8
members residing	4-6	48.9	3.9	35.7%	2.3	-0.3	8.2	1.3	13.0	17.6
together	6 above	41.7	5.2	21.4%	3.6	-0.4	5.9	-1.1	14.6	16.4
4. Rent-in land	None	55.8	3.5	3.8	48.8%	-0.5	4.3	0.5	12.5	16.8
(relong)	1-1.99	55.0	6.5	4.8	9.8%	0.1	2.4	-1.2	15.0	17.5
	2-4.99	52.3	5.0	5.2	26.8%	-0.4	7.4	0.1	13.6	17.8
	5 above	49.5	4.0	5.0	14.6%	0.7	12.0	2.3	13.8	16.8
5. Changes in size	None	55.5	3.6	3.6	1.7	62.2%	4.4	0.3	12.9	16.7
of rent-in land	Increase	51.3	5.7	6.3	4.9	10.8%	8.1	4.0	14.3	17.0
	Decrease	53.3	5.1	5.3	2.0	27.0%	9.2	-0.4	13.6	17.6
6. Operational land	0-4.99	53.2	4.5	4.4	0.8	-0.1	51.2%	0.0	13.6	16.3
(relong)	5-9.99	58.3	3.8	3.8	1.8	-0.4	29.3%	0.5	12.5	17.3
	10-14.99	47.4	3.5	5.2	5.9	-0.9	12.2%	1.4	14.0	18.0
	15 above	51.3	5.7	5.7	7.0	0.5	7.3%	2.5	14.3	17.7
7. Changes in size	None	55.3	4.3	3.7	2.4	-0.5	6.8	46.0%	13.0	17.4
of operational land	Increase	55.9	3.8	4.4	2.2	0.3	5.9	37.8%	13.4	16.6
	Decrease	48.8	4.8	6.0	1.2	-0.7	5.1	16.2%	14.0	17.3
8. Paddy yield for	0.99	64.0	6.0	3.0	5.0	0.0	6.0	0.0	3.9%	15.0
1st season (gunny)	10-14.9	55.9	4.1	4.5	1.2	-0.7	6.8	0.8	57.7%	16.9
	15 above	52.7	4.5	4.7	4.2	0.2	7.6	1.3	38.4%	17.4
9. Paddy yield for	0.99	—	—	—	—	—	—	—	—	—
2nd season (gunny)	10-14.9	70.0	2.0	2.0	0.0	0.0	2.0	2.0	10.0	3.9%
	15 above	54.4	4.4	4.6	2.6	-0.4	7.3	0.9	13.5	96.1%

1 relong = 0.29ha, 1 gunny = 80-90kg.

