Chapter 5

RESULTS OF THE ANALYSIS AND INTERPRETATION

5.1 Model Verification, Validation and Hypothesis Testing

5.1.1 Model verification and validation

Model verification is the step to evaluate whether the model is correct as a linear programming model. It requires that, among other things, the linkages between activities, the signs, the measurement of the activities and constraints, and the coefficients which relate differently measured activities and constraints, must be correct. Further, the model must behave in a logical way, or in other words, the results of the model solutions must be consistent with common sense or with the theory (Anderson 1974).

The simplified form of the decision model used in this study was presented in Figure 4.1. As the model exhibits the main, distinct linkages of the actual model, it can be used to assess the correctness of the model. The underlying logical relationship implies that, among others, the level of production activities can not exceed that allowed by the available resources. The level of consumption and sales activities can not exceed that allowed by the corresponding production and borrowing activities.

Having assessed the model according to the requirements of model verification, it can be confirmed that the model used for this study is correct as a linear programming model. Readers who wish to verify this are referred to Section 4.2.

Model validation is the step to evaluate whether the model resembles the real system to be studied (Anderson 1974). Two aspects can be looked upon in this case. First, the components of the model and the inter-relationships of those components must be consistent with those of the real system. Second, the outcome of the model solution must conform to that of the real system. It is obvious that the second aspect depends largely on the first aspect; i.e. the results of the model solution depend on the model structure: the model components and their interrelationships. If they closely resemble that of the real system, then the solution should be close to that of the real system. In other words, the model is valid as a representation of the system to be studied.

Preceding discussion is directed to explain the possible approach in model validation. In this case, by comparing the results of model solution - given the present farm data - with that from the real farm.

In this study, Nimboran farmers' annual decision making is modelled. Three main components of the model are the farm production and household organization, farmer's subjective probability distribution of the states of nature affecting the production, and farmer's utility function. The indices measuring the outcomes of farmers decisions, and which will be used as basic indices to compare the model solution with the average figures from the real farm data are the expected net cash income (NCI), the level of farm enterprises, and resources - land and labour - allocation. The results are presented in Table 5.1.

Actually the figures of the indices in both columns of Table 5.1 can not directly be matched, because the first column represent the average situation whereas the other represents the median, which, in skewed distribution, may not be equal. Despite that, the levels of subsistence crop activities - Xanthosoma, Yam, Amaranthus and Sago - appear to be very close between the real farm average and the model solution. The figures, showing the level of semi-commercial crop activities - Banana, Corn, Coconut and Betelnut - from computer solution appear to be greater than the average figures from the real farm data. It is also shown that the value of the expected net cash income (NCI) from the model solution appears to be closer to the value of the realised or expected cash consumption than to the value of the actual NCI. That the level of Coconut, Sago, Betelnut and Cocoa from computer solution are greater than the average from the real farm data is consistent with the fact that their median figures are also greater than their average figures (compare the area of perennial crops in Table 4.4 and in Appendix Table A2.1). The median of labour availability and labour use appear also to be higher than the average figure.

Table 5.1

The Results of Optimum Solution of the Representative Farm's Decision Model and the Averages of the Main Indices from Real Farm Data from Nimboran, Irian Jaya

Main Indices	Average from real farm data	Optimum solution for the representative farm (utility maximizing)
Net Cash Income (NCI) ('000 Rp)	156.00	
Expected NCI ('000 Rp)	-	312
Realised Cash Consumption ('000 Rp)	220.00	
Level of Activities		
Xanthosoma (M^2)	491.00	461.00
Yam (M^2)	182.00	197.00
Amaranthus (M^2)	105.00	105.00
Banana (M^2)	675.00	1544.00
Corn (M^2)	89.00)	1807.00
Coconut (man-hours)	256.00	584.00
Sago (man-hours)	302.00	416.00
Betelnut (man-hours)	123.00	278.00
Cocoa (man-hours)	116.00	152.00
Wage earning (man-hours)	527.00	527.00
Land used for shifting cultivation (ha)	0.23	0.41
Unused land (ha)	12.77	12.59
Total labour used		
Male family labour ('00 man-hours)	23.46	47.32
Female family labour ('00 man-hours)	35.76	76.80
Male non fam. labour ('00 man-hours)	18.60	18.60
Female non fam.labour ('00 man-hours)	21.94	21.94
Unused labour		
Male family labour ('00 man-hours)	46.54	24.68
Female family labour ('00 man-hours)	46.00	0
Male non fam. labour ('00 man-hours)	0	0
Female non fam. labour('00 man-hours)	0	0

The task to bring the figures from model solution closer to the real farm situation appears to be a difficult step in farm modelling. The difficulty arises on two grounds. First, especially when dealing with a representative farm for a region rather than for a particular farm, not all the details of the real farm situation can be captured. For example, in this study, due to computer capacity restrictions, the initial matrix of 965 rows and 540 columns had to be reduced to 320 rows and 201 columns, causing many of the less important enterprises to be excluded from the model. The median figures included in the basic model are taken from the distribution of data from all farms, including cocoa and non-cocoa growers, despite the fact that in the real situation they are separate decision units. Second, decisions are made in a dynamic environment (Beesley 1979). Annual decisions are therefore subject to revisions, which can be done monthly, weekly, or even daily. Examples in Nimboran are the decision to delay work in order to pay tribute to dead relatives in other villages and the decision to sell crops, which may be forced by sudden cash needs. The sudden decisions mainly affect labour allocation. Unfortunately, those dynamic aspects can not be specified in detail in the static model used. The results of the model solution represent static equilibrium conditions, and it may not necessarily equalize the dynamic equilibrium figures, represented by the average from the real farm data.

These arguments imply that it is reasonable not to emphasize to equality or otherwise of the absolute figures, but the degree to which the prominent features of the real farm situation are captured in the model solution. Based on the type of enterprises, all crops grown appear to be included in the model solution. Labour use pattern in terms of male and female labour usage appears also to be captured nicely in the model solution. The higher figures of the perennial crops activities and labour usage in the model solution are consistent with the fact that their representative figures (median) used in the analysis are also higher than the average figures. Besides that, the closeness of the value of the expected NCI from the model solution to the value of the expected cash consumption is logically acceptable, particularly for consumption oriented farmers. Despite its weakness as a static model to represent a basically dynamic process, given that it captures the main results of Nimboran farmers' decision making, it is acceptable as Nimboran farmers' decision making model.

5.1.2 Hypothesis testing

The first objective of this study, which is reformulated more precisely in the hypotheses to be tested, is to find out factors constraining Nimboran farmers from increasing their net cash incomes. The main hypothesis implies a constrained optimization, which is elaborated in sub-hypotheses saying that labour available, and not farmers' preferences, is the most limiting factor. In the model, labour figures are distinguished between male and female. Further segregation into monthly figures, as initially planned, was abandoned due to computer capacity restrictions. The result of the model solution (Table 5.1) reveals that at optimum solution, female labour time is fully used. As is shown in the second column of the same table concerning the average situation, it seems as if there exists surplus female labour time. However, as may be seen in Appendix Table A2.8, female labour time in 29 out of 30 sample farms are fully used. The surplus in the average figure accrue to one sample farm only. Thus, it may be summarized that, at present, constrained optimization exists in Nimboran farm operations, where female labour available appears to be the most limiting factor.

To accept this finding, or to confirm that the female labour is the most limiting factor, two supportive reasons can be given. The first is an economic reason. Job distribution between male and female at the farm level in Irian Jaya has been explained on page 19 of this dissertation. The introduction of steel axes and hatchets - given the existing job distribution - saved labour, mostly male. By using steel tools instead of stone ones, time for tree felling has been significantly reduced. On the other hand, women do most of the planting and harvesting, and no significant labour saving technology has been introduced in this field. The second is a sociological reason. Until now, the development process in Irian Jaya has not changed much of the traditional male-female job distribution at the farm level. In this case, there appears to be a social classification between hard and easy jobs among the local population. Tree felling during land clearing for cultivation, hunting, and house building, among others, are classified as hard jobs, whereas planting, harvesting, selling and cooking, among others, are classified as easy jobs. Those classified as hard jobs have to be done by the male members of the community and the easy jobs are for female. Given this social custom, male labour is discouraged from doing the 'socially accepted' female jobs. If the female members of the family let the male ones do 'their' jobs, they will be regarded as 'lazy' by other members of the community. Especially for an unmarried woman, being called lazy is a disaster for herself and for the family. It will make hard for her to find a husband, and for the family this means a loss of bride price. Due to this rigid social classification of jobs, there is barely any substitution of male for female labour.

5.2 Results of Ancillary Analysis

5.2.1 Introduction

Having established that female labour time available is the most limiting factor, then ancillary analysis was directed to obtaining the second objective of this study, i.e. how this constraining factor can best be relaxed in order to increase Nimboran farm households' net cash incomes. Four types of ancillary analysis have been done, namely, comparing maximizing expected utility and maximizing expected income assumptions for both utility groups, increasing labour efficiency, expansion of industrial crops and introduction of cereal food crop. The first two analysis are related to the hypotheses, and the latter two analysis emphasize present agricultural development activities of the government. Thereby, evaluation can be made about the present policies in the light of the objectives of agricultural development in Irian Jaya - as stated previously in the introductory chapter. The results of the analysis will be reported and briefly discussed in turn.

5.2.2 Maximizing expected utility vs. expected NCI

As farmers' preferences for cash income are summarized in their utility function, then the analysis to see the effect of preferences on the result is done by (1) running the program under a utility maximizing assumption, and (2) running the program without incorporating a utility function as the objective, or under maximizing expected NCI assumption. Both cases were run for the majority of farmers' group; whose utility function had very steep and almost flat parts, and for the better educated group; whose utility function had no flat part. The results are presented in Tables 5.2 and 5.3.

For both groups, expected NCI under maximizing expected NCI assumption appears to be higher than under maximizing expected utility assumption. The difference is between 10.22 per cent and 14.15 per cent for the majority of the farmers' group and the better educated ones, respectively. This difference may be regarded as the effect of introducing utility functions into the programming model. As noticed, the expected NCI under utility maximizing conditions (Tables 5.2 and 5.3) appears to be closer to the value of the expected consumption (Table 5.1). Thus, the results appear to be still in line with the notion that Nimboran farmers' objective is to maximize expected utility. Only the levels of Corn, Coconut and Sago activities change under both assumptions. Under maximizing expected utility assumptions, the level of Corn and Coconut activities appear to be higher, and the level of Sago activity appears to be lower than under maximizing expected income assumption.

Under utility maximizing assumption, the level of crop activities between the groups appears to be the same. Only the expected NCI varies, where the better educated farmers' group appear to have lower expected NCI than the majority of the farmers group. As noticed, the expected NCI of the better educated farmers group (Table 5.3), appears to be closer to the value of the expected consumption (Table 5.1). Two possible interpretations may be given to these facts. First, that the difference in preference for cash income is not big enough to affect resource allocation by both farmers groups. Or in other words, the type of education or training given to the 'better educated' farmer group does not shift significantly their aspirations towards a higher cash income expectation. It only makes them good at predicting the possible states of nature. The second possible interpretation is that the pattern of resource allocation or the level of crop activities shown is the best - given the existing resources, technology and institutional conditions - regardless of whether the aspirations have increased or not. The second interpretation appears to be consistent with the result of hypothesis testing where factors, other, than preference - in this case female labour availability - may become a limiting factor to increasing farmers' net cash incomes.

Table 5.2

Model Solutions for the First Utility Group of Nimboran Farmers Under Maximizing Expected Utility and Maximizing Expected Income Cases

Main Indices		Maximizing Expected Utility	Maximizing Expected NCI
Expected NCI ('000 Rp)		312.0	343.0
Level of Activities			
Xanthosoma	(M^2)	461.0	461.0
Yam	(M^2)	197.0	197.0
Amaranthus	(M^2)	105.0	105.0
Banana	(M^2)	1544.0	1544.0
Corn	(M^2)	1807.0	1800.0
Coconut	(man-hours)	584.0	565.0
Sago	(man-hours)	416.0	443.0
Betelnut	(man-hours)	278.0	278.0
Cocoa	(man-hours)	152.0	152.0
Wage earning	(man-hours)	527.0	527.0
Shifting cultivation	(ha)	0.41	0.41
Unused land	(ha)	12.59	12.59
Total labour used			
Male family labour	('00 man-hours)	47.32	47.32
Female family labour	('00 man-hours	76.80	76.80
Male non fam. labour	('00 man-hours)	18.60	18.60
Female non fam. labour	('00 man-hours)	21.94	21.94
Unused labour			
Male family labour	('00 man-hours)	24.68	24.68
Female family labour	('00 man-hours)	0	0
Male non family labour	('00 man-hours)	0	0
Female non family labour	('00 man-hours)	0	0

Table 5.3

Model Solutions for the Second Utility Group of Nimboran Farmers Under Maximizing Expected Utility and Maximizing Expected Incomes

Main Indices		Maximizing Expected Utility	Maximizing Expected NCI
Expected NCI ('000 Rp)		304.0	346.0
Level of Activities			
Xanthosoma	(M^2)	461.0	461.0
Yam	(M^2)	197.0	197.0
Amaranthus	(M^2)	105.0	105.0
Banana	(M^2)	1544.0	1544.0
Corn	(M^2)	1807.0	1807.0
Coconut	(man-hours)	584.0	513.0
Sago	(man-hours)	416.0	482.0
Betelnut	(man-hours)	278.0	278.0
Cocoa	(man-hours)	152.0	152.0
Wage earning	(man-hours)	527.0	527.0
Shifting cultivation	(ha)	0.41	0.41
Unused land	(ha)	12.59	12.59
Total labour used			
Male family labour	('00 man-hours)	47.32	47.18
Female family labour	('00 man-hours)	76.80	76.80
Male non fam. labour	('00 man-hours)	18.60	18.60
Female non fam. labour	('00 man-hours)	21.94	21.94
Unused labour			
Male family labour	('00 man-hours)	24.68	24.82
Female family labour	('00 man-hours)	0	0
Male non fam. labour	('00 man-hours	0	0
Female non fam. labour	('00 man-hours)	0	0

5.2.3 Increasing labour efficiency

The pattern of labour allocation is shown in Table 5.4. Local farmers appear to have allocated large amounts of labour time for harvesting activities, especially for annual crops. As storage technology has not been developed, local farmers prefer to practice ground storage, by leaving the crops in the field, and harvesting a small amount two or three times a week, just enough for consumption or for sale. As is shown in the Appendix Diagram A2.1, harvesting activities occur almost throughout the whole year. On average, female labourers spend 208 days work for harvesting annual crops. Male labourers join the female in harvesting only one in two days work. Thus, they use only 104 days for harvesting.

