MOTIVATION AND THE RESPONSE TO ECONOMIC INCENTIVE: A CASE STUDY OF THE SEAQAQA SUGAR DEVELOPMENT PROJECT, FIJI

by

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Except where otherwise acknowledged in the text, this thesis represents the original research of the author.

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ABSTRACT

MOTIVATION AND THE RESPONSE TO ECONOMIC INCENTIVE: A CASE STUDY OF THE SEAQAQA SUGAR DEVELOPMENT PROJECT, FIJI.

This study seeks to identify factors influencing the response of traditional farmers to economic incentive. The Seaqaqa Sugar Development Project is used as a case study. A stratified sample of 60 of the families participating in the project was selected, and data were collected in Seaqaqa from July 1977 to July 1978. However, difficulties with the responses of three families meant that only 57 were included in the subsequent analysis.

The Seaqaqa Project Administration had introduced a system of incentives and disincentives designed to encourage family commitment to the cash crop - sugar cane. This was in accordance with the official view that the performance of settlers could be judged in terms of cane output. Families, however, appeared to judge their own performance in terms of a larger number of variables and had not always reacted to the official incentives in the manner that was expected. In this thesis the impact of these policies on family labour inputs to the cash crop is examined.

The analysis is based on a neo-classical model adapted to include the impact of time on decision making. It revealed that some of the incentives would in fact have discouraged commitment to the commercial economy. In these cases, alternatives are suggested.

In the discussion it emerged that the perceived marginal productivity of labour in cane production, and the subjective rate of time discount, were crucial determinants of household behaviour. Neither could be estimated because of data difficulties, but it is concluded that a multi-period production function study of cane production in Fiji should be undertaken. Suggestions are made for the type of data which needs to be collected for this study. Moreover, a

method of deriving an indicator of time preference for each family from observed behaviour is developed. This could be calculated once a production function of the type described has been estimated, and is likely to prove useful in other situations where there is a choice in allocating inputs between a perennial and an annual crop, both in Fiji and elsewhere.

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CONVENTIONS

Fijian Words.

Fijian words are used only where no suitable substitute is available. Fijian spelling is employed. The pronunciation is the same as in English, except for the following:

b is pronounced	mb
c	th
d	nd
g	ng
q	ng-g

Abbreviations.

The following abbreviations are used.

CCC = Central Coordinating Committee.

CSR = Colonial Sugar Refinery.

FAO = Food and Agricultural Organisation of the United Nations.

FDB = Fijian Development Bank.

FSC = Fiji Sugar Corporation.

LCC = Local Coordinating Committee

MAFF = Ministry of Agriculture Fisheries and Forests.

NLDC = Native Land Development Corporation.

NLTB = Native Land Trust Board.

WFP = World Food Programme.

CHAPTER 1

INTRODUCTION

1.1 The Role of Traditional Agriculture in Development Theory

Traditional agriculture was assigned a passive role in early theories of economic development.[1] The historical experience of rapid industrialisation in the developed countries led to the belief that economic development could proceed through industrialisation in the less developed countries, with agriculture the source of a constant supply of cheap labour to the modern sector. Attention was focussed on import substitution because the presence of imports had demonstrated the existence of accessible markets. After an initial stimulus to industrialisation which would cause income per capita to reach some critical level, growth was expected to be a self sustaining process.

This general formula for economic development met with scant success. Winkleman (1972) argued that special circumstances could explain the progress of the few developing countries which achieved high growth rates - oil in Venezuela, the proximity of Mexico to the United States and the special relationship between Korea and the United States of America, for example. Historical evidence suggested that the formula was either incorrect, or it would take generations to succeed. In the latter case, the problem of poverty in certain sectors, notably traditional agriculture, had to be alleviated in the short run. On the assumption that a policy of development through industrialisation was incorrect, an alternative theory in

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1 A full discussion of the role theorists have envisaged for traditional agriculture in economic development is found in Winkleman (1972).

which traditional agriculture was seen as a motivating force of economic development emerged. Either way, the focus of attention swung more toward the need to foster development in the agricultural sector.

Traditional farmers in many developing countries were engaged mainly in subsistence production and did not have strong links with the cash economy. However, the benefits of trade, specialisation and the division of labour could not accrue fully until there was extensive participation in markets. Planners therefore became concerned with the problem of how to accelerate the transition of people in the traditional sector from "non-monetary self-subsistent economic activity to full activity on the monetized exchange system of the market" (Fisk 1975, p53). Fisk identified four key stages in the transition from subsistence to cash farming. They are:

1. Pure Subsistence in Isolation where there is no contact with the cash sector.

2. Subsistence with Supplementary Cash Production where most needs are met by subsistence activity but some supplementary production is undertaken "in order to secure access to market goods and services" (Fisk 1975, p53). An important feature of this stage is that markets for subsistence produce either do not exist or are not relied on to any great extent.