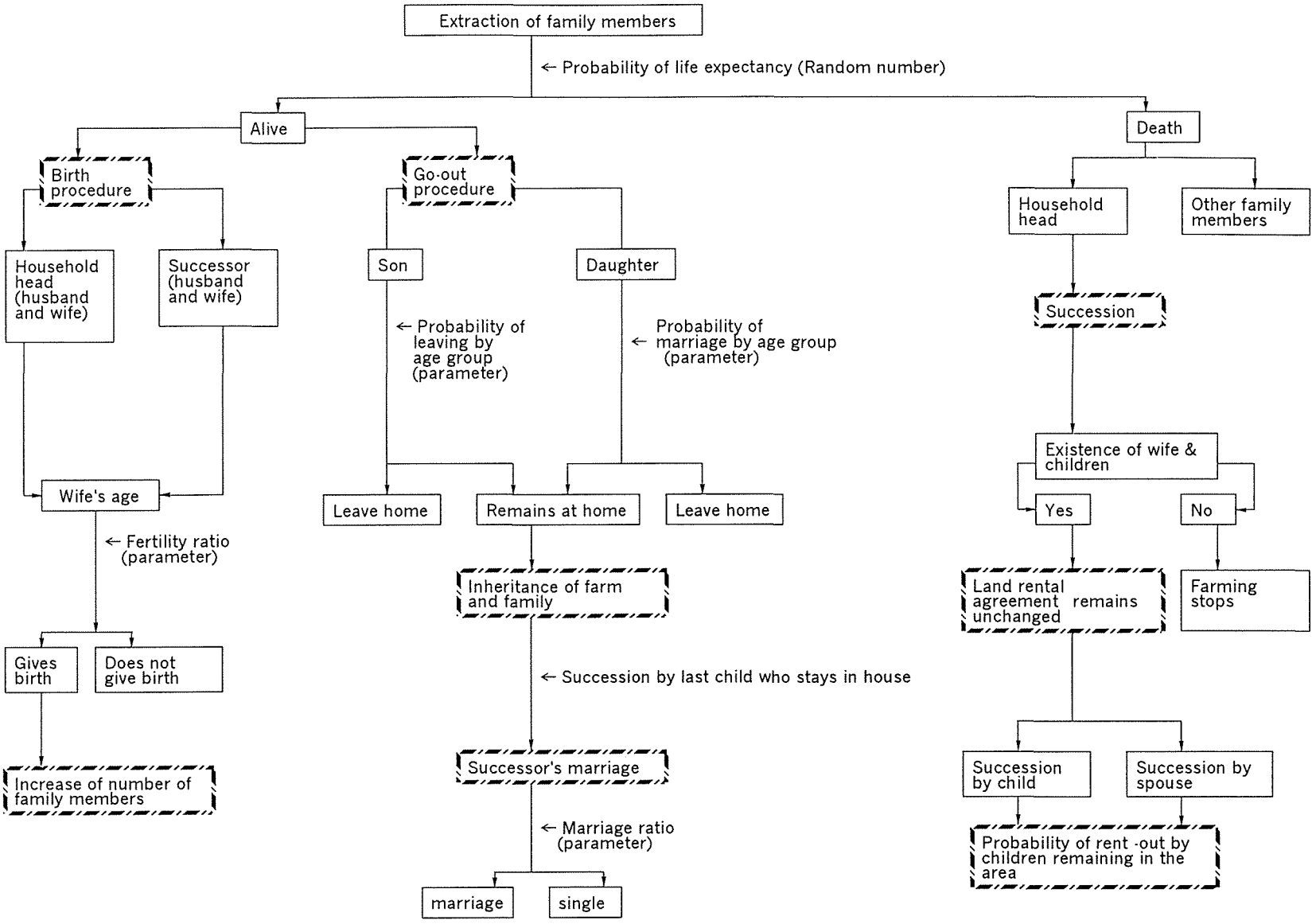

Fig. 2. Flowchart of Procedure of farm family population

out of land, were extracted from the data base (Fig. 3). In determining whether a farmer will buy more land, we examined the farmer's age first. If he is more than 60 years old or less than 60 years old without a successor, he is not likely to buy more land. When the farmer is less than 60 years old and if he has a successor, then whether he has currently more than 10 relong of operational land or not is also considered. If the size of his operational land is more than 10 relong, we examined the farmer's opinion to access his intention for buying land. If he intends to buy land, the probability of buying land will be high. Thus the process of using random numbers is initiated to determine whether he will buy land. On the contrary, if the probability is nil, it is assumed that he will not increase his operational land by buying more land. If the size of the operational land is less than 10 relong and the farmer has side-jobs, the determination process is repeated as before. Hence, we assumed that the farmer would not purchase more land if he had no side-jobs because he cannot afford to do so.

To predict the probability of farmer's selling of land, the size of his operational land is first determined. If the farmer has more than 10 relong of land, he will not sell his land. The same procedure is repeated when the farmer has less than 10 relong of land, but at the same time holds a side-job. If the farmer has no side-job and he intends to reduce the size of his operational land, a random number process is initiated to determine whether he will sell the land or not.

Now, the farmer may enlarge the size of his operational land by renting-in more land. Here, the age of the household head is considered. If the farmer is more than 60 years old and he has no successor, most probably he will not rent-in more land. If he is more than 60 years old with a successor or if he is less than 60 years old, 1) his intention to increase the size of his operational land, 2) the number of family members, 3) the number of farm labor and 4) size of operational land are considered. Therefore, random number analysis is applied to predict the outcome; whether he rents-in land or otherwise. On the other hand, to determine whether a farmer will rent-out land, 1) his intention to operate land, 2) his age, 3) the number of family members, 4) the number of farm labor and 5) the size of operational land are considered. There after, the process of random number analysis is carried out to finalize the outcome.