Increasing labour efficiency in this case refers to reducing labour time per hectare for shifting cultivation. This is obtained by reducing the number of days used for harvesting activities from 208 to only 52 days. Of course, this undertaking entails a very complex process of developing storage technology. The result of the analysis is presented in Table 5.5.

As is shown, given the present farm situation, subjective probability distribution and utility function, and provided that Nimboran farmers are willing to allocate extra time saved to other productive activities, then the expected net cash income can be increased by 77.54 per cent, if the number of harvest days of annual crops are reduced from 208 to 52 days. As suggested, the labour time saved can be allocated to corn production. In the last column of Table 5.5, labour time allocated to Coconut, Sago and Betelnut activities are also reduced. Corn appears to be a substitute to generate cash income, as well as energy required. By increasing labour efficiency and its corresponding consequence - expanding Corn activity - unused male family labour appears to be absorbed entirely, including those normally devoted to wage earning activities. A small portion of female non family labour time becomes idle. These findings suggest that Corn production, as a cereal, can be expanded, provided that labour efficiency can be increased.

5.2.4 Expansion of industrial crops

The industrial crops considered were Cocoa and Coconut. The results of the analysis for Cocoa expansion is presented in Table 5.6. In this

Table 5.4

Number of Days Work Spent by the Male and Female Labour on Shifting Cultivation - at the Representative Farm in Nimboran, Irian Jaya; 1979-1980

	Nr. of days for each type of work					
	Land clearing	Tree felling	Burning and final cleaning	Planting	Nursing	Harvest and selling
Male	3.0	10	2.0	12.0	2.0	104.0
Female	3.0	-	2.0	12.0	4.0	208.0
	Total labour time (man-hours)					
Male	72.0	300	48.0	288.0	12.0	1872.0
Female	76.8	-	51.2	307.2	25.6	3993.6

Table 5.5

The Effects of Improving Labour Efficiency on the Expected NCI and Resource Allocation of the Representative Farm in Nimboran, Irian Jaya

Main Indices		Initial solution	Female harvest days 156	Female harvest days 104	Female harvest days 52	Female and Male harvest days 52
Expected NCI ('000 Rp)		312.0	353.0	400.0	400	553.0
Level of Activities						
Xanthosoma	(M^2)	461.0	461.0	461.0	461.0	461.0
Yam	(M^2)	197.0	197.0	197.0	197.0	197.0
Amaranthus	(M^2)	105.0	105.0	105.0	105.0	105.0
Banana	(M^2)	1544.0	1544.0	1544.0	1544.0	1544.0
Corn	(M^2)	1807.0	2904.0	4717.0	4717.0	8912.0
Coconut	(man-hours)	584.0	587.0	321.0	321.0	321.0
Sago	(man-hours)	416.0	407.0	394.0	394.0	340.0
Betelnut	(man-hours)	278.0	278.0	278.0	278.0	169.0
Cocoa	(man-hours)	152.0	152.0	152.0	152.0	152.0
Wage earning	(man-hours)	527.0	527.0	0	0	0
Shifting cultivation	(ha)	0.41	0.52	0.7	0.7	1.12
Unused land	(ha)	12.58	12.48	12.3	12.3	11.88
Total labour used						
Male family labour	('00 man-hours)	47.32	72.00	72.00	72.00	72.00
Female family labour	('00 man-hours)	76.80	76.80	76.80	65.20	76.80
Male non fam. labour	('00 man-hours)	18.60	62.40	18.60	18.60	18.60
Female non fam. labour	('00 man-hours)	21.94	21.94	18.90	0	19.37
Unused labour						
Male family labour	('00 man-hours)	24.68	0	0	0	0
Female family labour	('00 man-hours)	0	0	0	11.60	0
Male non family labour	('00 man-hours)	0	12.36	0	0	0
Female non family labour	('00 man-hours)	0	0	3.04	21.94	2.57

Table 5.6

The Effects of Cocoa Area Expansion on the Expected NCI and Resource Allocation of the Representative Farm in Nimboran, Irian Jaya

Main Indices		Initial Solution .57 ha	Expansion of Cocoa area - max. yield 1500 kg/ha					
			.75 ha	1 ha	1.5 ha	2 ha	2.5 ha	3 ha
Expected NCI ('000 Rp)		312.0	420.0	464.0	499.0	565.0	485.0	485.0
Level of Activities								
Xanthosoma	(M^2)	461.0	461.0	461.0	461.0	461.0	461.0	461.0
Yam	(M^2)	197.0	197.0	197.0	197.0	197.0	197.0	197.0
Amaranthus	(M^2)	105.0	105.0	105.0	105.0	105.0	105.0	105.0
Banana	(M^2)	1544.0	1544.0	1544.0	1509.0	945.0	955.0	955.0
Corn	(M^2)	1807.0	1014.0	693.0	88.0	88.0	88.0	88.0
Coconut	(man-hours)	584.0	582.0	582.0	600.0	558.0	556.0	556.0
Sago	(man-hours)	416.0	422.0	424.0	411.0	292.0	290.0	290.0
Betelnut	(man-hours)	278.0	278.0	278.0	278.0	278.0	137.0	137.0
Cocoa	(man-hours)	152.0	852.0	1136.0	1705.0	2273.0	2296.0	2296.0
Wage earning	(man-hours)	527.0	527.0	527.0	527.0	527.0	527.0	527.0
Shifting cultivation	(ha)	0.41	0.33	0.3	0.24	0.18	0.18	0.18
Unused land	(ha)	12.59	12.49	12.3	11.83	11.39	10.90	10.40
Total labour used								
Male family labour ('00 man hours)		47.32	45.44	44.68	43.20	40.90	40.00	40.00
Female family labour ('00 man-hours)		76.80	76.80	76.80	76.80	76.80	76.80	76.80
Male non family labour ('00 man hours)		18.60	18.60	18.60	18.60	18.60	18.60	18.60
Female non family labour ('00 man hours)		21.94	21.94	21.94	21.94	21.94	21.94	21.94
Unused labour								
Male family labour ('00 man-hours)		24.68	26.56	27.32	28.80	31.10	32.00	32.00
Female family labour ('00 man-hours)		0	0	0	0	0	0	0
Male non family labour ('00 man-hours)		0	0	0	0	0	0	0
Female non family labour ('00 man hours)		0	0	0	0	0	0	0

case the area of Cocoa is expanded from the present average : 0.57 ha, up to three hectares. As is shown, other factors remain constant, the highest expected NCI is reached when Cocoa area is expanded to two hectares. The expected NCI is 81.31 per cent higher than that obtained at the initial solution using present farm data. Male labour time allocated to Cocoa production to reach maximum NCI has also increased by about 1400 per cent. As a result, labour used for annual crop production and other perennial crops were reduced. Annual crops affected are Banana and Corn, as shown by the area of the area cultivated. Other perennial crops affected are Coconut and Sago.

The expansion of the area of cocoa appears to have encouraged reallocation of labour between crops grown. However, it does not change the traditional labour use pattern between male and female. Instead, as can be seen in Table 5.6, it increases unused male family labour time. In other words, it increases labour saving only for male members of the farm family. This phenomenon can be explained as follows. Under the existing cocoa production pattern, female labour time devoted to cocoa activities is 2.33 times higher than that of the male ones. Weeding, harvesting and selling are done mostly by women. The composition of male and female labour requirements differ between crops cultivated. Because there is a trade-off relationship between cocoa and other crops in terms of labour use, expansion of cocoa activity reduces the level of labour time for other crops. Thus, of the male labour time released from other activities, due to labour composition required in cocoa activity, only a portion of it can be used.

The results of the analysis for coconut expansion are presented in Table 5.7. As is shown, the highest expected NCI is reached when the area of coconut is increased by 13 times the present average of 0.1051 ha to be 1.3663 ha. The corresponding expected NCI is about 101.0885 per cent higher than that shown by the initial solution which represents present farm situation. Male labour time allocated to coconut production is also increased by 871.9634 per cent.

Table 5.7

The Effect of Coconut Area Expansion on Expected NCI and Resource Allocation of the Representative Farm in Nimboran, Irian Jaya

Main Indices	Initial Solution	Expanded from the Present Area (.1051 ha) by			
		1.5 times	2 times	2.5 times	3 times
Expected NCI ('000 Rp)	312.0	326.0	339.0	352.0	363.0
Level of Activities					
Xanthosoma (M^2)	461.0	461.0	461.0	461.0	461.0
Yam (M^2)	197.0	197.0	197.0	197.0	197.0
Amaranthus (M^2)	105.0	105.0	105.0	105.0	105.0
Banana (M^2)	1544.0	1544.0	1544.0	1544.0	1544.0
Corn (M^2)	1807.0	1758.0	1647.0	1536.0	1424.0
Coconut (man-hours)	584.0	717.0	1023.0	1330.0	1634.0
Sago (man-hours)	416.0	416.0	417.0	418.0	419.0
Betelnut (man-hours)	278.0	278.0	278.0	278.0	278.0
Cocoa (man-hours)	152.0	152.0	152.0	152.0	152.0
Wage earning (man-hours)	527.0	527.0	527.0	527.0	527.0
Shifting cultivation (ha)	0.41	0.41	0.40	0.38	0.37
Unused land (ha)	12.59	12.54	12.50	12.46	12.42
Total labour used					
Male family labour ('00 man-hours)	47.32	48.10	49.92	51.73	53.54
Female family labour ('00 man-hours)	76.80	76.80	76.80	76.80	76.80
Male non family labour ('00 man-hours)	18.60	18.60	18.60	18.60	18.60
Female non family labour ('00 man-hours)	21.94	21.94	21.94	21.94	21.94
Unused labour					
Male family labour ('00 man-hours)	24.68	23.90	22.08	20.27	18.46
Female family labour ('00 man-hours)	0	0	0	0	0
Male non family labour ('00 man-hours)	0	0	0	0	0
Female non family labour ('00 man-hours)	0	0	0	0	0

Table 5.7 continued ...

Table 5.7 continued

Main Indices		Expanded from the Present Area (0.1051 ha) by				
		4 times	5 times	6 times	7 times	8 times
Expected NCI ('000 Rp)		390.0	436.0	462.0	488.0	513.0
Level of Activities						
Xanthosoma	(M^2)	461.0	461.0	461.0	461.0	461.0
Yam	(M^2)	197.0	197.0	197.0	197.0	197.0
Amaranthus	(M^2)	105.0	105.0	105.0	105.0	105.0
Banana	(M^2)	1544.0	1544.0	1544.0	1544.0	1544.0
Corn	(M^2)	1215.0	1252.0	1085.0	918.0	751.0
Coconut	(man-hours)	2245.0	2142.0	2600.0	3059.0	3518.0
Sago	(man-hours)	395.0	395.0	396.0	397.0	398.0
Betelnut	(man-hours)	278.0	278.0	278.0	278.0	278.0
Cocoa	(man-hours)	152.0	152.0	152.0	152.0	150.0
Wage earning	(man-hours)	527.0	527.0	527.0	527.0	527.0
Shifting cultivation	(ha)	0.35	0.36	0.34	0.32	0.31
Unused land	(ha)	12.33	12.22	12.14	12.05	11.96
Total labour used						
Male family labour	('00 man-hours)	57.05	56.44	59.16	61.87	64.59
Female family labour	('00 man-hours)	76.80	76.80	76.80	76.80	76.80
Male non family labour	('00 man-hours)	18.60	18.60	18.60	18.60	18.60
Female non family labour	('00 man-hours)	21.94	21.94	21.94	21.94	21.94
Unused labour						
Male family labour	('00 man-hours)	14.95	15.56	12.84	10.13	7.41
Female family labour	('00 man-hours)	0	0	0	0	0
Male non family labour	('00 man-hours)	0	0	0	0	0
Female non family labour	('00 man-hours)	0	0	0	0	0

Table 5.7 continued ...