3. Cash Orientation with Supplementary Subsistence. Most of the producer's effort is concentrated on the cash economy but basic needs are home produced where it pays to do so. Markets for most commodities exist and are widely used.

4. Complete specialisation in the Market where the benefits from specialisation and the division of labour are exploited fully.

Efforts to induce people to move from stage 1 toward stage 4 have ranged from large scale projects such as land resettlement schemes, to less ambitious policies such as price support schemes for individual agricultural commodities. Planners however, often have found responses to these incentives to be disappointing, especially in Melanesia, (Mellor 1969, Fisk 1975). It is important therefore to understand the factors influencing the way farmers respond to the incentives designed to stimulate a movement toward stage 4 of the development process.

1.2 The Seaqaqa Sugar Development Project

Some of the problems involved in the increasing commercialisation of agriculture are studied in this thesis with reference to the Seaqaqa Sugar Development Project, Fiji, an ambitious land resettlement scheme. An aim of the project was to settle eight hundred families on previously uncultivated land, with each family tending at least six hectares of sugar cane. A detailed description of the scheme is found in Chapter 2.

The Seaqaqa region of Fiji was not a traditional cane producing area. Families which had been living in the area before the scheme began, and which were given first priority when blocks were allocated, had been engaged almost totally in subsistence production. However, periodic participation in the cash economy had been necessary, to meet school fees and local taxes for example. This participation was limited either to the sale of subsistence produce in the nearest township or to casual wage labouring opportunities which generally had involved migrating to a cane growing region during the harvesting season to cut cane. Thus, the families which had been living in Seaqaqa before the project began had been in stage 2 of the development process.

Families which were either engaged in full time wage employment or in control of a commercial farm, were not eligible to apply for blocks.[2] These restrictions limited

[2] Sample selection procedures are described in more detail in Chapter 4.

applications to three groups:

a. Fijians who had been living in a village, engaged mainly in subsistence production, but who would have had to participate occasionally in the cash sector to meet expenses such as local taxes.[3]

b. Unemployed rural based Indians who were living on the farms of friends or relatives because they had not been able to obtain wage employment or to lease or buy a farm.[4] These people often provided farm labour in return either for food, or for the right to grow subsistence crops on a portion of the farm. Although they may have been living on semi-commercial cane farms, generally the only cash earning opportunity available was cutting cane during the harvesting season.

c. Unemployed town based Indians and Fijians. This group was traditionally small in Fiji. Fijians tended to return to their villages after a period of unemployment. Indians who had been born in rural areas also generally returned to their place of origin when they could not find employment, and would have been described in the previous section. Many Indians born in towns could find some form of employment in businesses operated by relatives, and in any case were unlikely to apply for a farm in an area as isolated as Seaqaqa.

After the families originally resident in Seaqaqa had been allocated their blocks, a majority of the applicants for the remaining farms came from the first two groups. Most had been involved mainly in subsistence production, supplemented by some cash earning activity, and as such were in stage 2 before becoming involved in the scheme. Some

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3 For convenience, Fijian citizens of Indian origin are called "Indians" throughout the thesis, while those of Melanesian origin are termed "Fijians".

4 Unemployment in Fiji and the problems the land tenure system poses for Indians are described in Chapter 2.

exceptions however existed. Some leaseholders had qualified for blocks by resigning from full time wage employment immediately before submitting applications. Moreover in Chapter 2 it will be shown that the selection criteria were circumvented to the extent that over 15% of the farms were allocated to people holding full time wage employment. These people had been in either stage 3 or stage 4 before the scheme began.

Once a block had been allocated, households were encouraged to plant six hectares of cane for sale to the Fiji Sugar Corporation (FSC). Although farms on average were larger than six hectares to allow for some subsistence production, the attention of the Project Administration was focussed on a household's performance with the commercial crop, cane. A system of incentives and disincentives designed to encourage settlers to spend as much time as possible in cane production was introduced. The system is described fully in Chapter 2 but important features included:

a. A network of extension services which provided information on cane farming techniques, organised the delivery of inputs, and marketed the output of the commercial sector.
b. A loan facility, commonly called the subsistence allowance, designed to meet cash requirements during the time families received no income from cane. In this way it was hoped to prevent settlers from spending too much time in the production of subsistence crops.
c. Extensive loan finance at concessional rates to bring cane land into production.
d. A clause in each tenancy agreement which enabled the Project Administration to evict settlers whose cane farming performance was not satisfactory.

Thus the project was designed to move those families who had been operating in stage 2 into stage 3, where year round commercial cultivation would be supplemented by some subsistence production.

1.3 Objectives of Thesis and Chapter Outline

The scheme commenced late in 1974. After a short period planners became puzzled by wide variations in response to apparently similar incentives. For example, the system of incentives and disincentives was designed to encourage households to apply as much of their labour as possible to cane, yet there were vast differences in the quantities of labour actually applied. In the thesis an attempt is made to study some of the factors involved in this response to economic incentive.