Results of simulation

1) Overall situation in Kg. Sala Kechil

(1) Demographic situation

Table 3 shows the probability of 1,000 simulations made based on the size of operational land (0-4.9 relong, 5-9.9 relong and >10 relong), the number of family members, the number of family members who reside together and the number of farm labor. The simulation of the number of family members shows a decrease in the total number of family members from 252 (now) to 216 (next 20 years), a reduction of 14%. The same outcome is obtained for the number of family members who reside together and the number of farm labor, showing a decrease from 198 to 111 (44%) and 112 to 70 (38%), respectively. Hence, we can say that the population in the agricultural sector will be much smaller in the next 20 years as compared with the present. As for the size of operational land, the decrease in the number of small-scale farmers (operational land, 0-4.9 relong) exceeds that of middle and larger-scale farmers operating 5-9.9 relong and more than 10 relong. We should notice that we did not consider whether children plan to remain in the same village after they become independent from their parents. If we add the assumption regarding this possibility, the decrease in farming labor will be less drastic.

(2) Farm size change

As shown in Table 4, the results of 1,000 simulations on land holding situation show that the status of owned land will be reduced by 34% (178 to 119) for all the 4 types of simulations. Based on the size of the operational land, decreasing rate of the category above 10 relong (44% from 75 to 42) was