Table 5.7 continued

Main Indices		Expanded from the Present Area (0.1051 ha) by					
		9 times	10 times	11 times	12 times	13 times	14 times
Expected NCI ('000 Rp)		539.0	565.0	590.0	609.0	627.00	579.0
Level of Activities							
Xanthosoma	(M^2)	461.0	461.0	461.0	461.0	461.0	461.0
Yam	(M^2)	197.0	197.0	197.0	197.0	197.0	197.0
Amaranthus	(M^2)	105.0	105.0	105.0	105.0	105.0	105.0
Banana	(M^2)	1544.0	1544.0	1544.0	1544.0	1481.0	1435.0
Corn	(M^2)	584.0	417.0	312.0	197.0	88.0	88.0
Coconut	(man-hours)	3976.0	4435.0	4817.0	5201.0	5678.0	5875.0
Sago	(man-hours)	400.0	400.0	335.0	288.0	288.0	288.0
Betelnut	(man-hours)	278.0	278.0	278.0	278.0	278.0	169.0
Cocoa	(man-hours)	152.0	152.0	152.0	152.0	152.0	152.0
Wage earning	(man-hours)	527.0	527.0	527.0	319.0	38.0	0
Shifting cultivation	(ha)	0.29	0.27	0.26	0.25	0.23	0.23
Unused land	(ha)	11.87	11.76	11.69	11.59	11.51	11.41
Total labour used							
Male family labour	('00 man-hours)	67.30	70.02	72.00	72.00	72.00	72.00
Female family labour	('00 man-hours)	76.80	76.80	76.80	76.80	76.80	76.80
Male non family labour	('00 man-hours)	18.60	18.60	18.60	18.60	18.60	18.60
Female non family labour	('00 man-hours)	21.94	21.94	21.94	21.94	21.94	21.94
Unused labour							
Male family labour	('00 man-hours)	4.70	1.98	0	0	0	0
Female family labour	('00 man-hours)	0	0	0	0	0	0
Male non family labour	('00 man-hours)	0	0	0	0	0	0
Female non family labour	('00 man-hours)	0	0	0	0	0	0

Expansion of coconut activity adversely affects corn activity. Additional labour time to coconut activity appears to be released from that used for corn activity. Another effect, which is due to the difference in male and female labour composition required in corn and coconut activities, is that only part of the labour time released are used in coconut activity. Another small part is absorbed in sago activity, which appears to increase, compatible with coconut activity.

Further, there are two other effects which can be traced in the results of this analysis. First, at the level where coconut area is increased by five times the present average area, a reorganization in consumption and sales composition occurs. Second, at the level where coconut area is increased by 11 times the present average area, all male and female labour time is fully used. At this stage, sago activity, beside corn activity, becomes competitive with coconut activity in terms of labour use, instead of complementary as found initially. Further, wage earning activities are also reduced, releasing labour to support the increasing coconut activity.

The occurrence of the first phenomenon can be explained as follows. As sago production is increased compatible with coconut activity, more sago is produced. Due to its bigger contribution in energy requirements, additional sago tends to be consumed, thereby allowing more of other crops to be sold after minimum energy requirements are met. Thus, increases in expected NCI at this stage do not accrue to the increase in coconut production and sale, but mostly to the increase in sales of other crops such as xanthosoma and banana. After this stage, the level of those activities except coconut, sago, corn and wage earning remain unchanged for each increase in coconut area, until the maximum expected NCI is reached.

5.2.5 Introduction to rice

Introduction of rice is specified in the model by adding rice production, consumption and sales activities. As none of the indigenous farmers cultivated rice, data on rice coefficients were obtained from transmigrant farmers. Indigenous farmers were asked to estimate yield and labour coefficients. Compared with the responses from the transmigrants, the indigenous farmers greatly discounted yields and increased labour requirements. The subjective estimates of rice coefficients from the indigenous farmers were included in the matrix. The resulting solution indicated that rice should not be grown.

To find out which changes are needed in order that rice may be introduced into the basis, three possibilities were tried first, i.e. increasing price, yield perception, and both. Further, those three possibilities were tried in combination with increasing labour efficiency, which is outlined in sub-section 5.2.3. The results of the first trials will be reported subsequently.

Present net price of rice at the farm level is 75 Rupiahs per kg dry grain. Several trials were conducted by each time increasing the net price by 25 Rupiahs. The results of the analysis are presented in Table 5.8. It is shown that rice can only be introduced, if its net price is increased to 150 Rupiahs per kg dry grain, twice the present level, given that indigenous farmers estimates of yield and labour requirements are used.

Present yield perception by the indigenous farmers is 240 kg/ha, 184.5 kg/ha and 131.24 kg/ha for good, normal and bad state of nature, respectively. Those are the discounted figures from 2000 kg/ha, 1500 kg/ha and 1067 kg/ha, respectively. The latter figures are obtained from the transmigrants. Several trials were conducted by increasing the yield perception each time by 50 per cent. It was found that rice is recommended in the solution, only if its yield - as perceived by the indigenous farmers - is increased by 100 per cent. The result of the analysis is presented in the second column of Table 5.9.

The third trial was conducted by increasing both yield and price - as perceived by the indigenous farmers. It was found, as is shown in the last column of Table 5.9, that rice activity is recommended in the solution, when yield and price of rice - as seen by the indigenous farmers - are increased by 50 per cent and by 25 Rupiahs, respectively.

The figures concerning resource allocation and expected NCI do not vary significantly in all these solutions. The area of rice recommended is slightly less than 2.4 ha. Other notable features shown in the solutions

Table 5.8

The Results of Some Trials by Varying Price to Determine the Possibility to Introduce Rice in Nimboran

Main Indices		Initial Solution	Introducing Rice: Price of rice Rp 75, Rp 100 and Rp 125 per kg dry grains	Introducing Rice: Price of rice Rp 150/kg dry grains
Expected NCI ('000 Rp)		312.0	312.0	315.0
Level of Activities				
Xanthosoma	(M^2)	461.0	461.0	461.0
Yam	(M^2)	197.0	197.0	197.0
Amaranthus	(M^2)	105.0	105.0	105.0
Banana	(M^2)	1544.0	1544.0	1544.0
Corn	(M^2)	1807.0	1807.0	415.0
Rice	(M^2)	-	0	2.4×10^4
Coconut	(man-hours)	584.0	584.0	412.0
Sago	(man-hours)	416.0	416.0	426.0
Betelnut	(man-hours)	278.0	278.0	278.0
Cocoa	(man-hours)	152.0	152.0	152.0
Wage earning	(man-hours)	527.0	527.0	527.0
Shifting cultivation	(ha)	0.41	0.41	0.27
Unused land	(ha)	12.59	12.59	10.34
Total labour used				
Male family labour	('00 man-hours)	47.32	47.32	72.00
Female family labour	('00 man-hours)	76.80	76.80	76.80
Male non family labour	('00 man-hours)	18.60	18.60	18.60
Female non family labour	('00 man-hours)	21.94	21.94	21.94
Unused labour				
Male family labour	('00 man-hours)	24.68	24.68	0
Female family labour	('00 man-hours)	0	0	0
Male non family labour	('00 man-hours)	0	0	0
Female non family labour	('00 man-hours)	0	0	0

Table 5.9

The Result of Some Trials by Varying Yield as well as Yield and Price to Determine the Possibility to Introduce Rice in Nimboran, Irian Jaya

Main Indices		Solution at present yield perception	Increasing yield perception by 100 per cent	Increasing yield perception by 50 per cent and price by Rp 25
Expected NCI ('000 Rp)		312.0	316.0	316.0
Level of Activities				
Xanthosoma	(M^2)	461.0	461.0	461.0
Yam	(M^2)	197.0	197.0	197.0
Amaranthus	(M^2)	105.0	105.0	105.0
Banana	(M^2)	1544.0	1544.0	1544.0
Corn	(M^2)	1807.0	422.0	415.0
Rice	(M^2)	0	2.4×10^4	2.4×10^4
Coconut	(man-hours)	584.0	412.0	412.0
Sago	(man-hours)	416.0	400.0	426.0
Betelnut	(man-hours)	278.0	278.0	278.0
Cocoa	(man-hours)	152.0	152.0	152.0
Wage earning	(man-hours)	527.0	527.0	527.0
Shifting cultivation	(ha)	0.41	0.27	0.27
Unused Land	(ha)	12.59	10.34	10.35
Total labour used				
Male family labour	('00 man-hours)	47.32	72.00	72.00
Female family labour	('00 man-hours)	76.80	76.80	76.80
Male non family labour	('00 man-hours)	18.60	18.60	18.60
Female non family labour	('00 man-hours)	21.94	21.94	21.94
Unused labour				
Male family labour	('00 man-hours)	24.68	0	0
Female family labour	('00 man-hours)	0	0	0
Male non family labour	('00 man-hours)	0	0	0
Female non family labour	('00 man-hours)	0	0	0

are: all labour available is fully used; additional labour for rice activity appears to be transferred from corn and coconut activities; and the expected NCI does not increase significantly from that, shown in the initial solution which represent current farm condition. Thus, the introduction of rice appears to increase resources - land and labour - used, but contribute extremely little to the gain in expected NCI.

The second series of trials to find out the possibility of introducing rice is conducted by combining each of the above mentioned possibilities with increasing labour efficiency in existing annual crop production. The results reveals that if labour efficiency is increased, then it is better to allocate labour time saved to corn production rather than to rice production. Rice production appears to be excluded in all solutions, even for the expected level of price and yield twice the present expected level.

Chapter 6

SUMMARY AND CONCLUSIONS

6.1 General Summary

In this dissertation, the possible strategies to increase net cash income of the indigenous farmers in Nimboran, Irian Jaya are explored. Net cash income is defined as gross cash income generated minus cash costs spent by the farmers. It refers to the total net cash income before it is spent for consumption purposes. Its complement is net non-cash income, or net value of subsistence production. Both components of total net income are generated by using the resources available to the farmers. It is assumed that what the farmers achieve depends partly on what they did, and what they did is actually what they have decided to do. Thus, the results of the farm operations can be explained using the farmers' decision model. As decision theory is used, consistently, net cash income throughout the dissertation is called expected net cash income (NCI).

The use of the decision model and corresponding decision theory to solve the problem in this study is based on the propositions that: (1) farms operations are in fact planned operations, and thus (2) the amount of cash and non-cash incomes to be generated are predetermined. All these are manifested in farmers decisions. Farmers, in making their annual farm plans, consider their yearly needs which have to be fulfilled in kinds and amount. This forms the basis for determing how much of cash and non-cash incomes should be generated. Further, they consider the resources available to them. They are also aware of uncertain factors affecting the production process. From experience and knowledge, they estimate how, and to what extend, uncertain factors may occur. Based on those beliefs they make plans of resource allocation in such a way that the outcomes of farm operations are consistent with what the farmers prefer the outcomes to be.

Discrete stochastic programming with lexicographic specification is used as the basic model. Lexicographic specification entails the decision rule that maximizing expected net cash income is allowed after minimum subsistence food requirements have been met.

Nimboran farmers' utility functions for cash incomes and their subjective probabilities that yields and sales conditions will be good, normal or bad had been elicited and incorporated into the model. Other aspects concerning the utility functions of the Nimboran farmers and their subjective probabilities will be summed up sequentially in the next two sections.

It is found that in the Nimboran farm situation, Fisk's concept of subsistence affluence does not exist anymore. Instead, constrained optimization has occurred, where female labour time appears to be the most limiting factor. It is also shown that male labour time and land available are under used. Therefore it is suggested that whichever activity will be introduced to develop farms in Nimboran, the female and male labour requirement aspect should be considered carefully. The criterion for the best strategy is the one which gives the highest expected net cash incomes. Beside that, the activities which use more male labour and land than female labour are more desirable.

Four alternative strategies have been tested: improving labour efficiency, expansion of cocoa and coconut area and introduction of rice. Two of these, namely the expansion of cocoa area and introduction of rice, represent current Government programs. The expansion of coconut area generates the highest expected NCI, followed by cocoa expansion and improving labour efficiency. The introduction of rice shows no significant increase in expected NCI.

In the present farm condition, coconut activity uses more male labour than female labour per unit of product. For cocoa activity, more female than male labour is used per unit of product. In rice production, more male labour is used per hectare than female labour. Traditionally, as shown by the labour input for shifting cultivation, more female labour time is used per hectare than male labour time. Due to variations in labour requirements between the activities, it was found that expansion of some of the existing activities may encourage reallocation of labour which may further result in higher expected NCI. Expansion of cocoa and coconut areas are the examples of this possibility. There is, however, a substantial difference between these two strategies due to the difference in male and female labour requirements. At the level where coconut expansion resulted in the highest expected NCI, all male and female labour time is fully used. In cocoa expansion, at the level with the highest expected NCI, male labour time is still under used. Coconut expansion appears to fit the requirement as the strategy with the highest expected NCI, absorbing all the unused male labour time, and using part of the unused land.

In this study, a comparative static analysis is used; not a dynamic one. The true situation of coconut and cocoa expansion between planting and early harvest is not clearly shown. There is a time differential in between; three years for cocoa, and five to six years for coconut. Therefore, the advantage of coconut expansion should be interpreted carefully. It is suggested that a separate study be conducted using development budgeting to determine which one is the best to be expanded in Nimboran.