The Seaqaqa project, described in Chapter 2, was too large to allow every household to be studied in detail. A sample survey therefore had to be undertaken, and to this end the period from 1 July 1977 to 30 June 1978 was spent in Fiji. The method of sample selection, and the survey technique that was used are outlined in Chapter 4, and the data that were collected are described in Chapter 5.

Before the survey could begin however, it was necessary to determine what information should be collected. Accordingly previous attempts to understand aspects of the response to economic incentive are reviewed in Chapter 3. From this literature review a number of suggestions for the types of variables likely to influence the behaviour of the traditional farmer were derived. None of the models that were discussed however, were entirely applicable to Seaqaqa, but one suggested by Fisk was adapted and used to analyse the data that were collected. This model, developed in Chapter 6, proved a useful basis for examining the impact of the system of incentives on family labour input to cane.

It is shown that many of the incentives were likely to have the desired effect on labour input, but that both the loan repayment system with its high repayments and short term, and the subsistence allowance, could have discouraged families from applying labour to cane. Subsequent to the period of fieldwork the Project Administration in fact extended the term of the loan and reduced repayments. As for the subsistence allowance, it is suggested in Chapter 6 that a system in which families are paid for some of the labour devoted to producing cane would have achieved the aim of providing households with a cash income, and would have been more effective in directing labour into cane production.

A further conclusion is that some families in Seaqaqa may have had low aspirations for market goods, in which case some of the policies designed to encourage the application of labour to cane production could have had the opposite effect. It therefore is essential that these families be identified and appropriate remedial action be taken. Note is also made where policy implications might have relevance beyond Seaqaqa.

Inherent in the model of Chapter 6 is the fact that farmers in Seaqaqa have the option to combine two types of cultivation in different proportions. One is the production of annual crops, consisting largely of staple foods, and the other is the production of semi-perennial crop, sugar cane. Whether farmers behave in the manner predicted in Chapter 6 is dependent in part on whether the marginal physical product of labour used in cane production is of the nature normally assumed in neo-classical theory i.e. it initially is positive but decreases. It therefore is necessary to examine the production function for cane. Production functions for annual crops are static and can be estimated by well known methods. In the case of sugar cane, the concept of a production function becomes much more complex and the problem of estimation more difficult.

A related problem is the fact that the choice between annual and semi-perennial crops leads to differences both in current consumption opportunities and in future economic prospects. The choice depends heavily on the rate of time preference of individual families. In Chapter 7, the production function for cane is considered, while subjective rates of time discount are discussed in Chapter 8.

Although production functions have been estimated for some perennials such as rubber (Sepien 1979), it appears that no estimate is available for sugar when cultivated as in Fiji as a semi-perennial crop. In order to estimate such a function, reliable data covering a number of growing seasons are required, and it is shown that in the absence of such data, the function cannot be estimated. The ways in which annual data by themselves are not adequate are illustrated in Chapter 7. It is concluded that an avenue for further research, important not only for reasons of academic interest but also for its practical policy implications, is the estimation of a multi-period production function for cane in Fiji. Some of the pitfalls inherent in this type of estimation are highlighted, and suggestions are made about the sort of data which will need to be collected.

The rate of time preference has been given an important role in theories of economic development. For example it has sometimes been assumed that people in developing countries discount the future more heavily than residents in more developed countries, and that private individuals in less developed countries have a higher rate of time discount than is appropriate from a social point of view. An application of particular importance to Fiji is that it has often been assumed that Indians discount the future less heavily than Fijians, and that this is a reason for differences in their economic performance.[5]

It therefore is a matter of importance to have some way of measuring the rate of time preference of individuals. A

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[5] Similar arguments have been used in other multiracial societies. Swift (1963) for example, argued that ethnic Chinese in Malaya discounted the future less heavily than Malays.

method which has been used is to question farmers about their preferences for various sums of money payable in different time periods (Jayasuriya 1976). Jayasuriya did not find the answers to these hypothetical questions satisfactory, and it would be better to derive an indicator of time preference directly from observed behaviour. In Chapter 8 therefore, building further on the literature discussed earlier in the thesis, a model is constructed which can be used to derive an indicator of time discount for each household in a situation where the opportunity to observe farmer behaviour in the choice between annual and semi-perennial crops exists.

Two further contributions are made in the thesis.

1. A problem with commonly used forms of the production function is that they imply that all inputs are essential. For example in the Cobb-Douglas function

$$Y = \alpha X_1^{\beta_1} X_2^{\beta_2}, \tag{1.1}$$

where Y is output, the X_i are inputs and α, β_1 and β_2 are parameters. If either X_i is zero, output must be zero. Production cannot take place in the absence of either input.