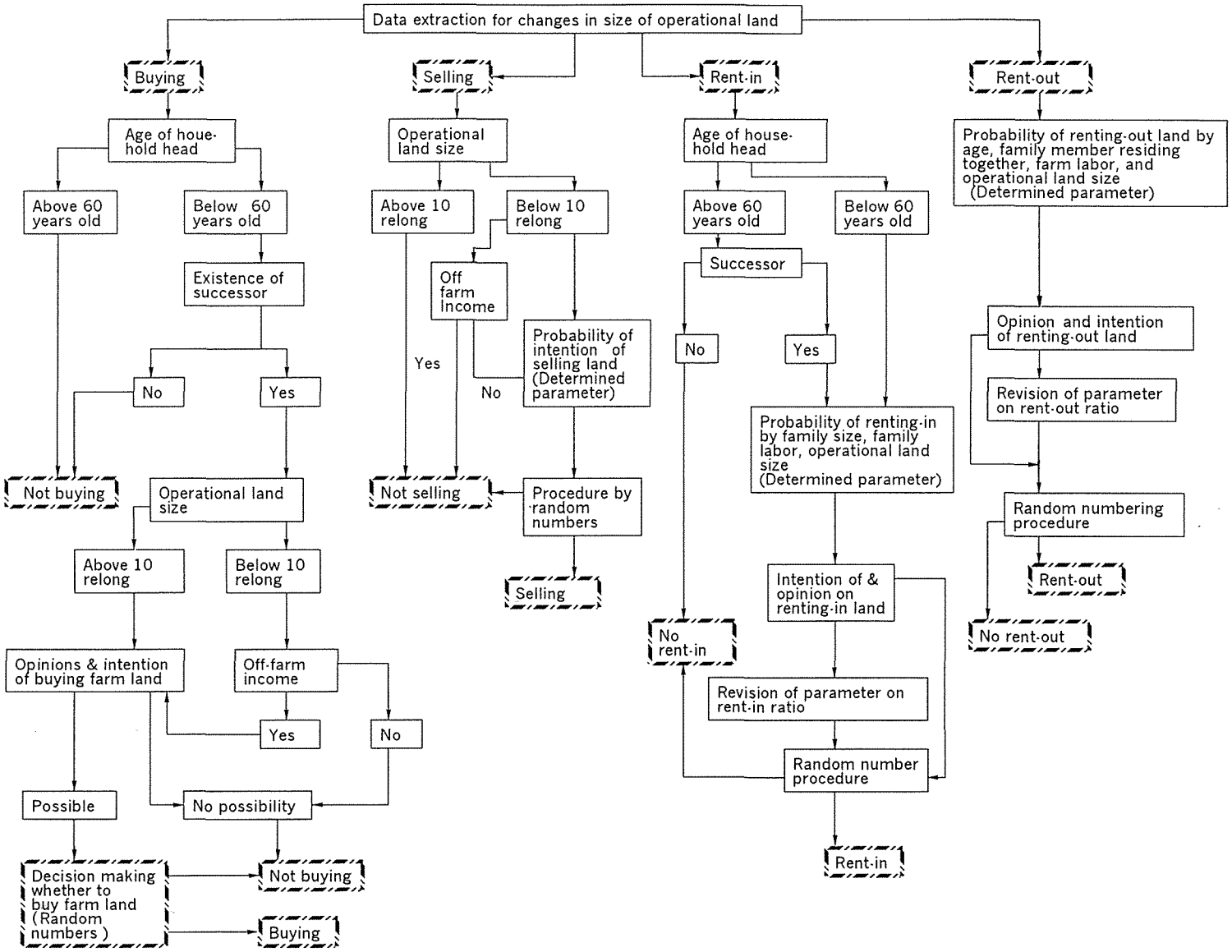

Fig. 3. Flowchart of procedure of poerational land size changes

Table 3. Results of simulation on agricultural population

		Operational land size (relong)			
		Total	0-4.9	5-5.9	above10
No. of family members	(present situation)	252	100	94	58
	(prediction)	216	80	84	52
No. of family members residing together	(present situation)	198	73	72	53
	(prediction)	111	40	44	27
No. of farm labor	(present situation)	112	44	39	29
	(prediction)	70	25	26	19

Figures indicate total size of land in this village.

Table 4. Results of simulation on land holding situation

	Item for prediction	Operational land size (relong)			
		Size of land	0-4.9	5-9.9	above10
Owned land	(present situation)	178	29	74	75
	(prediction: Basic)	119	21	56	42
	(prediction: A type)	119	21	56	42
	(prediction: B type)	119	21	56	42
	(prediction: C type)	119	21	56	42
Rent-in land	(present situation)	90	7	28	55
	(prediction: Basic)	155	42	51	62
	(prediction: A type)	139	38	46	55
	(prediction: B type)	145	37	47	61
	(prediction: C type)	130	35	42	53
Rent-out land	(present situation)	17	4	7	6
	(prediction: Basic)	33	11	113	9
	(prediction: A type)	30	11	11	8
	(prediction: B type)	33	11	13	9
	(prediction: C type)	29	11	11	7
Operational land	(present situation)	249	31	95	123
	(prediction: Basic)	256	49	95	112
	(prediction: A type)	244	48	92	104
	(prediction: B type)	247	47	90	110
	(prediction: C type)	237	46	89	102

Figures indicate total size of land in this village.

greater than that of the 0-4.9 relong (28% from 29 to 21) and 5-9.9 relong (24% from 74 to 56) categories. However, the outcome also shows the opposite aspect for rent-in and rent-out land. The size of rent-in land increased to a maximum value of 72% (90 to 155) with the major change affecting the 0-4.9 relong (500%) category. As for rent-out land, the total size almost doubled from 17 to 33 (maximum) with the most significant change occurring in the 0-4.9 relong category. Since the procedure for the change of operational land is not limited to the village as shown in Fig. 3, the size of rent-in and rent-out land in the prediction is not necessary tally. In the end, the size of the operational land shows a slight increase of 3% from 249 to 256 (Basic simulation).

Among the four types of simulations, Type C shows the major change in the size of operational land because this type C assumes the highest ratio of job opportunities in the rural area, and it also assumes that all the rental agreements will be terminated when the household head passes away.

Under these assumptions, the total size of operational land will be reduced.

To summarize, we can predict that there will be a remarkable change in the size of owned land but only a minimal one in that of operational land. Though the size of owned land is likely to decrease in every size category, a large number of new rent-in and rent-out agreements may be concluded under the Basic simulation conditions. The difference in the results among the farm size categories shows that the demand for rent-in land is higher for farmers with a small land holding than that for farmers with larger land holding because the former need to support their family if other job opportunities are scarce in the area. This tendency can be seen more clearly, if the age of the household head with a small-scale farm is younger. However, there will not be a major change in terms of size of operational land during the simulation period if the economic conditions are similar to those prevailing presently.