6.2 Utility Function

Due to time limitations during field work, only utility functions of five farm households could be elicited as outlined in section 4.4.3. The elicited utility functions are concave, showing risk aversion among Nimboran farmers. According to the shape of their utility functions, two groups of farmers have been distinguished in Nimboran. The first group belongs to those whose utility functions consist of very steep and almost flat parts. This means, at the beginning, there is a high increase in utility for each unit increase in cash income, until a certain level is reached. Beyond that level, each additional unit of money adds very little to utility. It was realised that the region where the curve turns from steep to flat appears to be around the level where cash income approaches the level of expected cash consumption. It is therefore assumed that for the first group the concavity of the utility function does not accrue to risk aversion alone, but to 'consumption mindedness' too.

The second group has a utility function that gradually increases; without a flat part. Here, risk aversion attitude appears to be the main cause of the convexity of the utility function. Based on the characteristics of the members of the groups, where the first group appears to be close to the majority of Nimboran farmers, the utility function of one of their members was selected randomly to be incorporated into the model.

It was found, despite the difference in the shape of their utility functions, both farmer groups have the same level of cropping activities or resources allocation among the cultivated crops, under the utility maximizing assumption. This finding is further used as an assumption to support the result of the hypothesis testing which says, that factors, other than preference, could be limiting at the farm level in Nimboran.

It is understood, that the utility function is an important component of the model used in this study, and thus determined the validity of the results. The utility function of only five farm households were elicited in this study. Therefore it is suggested that a further study be conducted in utility analysis in this region by taking more respondents, in which the effect of 'consumption mindedness' and risk aversion on the shape of the function may be examined.

6.3 Subjective Probability

It was assumed that farmers perceived the distribution of uncertain yields and sales as discrete, namely good, normal or bad. Based on the reasons as outlined in sub-section 4.4.4, yields and sales are assumed to be independent. Subjective probabilities of yield and sales are elicited separately, and using conventional probability calculus, transformed to form nine joint probabilities of the states of nature. It was found that local farmers tend to put high probability on the normal conditions. The subjective probability distribution that was chosen to be incorporated into the model is from the same respondent, whose utility function was selected.

6.4 Rice Dilemma

Very frequently, farmers do not act according to what has been recommended or planned by the government. A simple example in Nimboran is the introduction of rice. The complaint by the local Administrator to the author during field work clearly emphasizes this problem; a free translation of which can be reiterated as follows: I don't know what to do to develop this community; we have parcelled and cleared the land for each family, we provide tractors for soil tilling, and seeds, but no one ever tries to cultivate rice! It appears, that it is now possible to explain this phenomenon using the results of this study. It will be explained subsequently, beginning with an explanation of the present land availability pattern.

In this study, the median 15 ha of land available per farm is taken to represent the whole region. However, in fact, land availability per farm household varies from 5 ha to 18 ha. Two main factors have contributed to the land availability pattern in this region: (1) traditional heritage, and (2) village and town formation and development. Land currently owned by the clans, has been protected for generations. Historically strong tribes usually owned fertile and vast areas of land. If the present generation of Nimboran farmers are reluctant to release land to support government programs, this should be interpreted partly as a tribute to their ancestors, who had sacrificed even their lives to maintain land for their descendants.

The present village structure in Nimboran and many other places in Irian Jaya, including the clan or family name that distinguished land owning groups, is not traditionally formed, but forced from outside the community by the Government and the Missionaries. Formerly, small clans lived on their own land, scattered throughout the region. Those clans were forced to join in a new settlement, so that schools and church facilities could be used more efficiently. Certain clans who have donated their land for joint settlement now own less land for farming. As the village population grew, more and more land was used for housing sites, leaving those unfortunate families with less land. The same fate had also been encountered by those whose tribal land is used for the government administrative centre. Those tribes whose land is far from the present human settlements, still maintain their tribal land. However, some are very far from the settlement; and it takes about a one to two hours walk to reach them.

Rice is the main staple food of most Indonesians. However, domestic production appears to lag behind consumption (Mears 1978). Accordingly, the government has been attempting to encourage rice production towards self sufficiency by intensification and extensification programs. Intensification refers to increasing production per hectare by increasing and better use of irrigation water, fertilizer, insecticides and pesticides, and planting methods. Extensification refers to expanding land area under rice. Rice, however, is not a traditional crop in Irian Jaya. As shown in Table 2.5, the staple foods of the indigenes are mainly tubers and sago. The attempt to introduce rice to the indigenous farmers in Nimboran appears to face difficulty.

This campaign is conducted mainly in the villages surrounding Genyem, the administrative centre, and in the villages close to the transmigrant settlement. Given the existing land availability pattern, increasing pressure to release more of their land for public utilities forced them to consider using the remaining land more efficiently. Given their decision model as tested in this study, it is clear why indigenous farmers are reluctant to cultivate rice, since rice cultivation - according to their subjective assessment - uses more land and labour, but adds little to the expected NCI.

6.3 Conclusion

Many farm planning studies have been conducted using a decision theoretic approach. This study, in supporting the others, has shown that the decision theoretic approach can be used to explain the causes of stagnation in getting government programs accepted by the traditional farmers. It has been demonstrated that stochastic discrete programming can be used for planning small-farm development in a traditional community.

Despite the work of Dillon and Scandizzo (1978), Binswanger (1980) and Herath (1980) many people still consider it would be difficult, if not impossible, to elicit utility function for less educated, traditional farmers on small holdings. Here, it has once again been established that, given time, a good command of the subject matter and the way to express the idea in the communication process, both utility functions and subjective probabilities of traditional farmers can be elicited.

Based on the result of this study it can be suggested that, in the Nimboran situation, expanding perennial cash crops like coconut and cocoa appears to be the best strategy to increase farmers' net cash incomes. It is likely that local indigenous farmers will welcome such a strategy. In the long run, agricultural research and development strategy should be directed to break the constraint imposed by the female labour shortage.

APPENDIX I

Interview Guide

For the Field Survey in Nimboran

Date of interview: Time of interview:

Kampung: ...... Desa: Village Kecamatan

Personal Data

Name of family head:

Age:

Formal education attainment:

Years of experience in farming:

Former occupation:

Years engaged in former occupation:

Family members:

		Age	Active (a) or not active (na) on farm	Active (a) or not active (na) in other income earning activities	Formal education attainment
Wife		...	....	....	....
Child	1	...	....	....	....
	2	...	....	....	....
	3	...	....	....	....
	4	...	....	....	....
	5	...	....	....	....
	6	...	....	....	....
Other members					
	1	...	....	....	....
	2	...	....	....	....
	3	...	....	....	....
	4	...	....	....	....

Religion:

The attitude of being rich or poor will be elicited by asking

1. Whether the farmer wanted to be rich. The likely answer will be classified as follows:

yes' + explanation of his strong desire
yes, but ....
neutral; it does not matter whether rich or poor
satisfied if he can get enough for living
no'

2. Chck the consistency of the answer to Question 1, by asking the farmer, whether he thinks being rich is good, normal or bad.

3. Ask the reasons for his answer to Question 2.

Other socio-economic data

Location of the nearest shop/market:
- distance in km. from the residential location ....
- number of hours to reach it .... /walk/use vehicles: what type of vehicle: ....
- amount of cost to reach it: ....

Is the nearest shop/market the very frequently visited one or not? If not, where is the location of the very frequently visited market/shop?........
- distance in km. from the residential location ....
- number of hours to reach it .... /walk/use vehicles: what type of vehicle: ....
- amount of cost to reach it: ....

Frequency of attending different types of extension program per year for the last five years.

Year 1978/1979

Type of extension	Frequencies	Useful or not	Which knowledge got
(1) Movie	..	..	....
(2) Visit by extension officer	..	..	....
(3) Radio program listeners group	..	..	....
(4) Meetings	..	..	....
(5) Tours	..	..	....
(6)	..	..	....
(7)	..	..	....
(8)	..	..	....
(9)	..	..	....

Year 1977/78

Type of extension	Frequencies	Useful or not	Which knowledge got
(1)	..	..	....
(2)	..	..	....
(3)	..	..	....
(4)	..	..	....
(5)	..	..	....
(6)	..	..	....
(7)	..	..	....
(8)	..	..	....
(9)	..	..	....

Year 1976/77

(1)	..	..	....
(2)	..	..	....
(3)	..	..	....
(4)	..	..	....
(5)	..	..	....
(6)	..	..	....
(7)	..	..	....
(8)	..	..	....
(9)	..	..	....

Year 1975/76

(1)	..	..	....
(2)	..	..	....
(3)	..	..	....
(4)	..	..	....
(5)	..	..	....
(6)	..	..	....
(7)	..	..	....
(8)	..	..	....
(9)	..	..	....

Year 1974/1975

Type of extension	Frequencies	Useful or not	Which knowledge got
(1)	..	..	....
(2)	..	..	....
(3)	..	..	....
(4)	..	..	....
(5)	..	..	....
(6)	..	..	....
(7)	..	..	....
(8)	..	..	....
(9)	..	..	....

Land available

Approximate land area where the farmer use to cultivate his crop ......ha, or by,

(a) total land owned by his tribe .... ha.

(b) Nr of families of that tribe ....

(c) a/b = average land available per farm family .... ha.

Land per crop

How many parcels of land? ....

Crops	Population of plants per parcel 1	2	3	4	5	6	7	8	Average dist. (m)
1	..	..	..	..	..	..	..	..	..
2	..	..	..	..	..	..	..	..	..
3	..	..	..	..	..	..	..	..	..
4	..	..	..	..	..	..	..	..	..
5	..	..	..	..	..	..	..	..	..
6	..	..	..	..	..	..	..	..	..
7	..	..	..	..	..	..	..	..	..
8	..	..	..	..	..	..	..	..	..
9	..	..	..	..	..	..	..	..	..
10	..	..	..	..	..	..	..	..	..

continued ......

Crops	Population of plants per parcel 1	2	3	4	5	6	7	8	Average dist. (m)
11	..	..	..	..	..	..	..	..	..
12	..	..	..	..	..	..	..	..	..
13	..	..	..	..	..	..	..	..	..
14	..	..	..	..	..	..	..	..	..
15	..	..	..	..	..	..	..	..	..
16	..	..	..	..	..	..	..	..	..
17	..	..	..	..	..	..	..	..	..
(a)	..	..	..	..	..	..	..	..	..
(b)	..	..	..	..	..	..	..	..	..

(a) = fill in : old garden, new garden, or home garden

(b) = distance from home in km and length of time to reach.

Labour available

1. Family labour

Month	Adult male			Adult female			Children		
	Nrs.	Days work	Hrs. of work/ day	Nrs.	Days work	Hrs. of work/ day	Nrs.	Days work	Hrs. of work/ day
Jan.	..	..	..	..	..	..	..	..	..
Feb.	..	..	..	..	..	..	..	..	..
Mar.	..	..	..	..	..	..	..	..	..
Apr.	..	..	..	..	..	..	..	..	..
May	..	..	..	..	..	..	..	..	..
July	..	..	..	..	..	..	..	..	..
August	..	..	..	..	..	..	..	..	..
Sept.	..	..	..	..	..	..	..	..	..
Oct.	..	..	..	..	..	..	..	..	..
Nov.	..	..	..	..	..	..	..	..	..
Dec.	..	..	..	..	..	..	..	..	..

continued .....

2. Exchange labour

Month	Adult male			Adult female			Children		
	Nrs.	Days work	Hrs. of work/ day	Nrs.	Days work	Hrs. of work/ day	Nrs.	Days work	Hrs. of work/ day
Jan.	..	..	..	..	..	..	..	..	..
Feb.	..	..	..	..	..	..	..	..	..
March	..	..	..	..	..	..	..	..	..
April	..	..	..	..	..	..	..	..	..
May	..	..	..	..	..	..	..	..	..
June	..	..	..	..	..	..	..	..	..
July	..	..	..	..	..	..	..	..	..
August	..	..	..	..	..	..	..	..	..
Sept.	..	..	..	..	..	..	..	..	..
Oct.	..	..	..	..	..	..	..	..	..
Nov.	..	..	..	..	..	..	..	..	..
Dec.	..	..	..	..	..	..	..	..	..

Labour use

Type of work needed in each month for each crop per year.

Crop	Work in each month for each crop											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												

Fill in : lc = land clearing, pl = plowing, pla = planting, nu = nursing, h = harvest, ah = after harvest handling, sl = selling.

Number of family labour employed for each type of work for each crop last year.

Crop	lc			pl			pla			nu			h			ah			sl		
	m	f	ch	m	f	ch	m	f	ch	m	f	ch	m	f	ch	m	f	ch	m	f	ch
1																					
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																					
19																					
20																					
21																					

m = male labour;

f = female labour;

ch = children labour.

Number of days spent by the family employed for each type of work for each crop last year.

Crop	lc			pl			pla			nu			h			ah			sl		
	m	f	ch	m	f	ch	m	f	ch	m	f	ch	m	f	ch	m	f	ch	m	f	ch
1																					
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																					
19																					
20																					
21																					

Number of hours per day spent by the family labour employed for each type of work for each crop last year.

Crop		lc			pl			pla			nu			h			ah			sl	
	m	f	ch	m	f	ch	m	f	ch	m	f	ch	m	f	ch	m	f	ch	m	f	ch
1																					
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																					
19																					
20																					
21																					

Number of exchange labour employed for each type of work for each crop last year.