Many inputs are not essential to crop production. For example, some crops will grow, however poorly, in the absence of fertiliser. Thus multiplicative production functions such as the Cobb-Douglas do not describe agricultural production processes adequately. Accordingly, a means of adapting such functions to incorporate zero inputs is developed, and Seaqaqa data are used to illustrate how the modified equation may be estimated.

2. A large body of previously unavailable data, some of which could not be analysed in the thesis, was collected. These data should be valuable to both planners and theorists, especially those interested in developing a multi-period production function along the lines suggested in the thesis. The data are presented in full, some at the conclusion of Chapter 5 and the remainder at the end of Chapter 7.

CHAPTER 2

THE SEAQAQA SUGAR DEVELOPMENT PROJECT

2.1 Introduction

In this thesis the Seaqaqa Sugar Development Project provides the focus of a study of the response to economic incentive. In the present chapter the Project is described from its original conception in the light of the economic problems faced by Fiji, to the stage it had reached at the time the field research was undertaken. The basic structure of the cane industry in Seaqaqa was similar to that in other areas of Fiji although a number of conditions were peculiar to Seaqaqa. These differences are described with particular attention given to the system of incentives and disincentives introduced to encourage families to spend time working in cane production.

2.2 Fiji

The Fiji archipelago, consisting of more than 300 islands, has a land area of 18,272 square kilometers. Only 100 of the islands are inhabited and the two largest, Viti Levu and Vanua Levu, account for over 90% of the population and 87% of the total land area. In 1874 the islands were ceded to Britain. From 1879 to 1916 the colonial administration allowed 60,000 Indians to be taken to Fiji as indentured labourers to work on European owned plantations. At the end of their period of indenture many remained in Fiji, and by the time independence was granted in October 1974, Indians outnumbered the indigenous Fijians (Gillion 1977). However, during the 1970's the proportion of Fijians increased due both to a decline in the birthrate of Indians and to the emigration of some Europeans and Indians. Late in 1978 it was estimated that

50% of the total population of 601,485 were of Indian descent, 44.4% Fijian and 5.6% people of other races.[1]

Two important problems have faced planners in Independent Fiji. Firstly, despite a relatively high growth rate, the modern sector has been unable to provide sufficient jobs for the people seeking employment. Secondly, opportunities for participation in the monetized economy have been distributed unevenly. Between 1965 and 1975, real GNP grew at a rate of 7% per annum. The number of people seeking employment increased at 3% p.a. while wage employment opportunities increased by only 2.5% p.a..[2] Open unemployment rose from 4.2% to 7% of the workforce, and government projections predicted it could reach 16% by 1981.[3]

Unemployment has been particularly severe in the districts of Macuata and Cakaudrove on Vanua Levu, and Ba/Magodro on Viti Levu. Moreover it has been higher on average in rural than in urban areas. These trends are illustrated in Tables 2.1 and 2.2 respectively. The latter table indicates however, that while unemployment was higher among rural than urban Indians, it was lower among rural than urban Fijians.

The difficulties faced by rural Indians in obtaining sufficient farm land might explain some of these differences.[4] Indian farmers with more than two or three children generally have more than enough labour to maintain their farms. Because additional land has not been available, children often have been forced to seek outside employment. However, opportunities have been scarce and few were successful, with the result that many returned to the farm but still reported themselves as

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1 This is an official estimate for 31/12/78.

2 These figures are for the period 1966-76 and are taken from the government publication, Current Economic Statistics.

3 Britton (1979) p141.

4 The land tenure system is described in Section 2.4.3.

being unemployed. Fijians on the other hand generally have had sufficient land at least for subsistence purposes, so would report themselves as unemployed only if they were actively seeking wage employment, usually in the towns.

Further aspects of Fiji's employment problem are illustrated in Tables 2.3 to 2.5. Almost 45% of economically active Fijian males were engaged in subsistence agriculture, producing cash crops only intermittently. Only 6.95% of Fijian males, compared to 36.64% of Indian males, were involved in the cultivation of Fiji's major cash crop - sugar cane. Table 2.5 shows that employment outside primary industry, as well as in cane cultivation was dominated by Indians.[5]

Government therefore had a strong interest not only in encouraging more opportunities for participation in the monetary sector in general, but also in attempting to ensure a more equal distribution of these opportunities throughout the economy. The latter aim could be approached in two ways. Firstly opportunities could be provided in rural rather than in urban areas, especially in those districts in which unemployment was particularly severe. Secondly, policies could be introduced to encourage greater Fijian participation in the modern sector, including commercial agriculture.