2) Simulation of each farm case

In the preceding section we focused our attention on the changes affecting both the farming population and farm size in Kg. Sala Kechil as a whole. It may be important to examine more closely farms on an individual basis. Table 5 shows the changes in the number of family members, family members who live together and family labor for farming.

Twenty farm households (49%) showed a decrease in the number of family members by 5%, 22% and 22% according to the respective categories

Table 5. Changes in the composition of the family

	Present Situation	Decrease			Increase		No changes
		Above 3	2	1	1	2	
(a) Changes in the number of family members	Above 10	1	2	1			
	9		2				
	8		1	1			
	7		1	2			7
	6	1	1	1			5
	5		1		1		2
	4		3		3		2
	3						2
	2			1			
	1			1			
(b) Chenges in the number of family members residing together	Above 10	2					
	9						
	8	1					
	7	6		1			
	6	6					
	5		3	1			
	4		3	1			4
	3		2		1		4
	2		2	3			1
	1			1			
(c) Chenges in the number of family labor	8	1					
	5	4					
	4	2	5				
	3		1	3			
	2			4	6	1	5
	1			2	4		1

The figure indictes the number of farms.

of decrease "above 3", "2" and "1". On the contrary, 4 farm households (10%) showed an increase in the number of family members while 17 others did not show any change. As for the family members who reside together, 32 farm households showed a decrease in the number. Only one farm household showed an increase in the number of family members who live together while in 9 other farm households (22% of the total farm households visited) no changes were observed.

As for farm labor, 22 out of 40 farm households (55%) showed a decrease in the farm labor force, which is in agreement with the findings on the number of family members and the number of family members who reside together. Eleven farm households (27%) showed an increase in the number of farm labor. A group of 7 farm households (18%) did not show any changes in the farm labor force for the next 20 years.

Table 6 reveals that out of 41 farmers, 21 (53%) showed a decrease in the total size of owned land. Three farmers who at present own more than 10 relong of land predicted a decrease of more than 5 relong in the next 20 years. For 41% of the farmers, a decrease of 1-2.9 relong is anticipated in the next 20 years. However, 19 farmers (47%) predicted that no changes in the size of their owned land would occur within the coming 20 years.

Table 6. Chenges in the composition of the family

	Present	Decrease in land size			Increase in land size		No
	Situation	more than 5	3-4.9	1-2.9	more than 3	1-2.9	changes
(a) Changes in	16-	1					
owned land size	14-15.9	1					
(relong)	10-11.9	1		1			
	8-9.9						1
	6-7.9		2	3			1
	4-5.9			5			
	2-3.9			8			4
	0-1.9						11
(b) Chenges the	10-11.9			2			1
size of	8-9.9					1	
rent-in land	6-7.9					1	
(relong)	4-5.9			2		1	1
	2-3.9				2	6	1
	0-1.9				7	12	4
(c) Chenges in	6-7.9			1			
size of	4-5.9			1			
rent-out land	2-3.9						2
(rolong)	0-1.9					10	27
(d) Chenges in	20-	1					
size of	16-17.9					1	
operational land	14-15.9		1				1
(relong)	12-13.9				1	1	1
	10-11.9	1				1	
	8-9.9		1	1		2	
	6-7.9		1	2			2
	4-5.9			2		5	
	2-3.9			2	1	1	2
	0-1.9			2	3	3	2

The figure indictes the number of farms

The results obtained in terms of changes in the size of rent-in land were consistent with the prediction that the majority of the farmers will increase the size of their rent-in land within a period of 20 years. The table shows that 30 farmers out of a total of 41 (73%) plan to increase the size of their rent-in land. Four farmers (10%) will experience a decrease in the size of their rent-in land by 1-2.9 relong while 7 farmers (17%) indicated that no changes in the size of their rent-in land would occur.