Crop	lc			pl			pla			nu			h			ah			sl		
	m	f	ch	m	f	ch	m	f	ch	m	f	ch	m	f	ch	m	f	ch	m	f	ch
1																					
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																					
19																					
20																					
21																					

Number of days spent by the exchange labour employed for each type of work for each crop last year.

Crop	lc			pl			pla			nu			h			ah			sl		
	m	f	ch	m	f	ch	m	f	ch	m	f	ch	m	f	ch	m	f	ch	m	f	ch
1																					
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																					
19																					
20																					
21																					

Number of hours per day spent by the exchange labour employed for each type of work for each crop last year.

Crop	lc			pl			pla			nu			h			ah			sl		
	m	f	ch	m	f	ch	m	f	ch	m	f	ch	m	f	ch	m	f	ch	m	f	ch
1																					
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																					
19																					
20																					
21																					

Production

Production of each crop (if good)

Crops	Parcel 1	2	3	4	5	6	7	8
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								

Conversion: 1 .... (local unit) of product 1 = ... kg
1 .... " " 2 = ... kg
1 .... " " 3 = ... kg
1 .... " " 4 = ... kg
1 .... " " 5 = ... kg
1 .... " " 6 = ... kg
1 .... " " 7 = ... kg
1 .... " " 8 = ... kg
1 .... " " 9 = ... kg
1 .... " " 10 = ... kg
1 .... " " 11 = ... kg
1 .... " " 12 = ... kg
1 .... " " 13 = ... kg
1 .... " " 14 = ... kg
1 .... " " 15 = ... kg
1 .... " " 16 = ... kg
1 .... " " 17 = ... kg

Production of each crop (if normal)

Crops	Parcel 1	2	3	4	5	6	7	8
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								

Production of each crop (if bad)

1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	

Total production of type 2 produce per year

Produce	Amount of Production		
	If good	If average	If bad
18			
19			
20			
21			

Conversion : 1 .... (local unit) of produce 18 = ... kg
1 .... " " 19 = ... kg
1 .... " " 20 = ... kg
1 .... " " 21 = ... kg

Marketing activities

Amount of produce sold each week in each month per year.

Type of prod.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												

Production sold at, i) village level/ii) brought to the market place/ iii) both.

How many times per week the farmer goes to the market place?

regular .... times

irregular .... times or .... times.

Transportation cost of commodity to be sold Rp .... per ....

Price of each produce sold

Product	If price good		If price average		If price bad	
	at village level	at market place	at village level	at market place	at village level	at market place
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						

Consumption

Amount of produce consumed each week in each month of the year (physical unit)

Prod.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												

Amount of food items bought each week in each month of the year (physical unit)

Food items	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												

Prices of each food item bought by the farmer (Rp.)

Food item	Prices
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Usual breakfast time ....

Usual lunch time ....

Usual dinner time ....

What is the equivalent amount of rice, taro, sweet potato, and sago needed to be consumed during breakfast, lunch, and dinner to keep an adult male worker doing regular physical jobs up to subsequent dining time.

Food item	Amount taken during		
	Breakfast	Lunch	Dinner
Rice			
Taro			
Sweet potato			
Sago			
idem for adult woman			
Rice			
Taro			
Sweet potato			
Sago			
idem for children 10-14 years old			
Rice			
Taro			
Sweet potato			
Sago			

For children of 5-9 years old

Food item	Amount taken during Breakfast	Lunch	Dinner
Rice			
Taro			
Sweet potato			
Sago			
idem for children of 2-4 years old			
Rice			
Taro			
Sweet potato			
Sago			
idem for children or less than one year old			
Rice			
Taro			
Sweet potato			
Sago			

Farm tools

Tool	Nr owned	Year bought	Price when bought	price now	Average life year
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					

Animal husbandry

Type of animal	Nrs owned	
	Male	Female
Chicken		
Pig		
Goat		
Cattle		

Fish ponds: Nrs .... Area: .... Ha Yield/year: ....

Housing condition

Roof made of .... Approximate

Floor made of .... value: Rp. ....

Wall made of ....

Furnitures	Nrs	Year bought or made	Value (Rp.)
1			
2			
3			
4			
5			
6			
7			

Type of vehicle owned	Nrs	Year bought	Value (Rp.)	Life year
1				
2				
3				

Family needs for off-farm non-food goods and services

Service items	Minimum frequency	Cost/ unit (Rp.)	Total cost (Rp.)	Maximum frequency	Total cost (Rp.)
1					
2					
3					
Goods items	Minimum amount	Cost/ unit (Rp.)	Total cost (Rp.)	Maximum amount	Total cost (Rp.)
4					
5					
6					
7					
8					
9					
10					

Lending and borrowing of farm products

Crops	The amount lent	The amount borrowed
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		

<u>Elicitation of farmer's subjective probabilities for yield and market condition</u>

Ask, which factors according to his experience affecting yield variability

Crops	Factors affecting yield variability
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	

Let the farmer distribute 20 matches according to his belief that yield will be good, normal or bad.

Nr out of 20		
Good	Normal	Bad
....	....	...

Percentage of total products that can be sold at good, normal and bad market conditions according to farmer's own experience.

Crops	Market		
	Good	Normal	Bad
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			

Let the farmer distribute 20 matches according to his belief that market conditions will be good, normal or bad.

Nr out of 20		
Good	Normal	Bad
....	....	...

Table A2.1

Area of Each Perennial Crops in the Sample Farms in Nimboran in 1979/80 Production Period

Farm Nr	Area of Crops (Ha)			
	Sago	Coconuts	Betelnuts	Cocoa
1	2.25	0.0486	0.0192	0.550
2	1.00	0.1620	0.0200	0.500
3	0.25	0.0972	0.0350	0.570
4	1.25	0.0972	0.0260	0.570
5	2.25	0.0639	0.0580	0.750
6	2.25	0.1798	0.0290	0.250
7	4.00	0.4050	0.0380	0.625
8	1.00	0.0243	0.0240	1.000
9	0.16	0.4050	0.0190	1.000
10	-	0.2430	0.0320	-
11	0.50	0.0972	0.0080	0.125
12	0.25	0.5000	0.0560	0.750
13	1.00	0.1700	0.0190	0.250
14	2.00	0.2672	0.0080	0.450
15	1.16	1.3550	0.2835	0.072
16	1.60	0.5000	0.0530	-
17	1.60	0.5000	0.0450	-
18	1.75	0.0973	0.0220	-
19	1.00	0.0768	0.0580	-
20	0.75	0.5000	0.0430	-
21	0.75	0.0339	0.0580	-
22	1.25	0.0256	0.0190	-
23	1.00	0.1129	0.0480	-
24	1.25	0.1296	0.0800	-
25	1.75	1.0000	0.0400	-
26	0.50	0.1129	0.0080	-
27	1.75	0.0740	0.0350	-
28	1.50	0.0467	0.0580	2
29	0.76	0.0876	0.0260	-
30	1.60	0.5000	0.0800	-
Average	1.27	0.2638	0.0449	0.631
SD	0.81	0.3026	0.0491	0.470

SD = Standard deviation.

Table A2.2

Area of Each of the Main Annual Crops in the Sample Farms in Nimboran in 1979/80 Production Period

Farm Nr	Area of Crops (ha)				
	Xanthosoma	Yam	Amaranthus	Banana	Corn
1	0.0255	0.0072	0.018	0.110	0.0065
2	0.0903	0.0176	0.024	0.070	0.0115
3	0.0416	0.0085	0.004	0.036	0.0043
4	0.0419	0.0054	0.002	0.043	0.0028
5	0.1065	0.0306	0.0108	0.023	0.0093
6	0.0951	0.0223	0.0072	0.044	0.0068
7	0.0554	0.0122	0.0064	0.032	0.0084
8	0.0272	0.0122	0.025	0.050	0.0048
9	0.0145	0.0081	0.010	0.032	0.0153
10	0.0098	0.0061	0.024	0.120	0.0155
11	0.0502	0.0162	0.0108	0.058	0.0088
12	0.0392	0.0464	0.0054	0.048	0.0068
13	0.0794	0.0093	0.009	0.110	0.0029
14	0.0334	0.0135	0.0048	0.110	0.0068
15	0.0477	0.0312	0.0088	0.120	0.0090
16	0.0806	0.0158	0.0192	0.130	0.0061
17	0.0349	0.0243	0.0066	0.144	0.0112
18	0.0279	0.0297	0.0054	0.160	0.0097
19	0.0500	0.0279	0.0156	0.043	0.0068
20	0.0146	0.0186	0.0143	0.064	0.0047
21	0.0685	0.0213	0.0096	0.084	0.0163
22	0.0253	0.0118	0.0099	0.027	0.0086
23	0.0277	0.0087	0.0117	0.106	0.0155
24	0.0709	0.0036	0.0072	0.020	0.0063
25	0.0344	0.0279	0.0077	0.080	0.0243
26	0.0112	0.0158	-	0.032	0.0047
27	0.0311	0.027	0.0035	0.026	0.0045
28	0.0898	0.01495	0.0081	0.054	0.0081
29	0.0781	0.01855	0.006	0.014	0.0086
30	0.0693	0.03635	0.0104	0.036	0.0127
Average	0.0491	0.0183	0.0105	0.068	0.0089
SD	0.0275	0.0103	0.0062	0.042	0.0047

Table A2.3

Total Available Land (Ha), Total Area in Crops (Ha) and its Fragmentation of each Sample Farm in Nimboran in 1979/80 Production Period

Farm Nr	Available land (Ha)	Total area in crops (Ha)	Nr of parcels of land in crops (fragmentation)
1	15.00	3.4900	6
2	15.00	2.3200	5
3	5.50	4.0500	4
4	6.00	2.4100	5
5	12.00	3.6000	4
6	18.00	3.2540	5
7	18.00	5.4750	4
8	5.00	3.0200	6
9	5.00	1.8300	5
10	5.00	3.5000	1
11	15.00	2.2050	5
12	5.00	1.9900	5
13	5.00	1.9500	5
14	15.00	3.0700	5
15	8.50	3.2850	5
16	15.00	2.7300	5
17	15.00	2.5700	6
18	15.00	2.4000	6
19	15.00	1.6200	3
20	15.00	1.8300	7
21	15.00	1.7800	4
22	15.00	1.5600	4
23	15.00	1.7850	5
24	15.00	2.3600	8
25	6.00	2.7000	4
26	15.00	2.0700	4
27	15.00	2.1000	9
28	15.00	4.0000	7
29	5.00	1.3200	4
30	15.00	2.5600	7
Average	12.97	2.6278	5.1
SD	4.72	0.9121	1.5

SD = Standard deviation.

Table A2.4

Total Male Labour Time Spent for Shifting Cultivation on Each Sample Farm in Nimboran in 1979/1980 Production Period

Farm Nr	(Man-hours)			
	Land clearing	Planting	Nursing	Harvest and selling
1	632	48	4	260
2	648	168	4	260
3	664	168	12	1560
4	616	168	8	520
5	552	504	12	1040
6	600	192	8	1040
7	608	208	4	624
8	252	40	4	312
9	184	336	8	1248
10	992	192	8	2496
11	296	168	4	624
12	304	208	4	520
13	156	252	4	624
14	108	126	4	520
15	408	144	8	1040
16	384	480	8	1560
17	480	720	12	2340
18	672	468	12	1560
19	400	216	8	1248
20	288	320	8	1040
21	544	84	4	780
22	232	126	4	520
23	182	48	4	936
24	336	384	16	4992
25	264	624	12	1872
26	152	168	4	260
27	312	90	4	936
28	208	156	4	936
29	320	320	8	1040
30	420	288	12	1872
Average	407	247	7.2	1153
SD	207	169	3.5	936

Table A2.5

Total Female Labour Time Spent for Shifting Cultivation on Each Sample Farm in Nimboran During 1979/80 Production Period

Farm Nr	(Man-hours)			
	Land clearing	Planting	Nursing	Harvest and selling
1	89.40	57.60	6.4	2575.73
2	253.60	201.60	12.8	4682.94
3	138.40	167.20	6.4	1202.55
4	376.80	134.40	12.8	2878.20
5	202.00	268.80	12.8	2972.50
6	136.60	76.80	6.4	1031.05
7	127.80	166.40	6.4	874.15
8	267.20	132.00	6.4	637.75
9	83.20	268.80	12.8	3041.80
10	793.20	153.60	12.8	2298.50
11	244.60	134.40	6.4	1106.05
12	251.00	166.40	6.4	982.25
13	148.00	201.60	6.4	848.65
14	170.40	201.60	12.8	2452.50
15	259.20	172.80	19.2	4773.24
16	202.40	384.00	12.8	2561.90
17	202.40	384.00	12.8	2777.70
18	202.40	249.60	12.8	2822.30
19	202.40	172.80	12.8	3154.50
20	202.40	256.00	12.8	2974.90
21	151.20	167.20	6.4	1360.65
22	89.60	100.80	6.4	1494.65
23	358.40	153.60	25.6	6271.19
24	202.40	153.60	12.8	2623.90
25	128.00	665.60	25.6	6363.99
26	89.60	134.40	6.4	1148.45
27	202.40	144.00	12.8	2739.50
28	89.40	124.80	6.4	1031.45
29	202.40	256.00	12.8	2979.50
30	128.00	307.20	25.6	3993.60
Average	206.49	205.25	11.73	2555.20
SD	133.18	117.05	5.84	1511.94