2.3 Background to the Seaqaqa Sugar Development Project

Sugar production in Fiji began to decline after 1968. This was serious because not only was sugar the major source

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5 The only available figures on employment subdivided by racial origin were the percentages given in Table 2.3 in which the total number of economically active males and females were not divided by racial origin. In order to produce the tables in this thesis, these people were divided between the two groups in proportion to their representation in the total population. It is possible that this method overpredicts the relative number of economically active Fijians, in which case the estimates of Table 2.5 would understate the dominance of Indians.

TABLE 2.1

UNEMPLOYMENT BY DISTRICT, 1973

District	Unemployment Rate 1973
Cakaudrove	9.0%
Macuata	13.9%
Nadi/Nawaka	6.5%
Lautoka/Vuda	7.0%
Ba/Magodro	11.1%
Tavua	7.0%
Greater Suva	5.5%
National Average	6.7%

Source: Social indicators for Fiji, No.3

TABLE 2.2

UNEMPLOYMENT BY RACE AND SEX, 1973

Group		Unemployed as a percentage of the number of economically active people in each group - 1973
Fijian males	- urban	6.5
	- rural	5.7
Fijian females	- urban	7.5
	- rural	6.6
Indian males	- urban	5.7
	- rural	8.2
Indian females	- urban	7.8
	- rural	8.3
All Fiji	- urban	5.9
	- rural	7.2
Total Fiji		6.7

Source: Social indicators for Fiji, No.3

TABLE 2.3

PERCENT OF ADULT MALES AND FEMALES IN EACH COMPONENT POPULATION WHO WERE ENGAGED IN EACH MAJOR GROUP OF INDUSTRIES, 1966

Sector	Males Total	Fijian	Indian	Females Total
Agriculture & pastoral	50.3	61.2	45.8)	
Other primary	2.8	3.9	1.6)	0.6
Secondary	6.5	3.3	8.6)	
Construction	5.6	4.4	6.9	0.4
Commerce	5.8	2.0	8.1	0.9
Transport & communications	3.6	2.2	4.4)	0.2
Other service	1.8	2.9	0.7)	
Entertainment	1.9	1.4	2.3	2.6
Administration & government	2.5	2.7	1.6	0.3
Professional & allied	3.9	3.9	3.0)	2.6
Miscellaneous	1.3	0.7	1.7)	
Unemployed	4.0	3.1	4.8	*
Economically active	90.1	91.6	89.3	7.6
Number of economically active	116,453	56,286†	62,627†	9,400

* Not availble for 1966

† Estimated

Source: Social indicators for Fiji, No.3

TABLE 2.4

ECONOMICALLY ACTIVE WORK FORCE ENGAGED IN AGRICULTURE

	Percentage of economically active work force engaged in agriculture	Percentage of those engaged in agriculture involved mainly in subsistence production	Percentage of those engaged in agriculture specialising in sugar cultivation
Fijians	61.2	73.4	11.4
Indians	45.8	0	80.0

Source: Social indicators for Fiji, No.3

TABLE 2.5

ESTIMATED NUMBER OF INDIANS EMPLOYED PER EMPLOYED FIJIAN IN SELECTED SECTORS, 1966

Sector	Indians per Fijian
Other service	0.27
Administration & government	0.66
Professional & allied	0.86
Commerce	4.51
Construction	1.74
Secondary industry	2.23
All non-primary	1.68
Sugar cane cultivation	5.87
All primary	1.96

Source: Social indicators for Fiji, No.3

of export revenue, but future market quotas under the International Sugar Agreement would depend on recent export performance. By 1973 it appeared that Fiji had export agreements for more sugar than it could produce. It therefore was in Fiji's interests to increase sugar production. Because there was considerable unused land in Fiji, the Government decided to bring additional land into the production of sugar cane rather than simply to concentrate on increasing the yields on existing farms.

The choice of location for a major expansion of cane planting was influenced by a number of factors. Firstly, of the four mills operating in Fiji, the one at Labasa, Vanua Levu, was regarded as being most suitable for expansion. Secondly, the Vanua Levu provinces had suitable unused land. Moreover, Macuata Province was a relatively depressed area with few existing employment opportunities. The Seaqaqa plateau, in Macuata district, about 40 kilometers south west of the Labasa mill (see Map 2.1), was chosen finally because of its suitability for cane, and because local land owners were willing to make a substantial area of land available.

The Seaqaqa project includes about 21,000 hectares of flat to undulating land, much of which is between 100 and 175 metres above sea level. Ninety-five percent of the soils are ferruginous latosols and red yellow podzolics.[6] These soils are well draining, and tend to dry out in periods of low rainfall. Such information as is avaialable on rainfall in the project area is summarised in Table 2.6. Rainfall in Seaqaqa exhibits the same pronounced dry season from May to September which has proved necessary for good cane production in other areas of Fiji. Soils in Seaqaqa however, are less fertile than in these other areas and fertiliser applications to cane must be correspondingly higher.