As for the changes in the size of rent-out land, 29 farmers (71%) assumed that changes would occur while 10 farmers or 24% considered that the size of their rent-out land would increase by 1-2.9 relong within the coming 2 decades. Only two farmers (5%) predicted a decrease in the size of their rent-out land. Consequently, the total area of rent-out land is unlikely to change appreciably.

Out of 41 farmers, 8 did not predict any changes in the size of their operational land. Nevertheless, 19 farmers indicated that they will operate a larger farm in 20 years' time, and the majority of them considered that the size of their operational land would increase by 1-2.9 relong. On the contrary, 14 farmers (34%) may operate a smaller farm in the future, with the majority of them predicting a decrease in the size of their operational land by 1-2.9 relong. Therefore, there may be a slight increase in the total area of operational land.

Conclusion

In this paper attempts were made to estimate the future situation of farming for 20 years from 1993, especially the size of farmland. To build a simulation model, we used individual farm data from one selected village in order to compensate for the insufficient information from official statistics data. For model building, we focused on the change of the family size, which is the major factor controlling the farm size in Malaysia. In addition, we considered the land inheritance custom in Malaysia in the simulation model. To predict the decision of the farmers to enlarge (or reduce) the farm size, the model considered the farmers' intention and opinions in relation to farming.

Based on the simulation, it was concluded that unless the children remained in the same village, the agricultural population was likely to decrease drastically within 20 years due to the independent life of the children, because the survey showed that the villagers adopt a nuclear family type. The number of farm labor is also likely to decrease, but so far the farm labor force is still sufficient in this area.

As for the farmland, the size of the land owned by the farmers in this village will decrease due to the inheritance custom after the death of the household head. Farmland will be divided for every child including those who will not stay in the village and will not be engaged in farming. They may rent-out their inherited farmland to the successor who will continue farming. In the end, compared with the decrease in the size of owned land, the size of operational land (farm size) will not change appreciably. The simulation also showed that if job opportunities increase near the village, the farm size would become smaller as every child who inherited land can manage farming on a part-time basis.

To conclude, the probability of developing large-scale farming remains low. Therefore, to achieve economies of scale, group farming is one alternative way to improve the present condition of the farmers in this area.

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マレーシア・ムダ地区における稲作の将来予測

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摘　要

本論文の目的は，マレーシアの稲作農村における農業人口と農地に関する将来予測を行うことにある。当地で分析に必要な統計情報等が得られないという点を鑑み，１つの村（サラ・クチール村）の悉皆調査から得られた結果を用いたモデルを開発した。データは農家数，農業労働力，農村人口，経営耕地面積，所有地，借地，貸地面積等の戸別調査データに加え，農民がさまざまな意思決定を行う際に影響を与えると考えられる価値観（考え方）に関するアンケート結果を用いた。こうしたデータをもとに，農村人口の変化に応じ農地の相続，貸借がどのように変化するかについて予測を行った。

シュミレーションは1993年を開始年次とし20年(2013年）後の予測値を求める作業を個々の農家について1,000回繰り返し，予測値とその出現確率を集計してもとめた。

その結果，調査村全体で農業人口は農家家族構成員の14％の減少，同居家族数の44％の減少，農業労働力の38％の減少が予測された。また，農地についてみると，所有地の34％の減少，借地面積の72％の増加，貸地の倍増が予測され，その結果，経営耕地面積は微増すると予測された。

個々の農家別に経営耕地面積の変動をみると，現在６ルロン以下の零細規模層で借地の増加による経営耕地面積増がみられた。これは世帯主の死亡により相続が発生した結果，他出者の農地を借り入れるケースが多く発生したためである。また，中層規模（６～10ルロン）では変化があまりなく，さらに，10ルロン以上の大規模には相続の発生によって大幅に経営面積を減少させる農家と，経営規模を拡大している農家の両方がみられた。

予測結果は，農業以外の兼業機会等の諸条件が現在と変わらないと仮定すると，サラ・クチール村の農家戸数及び農業就業人口は減少するが，貸借によって全体の経営耕地面積が変化せず，１戸当たりの経営耕地面積が増加する可能性が高いことを示唆した。

キーワード：農家の価値観，シミュレーション

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