Table A2.6

Total Male Labour Time Spent for Each Perennial Crop Production on Each Sample Farm in Nimboran During 1979/80 Production Period

Farm Nr	(Man-hours)			
	Sago	Coconuts	Betelnuts	Cocoa
1	192	31	69	27.0
2	288	189	71	54.0
3	240	28	65	34.1
4	288	39	51	23.1
5	240	29	81	22.0
6	288	205	60	25.0
7	144	391	33	23.1
8	360	188	40	95.1
9	270	49	40	25.9
10	240	213	83	-
11	120	68	131	34.6
12	180	147	117	29.0
13	432	112	48	34.6
14	504	64	82	29.8
15	192	160	86	31.7
16	360	183	80	-
17	288	93	65	-
18	360	88	83	-
19	144	69	102	-
20	240	61	112	-
21	144	30	83	-
22	144	20	99	-
23	576	123	187	-
24	576	137	102	-
25	240	134	124	-
26	256	147	77	-
27	576	63	88	-
28	540	38	85	6
29	216	74	123	-
30	432	156	105	-
Average	302	111	86	33
SD	140	80	32	20

Table A2.7

Total Female Labour Time Spent for Each Perennial Crop Production on Each Sample Farm in Nimboran During 1979/1980 Production Period

Farm Nr	(Man-hours)			
	Sago	Coconuts	Betelnuts	Cocoa
1	204.8	40	34	63.0
2	307.2	141	35	126.0
3	256.0	37	33	79.5
4	307.2	51	26	53.7
5	256.0	38	40	50.0
6	307.2	273	30	59.0
7	153.6	522	16	53.7
8	384.0	251	20	221.7
9	288.0	65	20	60.5
10	256.0	284	42	-
11	192.0	90	66	80.6
12	192.0	197	58	67.0
13	460.8	150	24	80.6
14	806.4	86	41	69.4
15	204.8	214	43	73.9
16	394.0	245	40	-
17	307.2	123	33	-
18	394.0	117	42	-
19	153.6	93	51	-
20	256.0	82	56	-
21	153.6	40	41	-
22	153.6	26	49	-
23	614.4	163	94	-
24	614.4	182	51	-
25	256.0	179	62	-
26	307.2	195	39	-
27	614.4	83	44	-
28	576.0	50	42	-
29	230.4	98	61	-
30	460.8	203	53	-
Average	335.3	144	43	76
SD	167.2	105	16	48

Table A2.8

Total Female Family Labour Available and Use
on 30 Nimboran Farms During 1979/1980

	Female Family Labour (man-hours)	
No.	Available	Used
1	3071	3071
2	5760	5760
3	1920	1920
4	3840	3840
5	3840	3840
6	1920	1920
7	1920	1920
8	1920	1920
9	3840	3840
10	3840	3840
11	1920	1920
12	1920	1920
13	1920	1920
14	3840	3840
15	5760	5760
16	3840	3840
17	3840	3840
18	3840	3840
19	3840	3840
20	3840	3840
21	1920	1920
22	1920	1920
23	7680	7680
24	3840	3840
25	7680	7680
26	1920	1920
27	3840	3840
28	1920	1920
29	3840	3840
30	7680	5171
Average	3622	3538
SD	1775	1630

Table A2.9

Total Products of Perennial Crops which are Directly Consumed by Each Sample Farm Household During 1979/1980 Production Period

Farm Nr.	Sago (kg)	Coconuts (Nr of nuts)	Betelnuts (Nr of bunches)
1	260	188	52.0
2	520	230	60.0
3	400	208	52.0
4	260	214	52.0
5	300	178	104.0
6	520	324	182.0
7	180	455	52.0
8	130	244	52.0
9	260	188	122.0
10	260	188	52.0
11	520	172	73.0
12	520	230	182.0
13	910	188	52.0
14	520	214	18.0
15	910	485	182.5
16	520	449	122.0
17	910	188	52.0
18	1040	224	52.0
19	520	172	122.0
20	910	136	183.0
21	520	224	52.0
22	260	136	122.0
23	520	276	365.0
24	1560	230	122.0
25	910	240	183.0
26	910	449	122.0
27	840	230	183.0
28	1000	224	52.0
29	520	172	183.0
30	520	290	183.0
Average	598	245	112.85
SD	326	95	73.65

Table A2.10

Total Products of Perennial Crops which are Sold from Each Sample Farm During 1979/1980 Production Period

Farm Nr	Sago (kg)	Coconuts (Nr of fruits)	Betelnuts (Nr of bunches)	Cocoa (kg)
1	0	0	0	117
2	0	0	0	115
3	0	0	0	130
4	0	0	0	120
5	0	0	0	88
6	0	260	0	79
7	0	500	0	104
8	0	480	0	350
9	0	150	0	142
10	0	600	30	-
11	0	250	0	124
12	0	375	0	120
13	0	360	0	76
14	0	0	32	115
15	150	250	0	190
16	0	450	0	-
17	0	260	0	-
18	110	390	0	-
19	0	260	0	-
20	20	135	0	-
21	0	0	0	-
22	40	0	0	-
23	0	286	0	-
24	20	333	0	-
25	120	168	6	-
26	0	0	0	-
27	0	120	0	-
28	600	40	7	0
29	0	240	0	-
30	150	240	0	-
Average	40	204.9	2.5	134
SD	115	178.7	7.9	68

Table A2.11

Total Products of Annual Crops which are Consumed by each Sample Farm Household During 1979/1980 Production Period

Farm Nr	Xanthosoma (kg)	Yam (kg)	Amaranthus (kg)	Banana (Nr of combs)	Corn (kg)
1	360.0	100	30.0	312	40
2	916.7	180	60.0	780	20
3	360.0	100	13.5	240	20
4	490.0	100	13.0	750	20
5	1100.0	270	26.0	867	30
6	820.0	180	22.5	864	40
7	410.0	120	9.0	350	20
8	270.0	80	30.0	960	20
9	270.0	80	18.0	768	40
10	180.0	10	19.5	384	20
11	360.0	150	22.5	784	40
12	360.0	270	19.5	416	30
13	1216.7	120	26.0	832	20
14	612.5	160	9.0	416	40
15	550.0	240	26.0	765	30
16	1830.0	60	18.0	2340	20
17	522.8	190	18.0	1872	40
18	732.0	260	19.5	1350	30
19	700.0	260	26.0	1296	30
20	360.0	150	9.0	864	20
21	916.7	230	18.0	750	40
22	540.0	160	9.0	1080	20
23	550.0	120	13.5	1350	20
24	1220.0	60	18.0	900	20
25	700.0	240	18.0	1080	40
26	130.0	160	-	810	20
27	550.0	230	13.5	540	30
28	1224.0	160	19.5	1440	30
29	1100.0	180	19.5	540	20
30	1225.0	300	26.0	357	20
Average	686.0	164.	20.3	869	28
SD	398.0	74.	9.8	470	9

Table A2.12

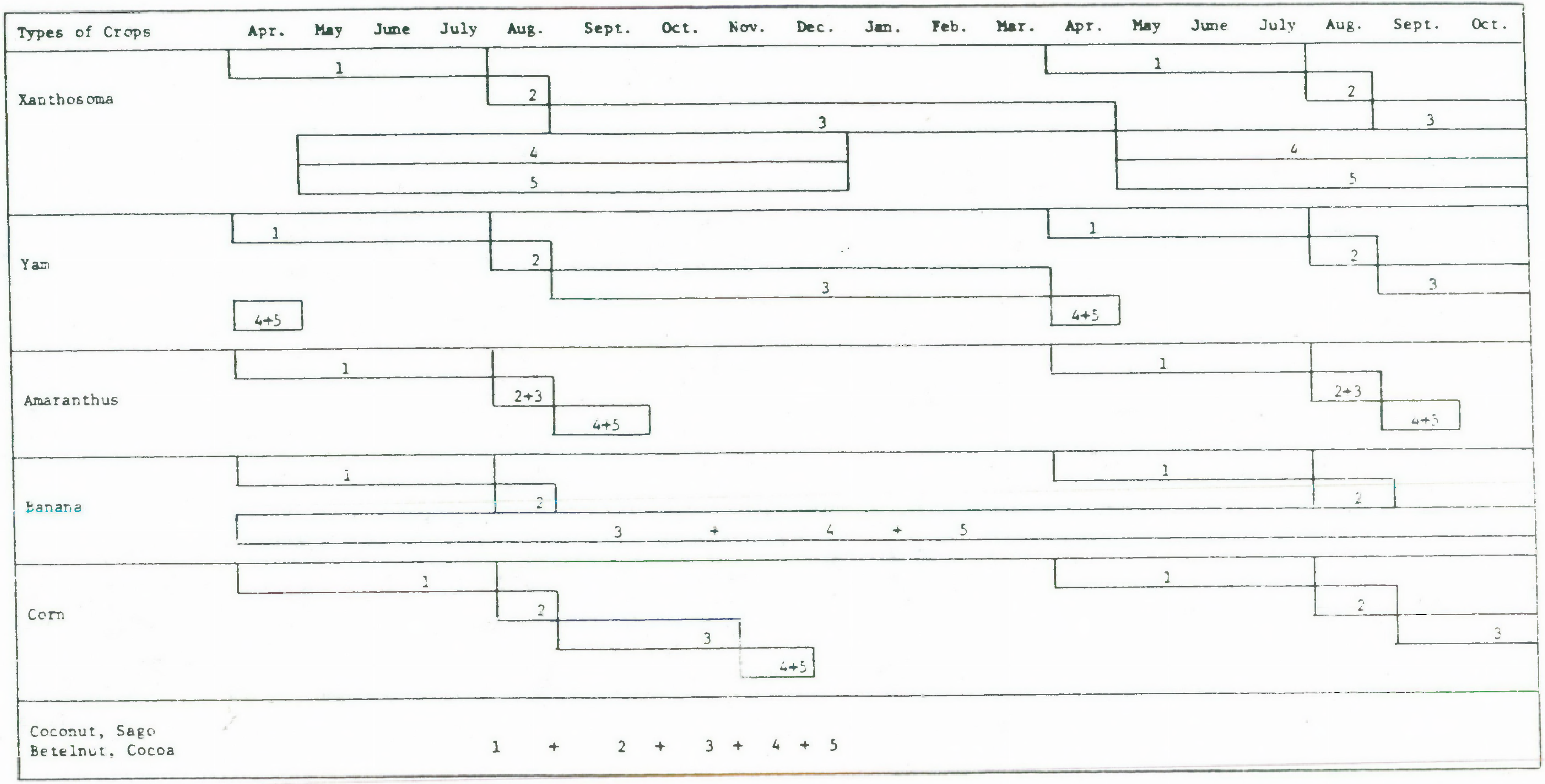
Total Products of Annual Crops which are Sold from each Sample Farm During 1979/1980 Production Period

Farm Nr	Xanthosoma (kg)	Yam (kg)	Amaranthus (kg)	Banana (Nr of combs)	Corn (kg)
1	0	0	0	45	0
2	160.00	0	0	24	20
3	0	0	0	104	0
4	0	0	0	250	0
5	0	0	0	288	0
6	0	0	0	200	0
7	0	0	10.0	255	40
8	60.00	15	20.0	80	0
9	0	0	26.0	60	40
10	0	0	30.0	1500	80
11	601.20	0	15.0	250	0
12	360.00	40	0	400	0
13	868.40	0	0	240	0
14	0	0	0	288	0
15	0	0	0	40	20
16	0	0	15.0	648	20
17	0	0	13.5	1080	0
18	0	0	0.0	648	0
19	0	0	9.5	250	0
20	0	0	17.0	50	0
21	0	0	0.0	250	0
22	0	0	6.0	720	0
23	0	0	15.0	900	40
24	0	0	7.5	324	20
25	0	0	15.0	81	60
26	0	0	0.0	0	0
27	0	0	0.0	35	0
28	0	0	10.0	72	5
29	0	0	12.0	432	20
30	0	0	20.0	30	40
Average	68.32	1.8	8.1	318	13.5
SD	197.77	7.7	9.0	353	21.1

Table A2.13

Conversion Figures from Local to I.S.U. Weight Measures Used in This Study

Crop	Local measurement	Common measurement
Xanthosoma	One noken (= 5 tumpuk)	7.5 - 16. kg
Yam	One noken	7.5 - 16. kg
Amaranthus	One bunch	046 - 0.57 kg (± .35 kg edible)
Corn	One noken One bag (± 2 noken = ± 250 cobs)	± 10 kg ± 20 kg



Notes: 1 = land clearing; 2 = planting; 3 = nursing; 4 = harvest; 5 = selling.

Diagram A2.1: Distribution of Activities in One Year Associated with the Main Crop Cultivated on the Representative Farm in Nimboran, Irian Jaya.