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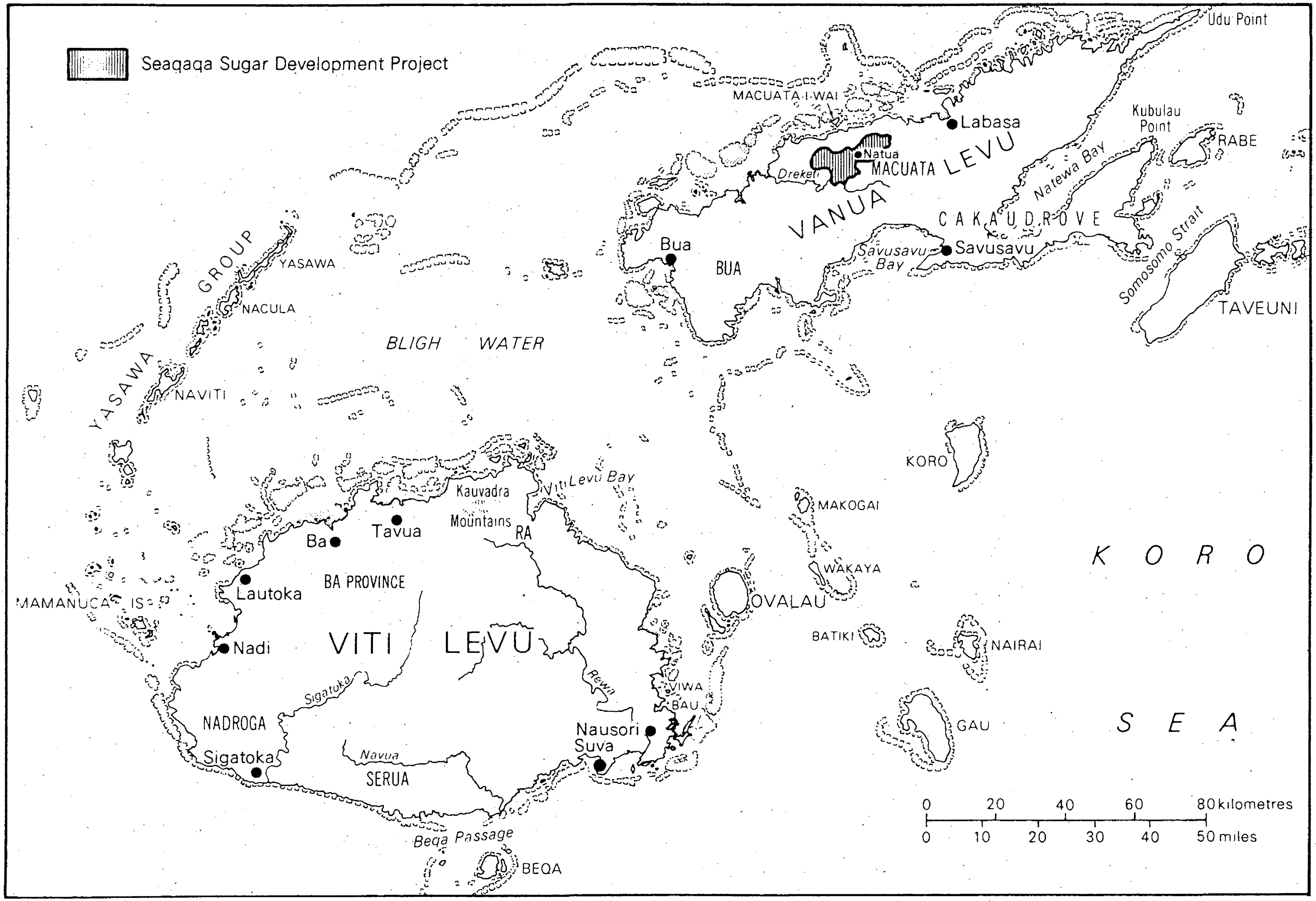
6 Snowsill S.B. in a report to the Local Coordinating Committee, 9th Feb. 1976 (unpublished).



Map 3.1

Fiji Showing the Seaqaqa Sugar Development Project

TABLE 2.6

RAINFALL - SEAQAQA AND OTHER CANE PRODUCING AREAS OF FIJI

	Rainfall in MMS												
	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Seaqaqa average 1963-1974	312	442	470	287	109	71	48	58	84	187	n.a.	n.a.	n.a.
wettest year 1963-1974	998	488	503	168	122	71	69	89	94	399	399	886	3427
driest year 1963-1974	114	292	185	104	18	25	22	0	33	104	178	257	2115
Fieldwork - July 1977 to June 1978	177	361	113	277	191	37	38	54	43	107	95	306	1799.5
Labasa - 45 year mean	330	366	366	213	122	53	48	46	71	91	152	257	2115
Lautoka - mean yearly													1771
Penang - mean yearly													2098

Source: Reports by the Project Manager to the Local Coordinating Committee

Before the scheme began it was estimated that 50 Fijian and 150 Indian families lived in the project area.[7] Most of the Fijians were engaged in village based subsistence activities. The Indians had migrated to the area as a result of a rice scheme which commenced in 1963, but which was unsuccessful. They had been producing rice largely for home consumption before the present cane based project began.