APPENDIX III

Results of Utility Analysis

Elicited Data for Farm Household Nr. 5

CE (Rp)	Utility
10,530	0
26,325	50
47,385	75
68,445	87.5
157,952	93.75
421,200	96.875
789,750	98.4374

Elicited Data for Farm Household Nr. 9

CE (Rp)	Utility
10,530	0
65,812	50
89,505	87.5
184,275	93.75
526,500	96.875
789,750	98.4375

Elicited Data for Farm Household Nr. 15

CE (Rp)	Utility
10,530	0
81,607	50
394,875	75
631,800	87.5
737,100	93.75

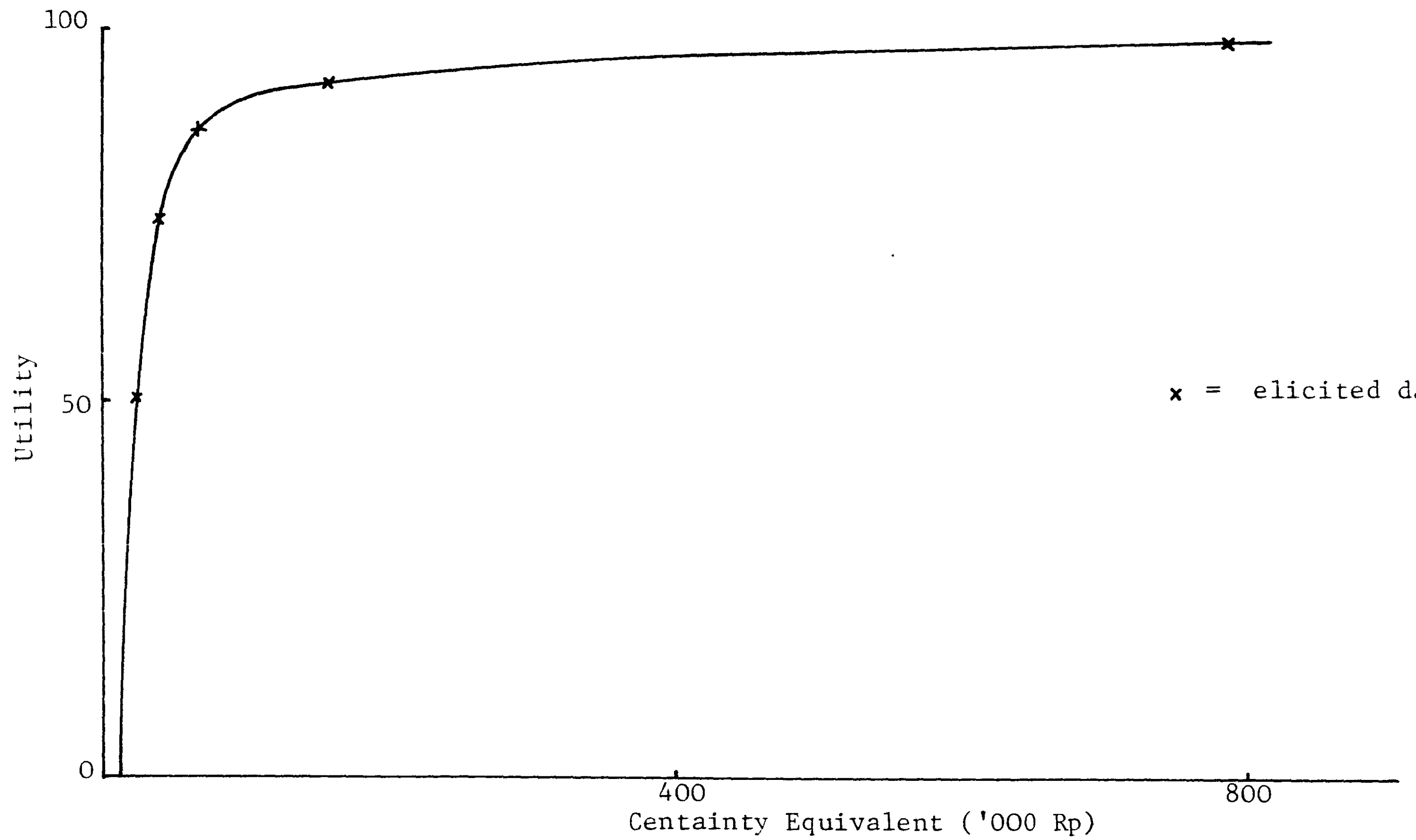


Figure A3.1: Elicited Utility Function for Expected NCI of Farm Household Nr. 5.

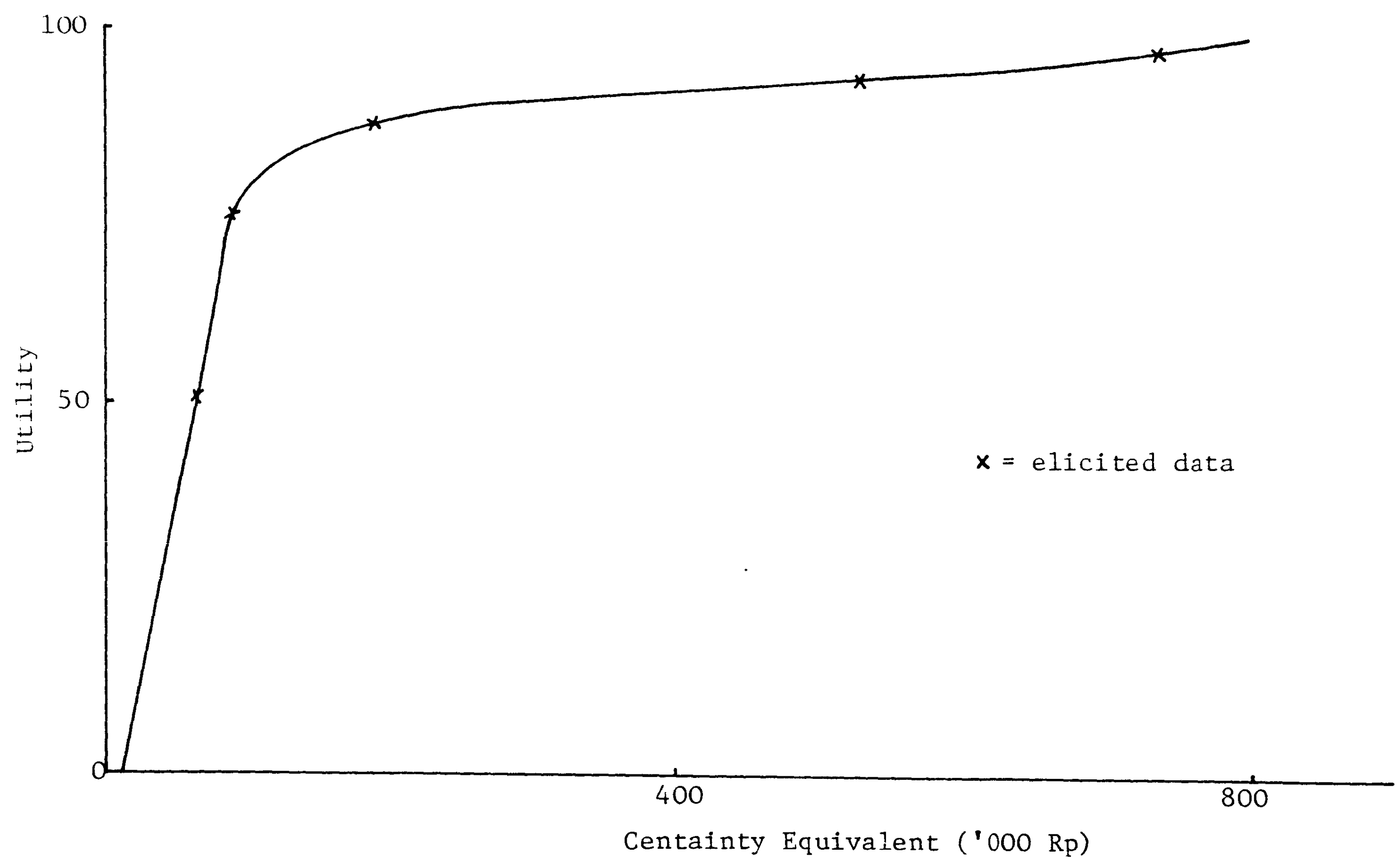


Figure A3.2: Elicited Utility Function for Expected NCI of Farm Household Nr. 9.

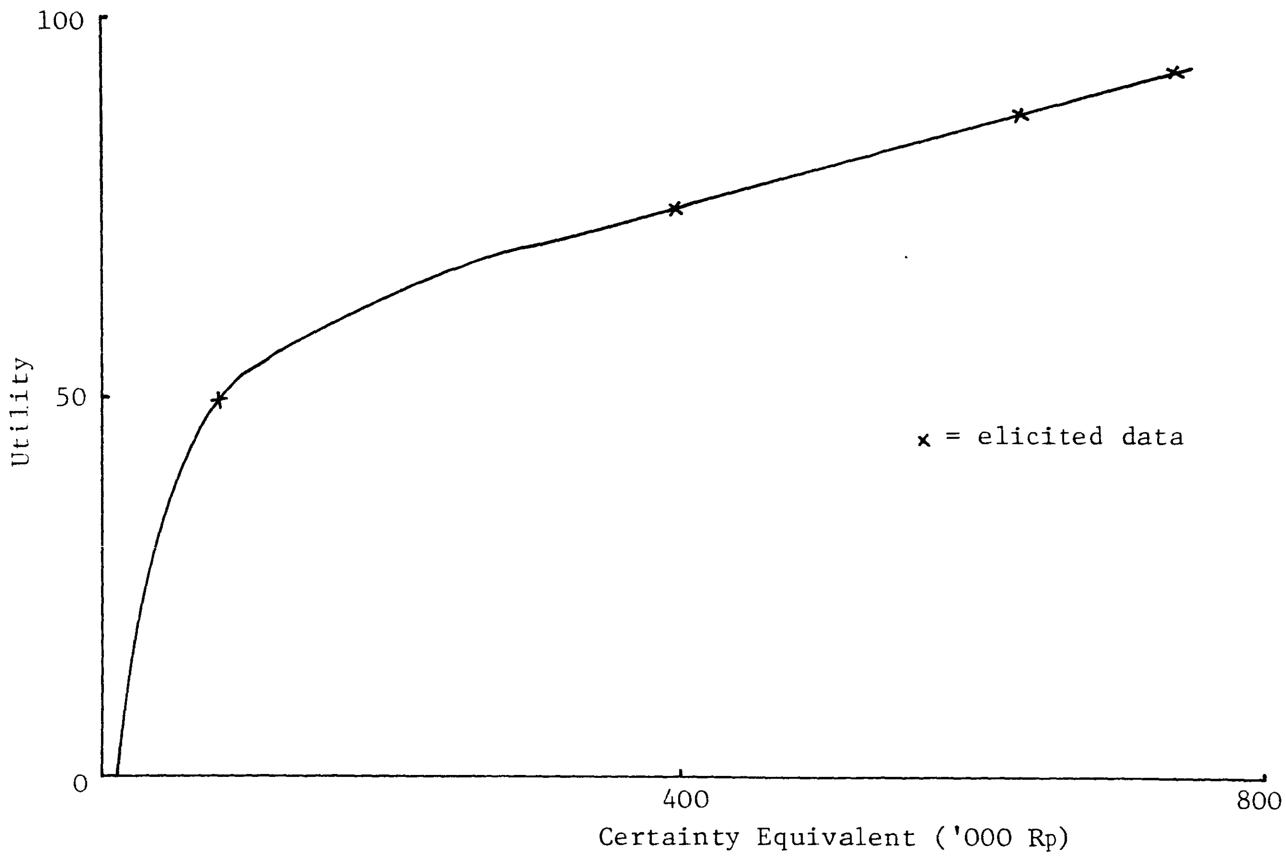


Figure A3.3: Elicited Utility Function for Expected NCI of Farm Household Nr. 15.

Elicited Data for Farm Household Nr. 23

CE (Rp)	Utility
10,530	0
105,300	50
289,575	75
579,150	87.5
684,450	93.75
789,750	96.875

Elicited Data for Farm Household Nr. 29

CE (Rp)	Utility
10,530	0
39,487	50
63,180	75
100,035	87.5
236,425	93.75
658,125	96.875
829,237	98.4375

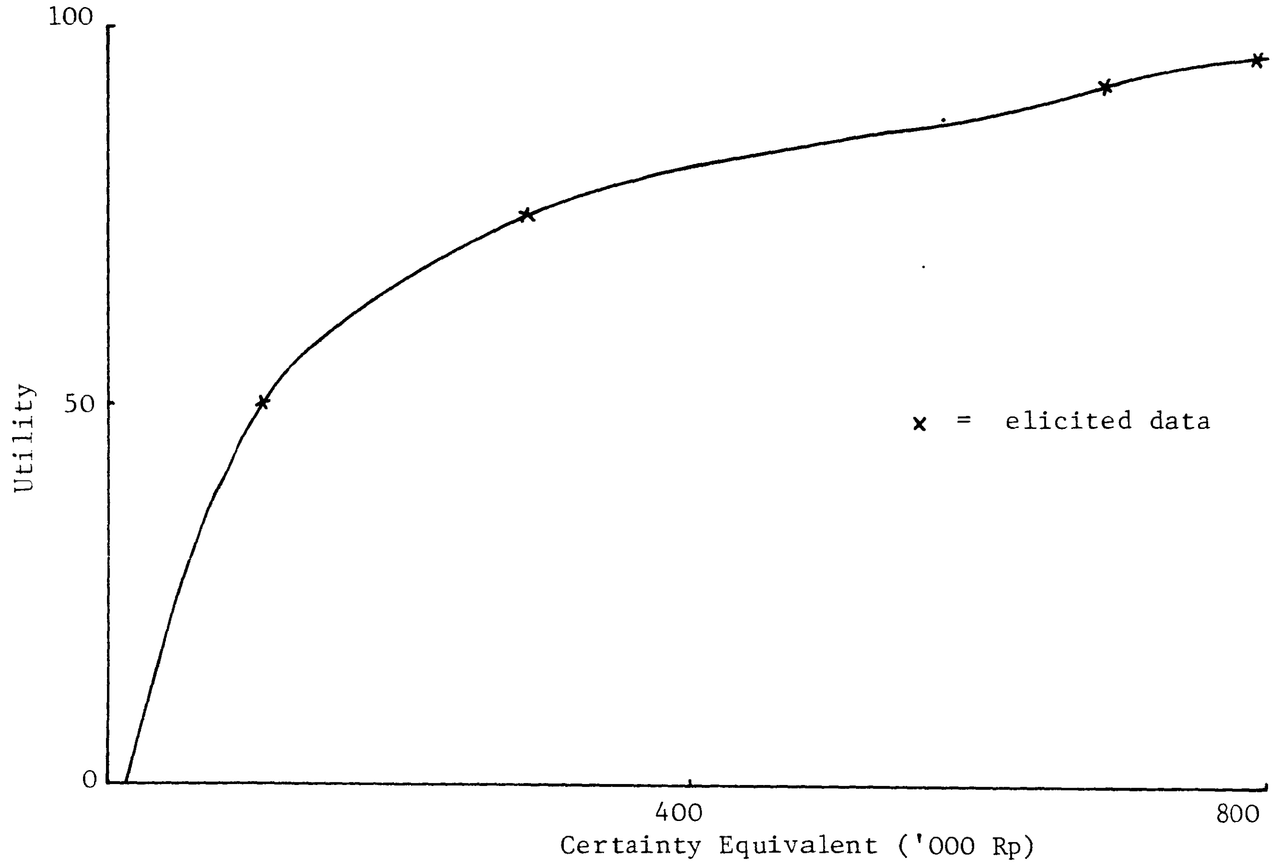


Figure A3.4: Elicited Utility Function for Expected NCI of Farm Household Nr. 23.

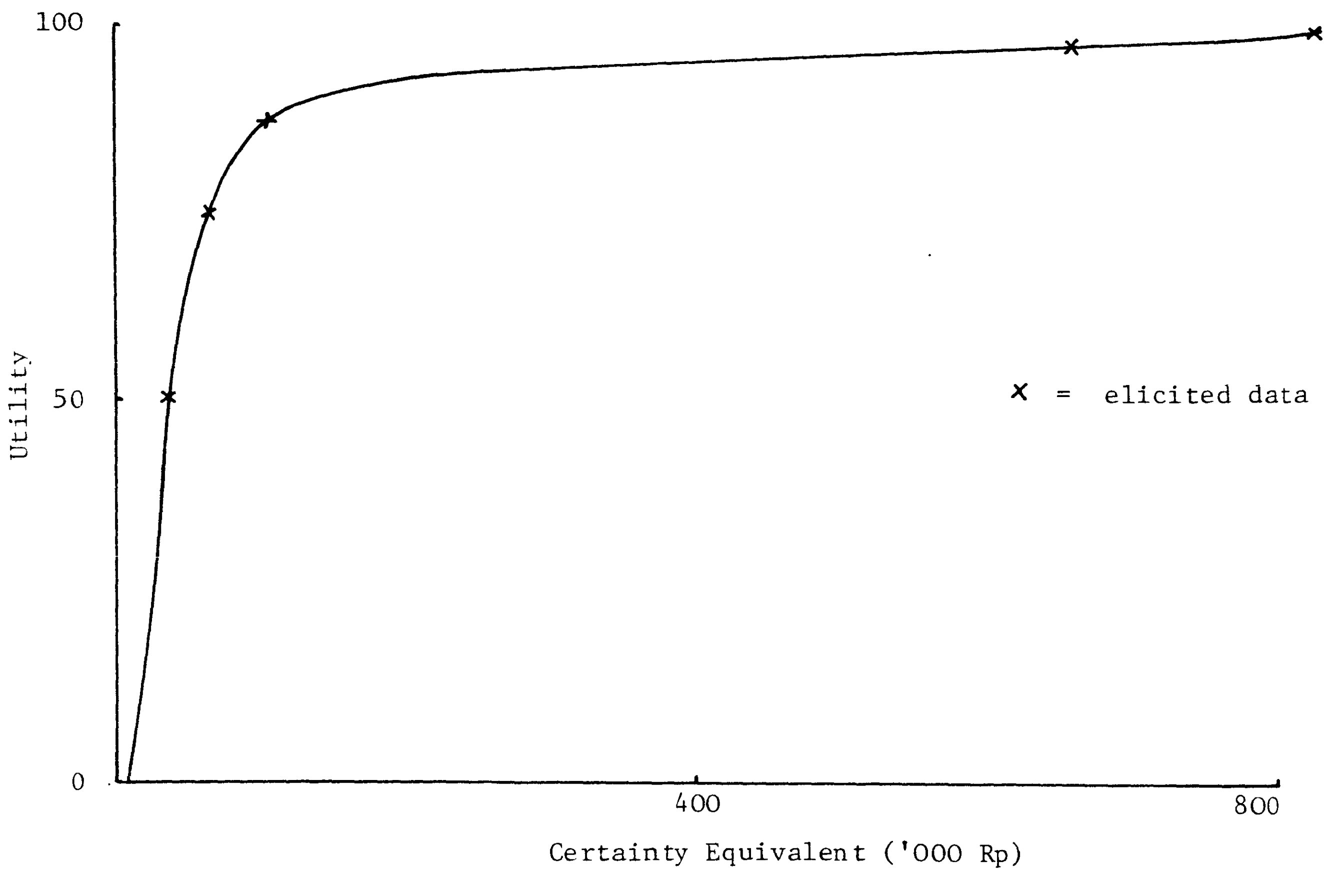


Figure A3.5: Elicited Utility Function for Expected NCI of Farm Household Nr. 29.

APPENDIX IV

Subjective Probabilities

Table A4.1

Nimboran Farmer's Probability Distributions of the Compound Events of Yield and Sales Quantity in 1979/1980

No.	Probabilities that								
	$Y_g M_g$	$Y_g M_n$	$Y_g M_b$	$Y_n M_g$	$Y_n M_n$	$Y_n M_b$	$Y_b M_g$	$Y_b M_n$	$Y_b M_b$
1	0.060	0.130	0.100	0.110	0.220	0.170	0.050	0.090	0.070
2	0.040	0.060	0.040	0.140	0.240	0.150	0.090	0.150	0.090
3	0.046	0.146	0.049	0.095	0.299	0.100	0.051	0.160	0.054
4	0.018	0.059	0.038	0.099	0.330	0.212	0.038	0.126	0.081
5	0.040	0.150	0.080	0.080	0.300	0.160	0.030	0.110	0.050
6	0.050	0.171	0.074	0.083	0.282	0.120	0.040	0.130	0.050
7	0.035	0.153	0.071	0.076	0.333	0.155	0.024	0.104	0.049
8	0.020	0.160	0.070	0.050	0.340	0.160	0.020	0.120	0.060
9	0.045	0.190	0.095	0.060	0.270	0.130	0.030	0.120	0.060
10	0.037	0.140	0.052	0.100	0.366	0.139	0.028	0.103	0.039
11	0.040	0.160	0.070	0.090	0.360	0.160	0.020	0.070	0.030
12	0.033	0.153	0.087	0.065	0.303	0.173	0.022	0.104	0.060
13	0.035	0.229	0.086	0.039	0.253	0.095	0.026	0.173	0.065
14	0.035	0.197	0.086	0.042	0.237	0.10[illegible]	0.033	0.186	0.081
15	0.069	0.135	0.061	0.139	0.273	0.12[illegible]	0.052	0.102	0.046

Table continued...

Table A4.1 continued

No.	Probabilities that $Y_g M_g$	$Y_g M_n$	$Y_g M_b$	$Y_n M_g$	$Y_n M_n$	$Y_n M_b$	$Y_b M_g$	$Y_b M_n$	$Y_b M_b$
16	0.084	0.136	0.060	0.161	0.259	0.115	0.056	0.090	0.040
17	0.06	0.250	0.091	0.070	0.290	0.110	0.02	0.080	0.032
18	0.046	0.177	0.072	0.081	0.315	0.12[illegible]	0.028	0.108	0.044
19	0.048	0.203	0.059	0.087	0.367	0.106	0.[illegible]2	0.085	0.025
20	0.067	0.223	0.094	0.072	0.238	0.100	0.036	0.119	0.051
21	0.047	0.206	0.082	0.062	0.271	0.108	0.032	0.138	0.055
22	0.029	0.139	0.062	0.081	0.390	0.174	0.016	0.076	0.034
23	0.031	0.171	0.068	0.062	0.343	0.135	0.022	0.121	0.048
24	0.026	0.15[illegible]	0.043	0.070	0.397	0.113	0.024	0.137	0.039
25	0.049	0.186	0.040	0.092	0.344	0.074	0.039	0.145	0.031
26	0.02	0.100	0.050	0.070	0.320	0.160	0.040	0.160	0.080
27	0.03	0.130	0.050	0.060	0.300	0.130	0.040	0.190	0.080
28	0.02	0.090	0.030	0.090	0.450	0.150	0.020	0.110	0.040
29	0.02	0.110	0.050	0.070	0.341	0.143	0.032	0.164	0.070
30	0.05	0.110	0.030	0.130	0.300	0.100	0.070	0.160	0.050

Notes: Y_g = Yield good; Y_n = Yield normal; Y_b = Yield bad; M_g = Market good; M_n = Market normal; M_b = Market bad.

APPENDIX V

Natural Conditions in Nimboran

Natural Conditions in Nimboran

1. Topography

Nimboran valley - which is also called Grime river plain - is part of a vast coastal plain which stretches along the North-eastern coast of Irian Jaya from Mamberamo river up to the border with Papua New Guinea. On the North, this valley is bounded by the so called 'A' mountain range, and to the South by the Nimboran mountain range. According to Wiradi and Handjojo (1962) who reviewed the report of the Wentholt expedition, the whole valley, about 33 000 ha, is divided into six terraces ascending from the West to South-east. The lowest terrace, about 19 800 ha, is almost flat and covers mainly with swamp forest. The second terrace, about 3 400 ha, lies South-east to the first one, and is about 10 m higher. The third, fourth, fifth and sixth terraces are about 1 000, 4 700, 2 200 and 1 900 hectares respectively.

2. Soil Condition

Based on the result of the Wentholt expedition as reviewed by Wiradi and Handjojo (1962), five soil types are found in Grime river plain. First, low humic gley soil, is found in the first and second terrace. The Western portion of the region is mostly flooded, rich in Phosphorous, Potash, Calcium and Magnesium, and therefore has a heavy texture. Second, brown latosol, is found in the sixth terrace. Its texture contains clay, it has a thin layer, and contains stones. Potash and Phosphorous are deficient. Third, grumosol, is found in the fifth terrace. It has a thin layer and contains gravel and stones. Fourth, humic gley soil, is found in most Eastern parts of the fifth terrace. The area is mostly flooded. It is rich in organic matter, Potash, Calcium, Magnesium, and Phosphorous. Fifth, yellow red mediteran, is found in third, fourth, and fifth terraces. It has a thick layer, and is rich in organic matter, Potash, Calcium and Magnesium.

The Nimboran sub-regency, which is taken as the study region, covers the first, second, third, fourth, and part of the fifth terraces. Later soil surveys in this region were concentrated on the second, third and fourth terraces, where soil texture is heavy and consists of silty clay and silty clay loam. It was also found that Potash is deficient.

3. The Climate

Average figure of rainfall, humidity, temperature and sunshine duration, is shown in Table A5.1. It can be cited briefly that in one year, two particular seasons can be distinguished in Nimboran: the rainy season, which starts in late October and reaches its peak in December, January and February, and dry season, which starts in late April and reaches its peak in July and August.

4. River System

Plenty of rivers run crossing this plain, which form part of two river systems. First, Sermoway and its tributaries on the West, and second, Moaif river and its tributaries, where Grime river is one of them. Grime and its tributaries, however, are the most important in that they run through the occupied areas, and are the main water resources for the people in this region.

Table A5.1

Climatological Data for Nimboran Region as Recorded in Genyem

Months	Average 1969 - 1978		Average 1976 - 1978		
	Rainfall (mm)	Rainy days	Temperature (oC)	Relative humidity (%)	Sunshine duration (%)
January	278	15	25.9	90	32
February	216	12	25.9	90	33
March	221	14	26.1	90	31
April	278	13	26.3	89	35
May	152	9	26.8	87	46
June	127	8	26.4	88	50
July	90	8	26.4	86	46
August	128	9	26.0	88	42
September	123	10	26.3	87	50
October	162	12	26.3	86	41
November	168	11	26.1	86	43
December	315	16	26.0	88	36

Note: Sunshine Duration is Recorded Between 8 a.m. and 6 p.m. and Measured in Per cent from Total nrs of Hours, i.e. 10 Hours a Day.

Source: Meteorology and Geophysical Office, Genyem, 1980.

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