The two major aims of the Seaqaqa project were to increase sugar production and to induce additional Fijian participation in the cash economy. As elsewhere in Fiji, production was to be undertaken by smallholders rather than on an estate basis. Some conflicts between the two aims existed. Indians had greater experience in the cash sector in general, and in sugar cultivation in particular, and thus might be expected to increase sugar production more quickly. On the other hand, a scheme consisting largely of Indian settlers would have reduced the proportional representation of Fijians in the cash sector. Eventually the project was designed for equal representation from both groups.

2.4 General Sugar Farming Conditions in Fiji

Cane in Fiji is grown by smallholders, the vast majority of whom are descendent from Indians who had once been indentured labourers on European owned plantations. There are over 17,000 sugar cane smallholders in Fiji. Milling is undertaken by a Government owned monopoly, the Fiji Sugar Corporation (FSC), which also provides farmers with a wide range of ancillary services. Relations between the FSC as the miller, and the growers, are governed by a formal contract.

2.4.1 The Contract. The FSC will handle only that cane supplied by farmers with whom it has signed a contract.

[7] Snowsill op cit.

Terms in force at the time of fieldwork were determined by the 1969 Denning Award, modified in 1974 by an increase in the share of proceeds allocated to growers. Important conditions include:

a. The FSC must purchase from each farmer the contracted quantity of cane from the contracted area of land. It is not required to accept more than this quantity from any grower, nor to accept cane grown on land not covered by the contract, though in recent years it has bought almost all cane produced. A farmer's quota can be reduced if he fails substantially, over a three year period, to produce the contracted output.

b. The price per tonne paid to growers is derived from the total proceeds the FSC obtains for sugar exports. First $200,000 is deducted from the gross proceeds to finance the FSC's Agricultural Experiment Stations, and the FSC retains 30% of the remainder to cover operating costs. The residual is divided among growers according to the tonnage each produced.

c. Under the Denning Award, the FSC guaranteed growers a minimum price of $6.92 per tonne for green cane. At the beginning of recent harvests it has announced a substantially higher guaranteed minimum price; for example $20 a tonne each year from 1976 to 1978. The contract provided that the guaranteed minimum price be paid in two instalments, the first not more than five weeks after the cane had been delivered to the mill, and the second within six weeks of the end of the crushing season. If export earnings were sufficient to justify a price above the guaranteed minimum, such additional payments were to be made in two further instalments, the first if possible by the end of June, and the second as soon as practicable after the final certificate of sales. For the 1977 harvest the higher guaranteed minimum was not met fully until the fourth payment. Twelve dollars a tonne were paid within 3 weeks of delivery, a further payment of \$4 in January 1978, and another of \$3 a tonne in March, brought the total to \$19. Two further payments of \$6 and \$1.46 in June and October respectively took the final price to \$26.45 per tonne, well above the guaranteed minimum.

d. The FSC is required to keep in good repair all tramlines, locomotives and rolling stock, and to supply each in sufficient numbers to complete the harvest in time. The cost of transporting cane along tramlines to mills is met by the FSC, and from the field to the tramline, by the grower.

e. The FSC is required to advance to the grower, without interest, some of the costs incurred in producing cane. Included are the costs of seed cane, fertiliser, harvesting and transportation to the delivery point. These advances are a first charge on any payments due from the FSC to the grower.

f. The grower on his part is required to meet certain obligations concerning farming and harvest practices, and cane transportation. Cane has to be of a variety approved by the FSC and the farmer is required to practice husbandry of a standard sufficient to fill his quota. He has to cooperate with the FSC to eradicate disease, although in practice, most of this work is undertaken by the FSC's disease control units which regularly visit farms. In this way diseased plants are treated, and the farmer's account is debited with the cost.

Groups of farmers are required to join together to form gangs to harvest each other's farms. A gang leader (sirdar) must be elected. In practice farmers must provide the gang with enough labour to harvest their own farms, with the gang deciding how much cane each member should cut. If, for example, it is agreed that each cutter will harvest 150 tonnes, and the FSC estimates that a given farm will produce 300 tonnes, the farmer must provide two cutters. Farmers can engage substitutes to take their places in the gang, but reliable substitutes often are in great demand and command a premium above normal cutting payments (Shaw 1973). Cutters are paid according to the quantity of cane they harvest, the minimum price per tonne being determined by the FSC at the beginning of the crushing season. The FSC, after consultation with the gang, lays down a harvesting programme which must be followed.

Cane must be cut as close to the ground as possible to ensure maximum output, and to promote the best regrowth. It is permitted to be burnt before harvesting only in exceptional circumstances, as this practice reduces sugar content. The FSC is not required to accept cane which has been burnt deliberately. For cane delivered to the mill within two days of being burned accidentally, 5% of the first cane payment per burned tonne is deducted, with a further 4% per day for each additional day's delay, to a maximum of seven days.

Cutters are required to clean cane of all "trash" before loading, and to load in a proper manner.[8] The gang is charged for expenses incurred in reloading tramtrucks which overturn in transit to the mill. Delivery of cane to either the tramway collection point or to the mill, is the responsibility of the gang, although the FSC plays a large part in organising haulage contractors. Cane can be sent to the mill by road or tramline. If the farm is close to the tramline, it is cheaper to use tramtrucks because farmers have to bear only the cost of delivery from the

[8] At harvest, the leaves were separated from the stalk of cane which was then sent to the mill. The leaves which were left on the ground commonly were called "trash".

field to the tramline. Direct delivery to the mill by road is used if the farm is some distance from a tramline or, as often happens late in a season, if a farmer is unable to obtain a sufficient number of tramtrucks. In most of the older cane areas, an extensive network of tramlines exists, and it generally is cheaper to use this method. Rates to be charged for all forms of transport are announced by the FSC prior to harvesting each year.

2.4.2 Other roles played by the FSC. The FSC plays a number of other important roles. It is the sole supplier of superphosphate, sulphate of ammonia, and potash, and organises fertiliser deliveries to each farm. It is a major supplier of weedicides, although there is substantial use from other sources of cheaper weedicides which the FSC regards as inferior. The FSC deducts tax on behalf of the government at the rate of 2.5% on the gross proceeds of harvests of between 150 and 300 tonnes, and 5% for harvests above 300 tonnes. Families producing less than 150 tonnes pay no tax. However tax payments on income derived from cutting and transport operations, which were 2.5% and 15% of gross proceeds respectively in 1977, were the responsibility of the sirdar and the individual transport operators respectively. Cane producers can also purchase on credit a quantity of rice and sugar each year from the FSC at prices lower than those that could be obtained on the open market.

Of primary importance is the network by which advice and information are transmitted to farmers. FSC Farm Advisors play a crucial role. Each Farm Advisor is allocated a group of farms and is responsible for organizing fertiliser and weedicide deliveries to each farm, for helping to solve any farming problems which may emerge, and for ensuring that information on techniques developed at the Agricultural Experiment Stations are disseminated. Much of their time is spent in daily visits to the farms in their area. It has often been claimed that the continued viability of a large number of smallholder farms is testimony to the overall success of this system.

2.4.3 Land tenure. Six percent of land in Fiji is freehold, 11% is Crown Land and the remainder is Native Land. The 1940 Native Land Trust Ordinance created the Native Land Trust Board (NLTB) to ensure that Native Land was not alienated from the Fijian owners. Should someone from outside the traditional land owning unit, the "mataqali", wish to bring Native Land into production, the mataqali's consent first must be obtained. Next, approval from the NLTB must be sought. The NLTB can grant a lease with a statutory minimum tenure of ten years. Two optional ten year extensions of tenure are granted automatically unless the mataqali can prove before a tribunal that if it did not regain control of the land, its members would suffer greater hardship than the lessee would suffer if he were evicted.

It is difficult for Indians to purchase land for farming purposes as freehold land rarely comes onto the market at a price a farmer could pay. Moreover it has not been simple to obtain a lease as either the mataqali or the NLTB would reject an application. Indians complain that the guaranteed minimum tenure of ten years provides insufficient security for them to make long term farm improvements. Fijians on the other hand, have complained of the difficulty of proving excess hardship before a tribunal in order to regain control of their land.

Rent is set at a maximum of 6% of the fair market value of the land, allowing rent of cane land to rise with increasing output per acre. Each five years the fair market value is reassessed by independent valuers approved by the NLTB. Rent is collected bi-annually by the NLTB which retains 25% to cover its running costs, and allocates 75% to the mataqali owning the land.

2.5 Project Aims and Achievements

2.5.1 Structure of the scheme. The structure of the sugar industry is basically the same in Seaqaqa as in other parts of Fiji. Seaqaqa farmers sign a contract with the FSC but for 6 hectares of cane, which is slightly more than the national average. The FSC provides inputs, helps to organize cutting and cane transportation, and provides credit for the purposes stated in the contract. It maintained its system of advice with four Field Officers and six Farm Advisors for the project area in June 1978.[9]

Administration is more complex than in other cane growing areas. A Central Coordinating Committee (CCC) based in Suva, under the chairmanship of the Permanent Secretary for Agriculture, is the controlling body. This body liases directly with the World Bank which provided a large part of the finance for the project. Responsible to the CCC is a Local Coordinating Committee (LCC) which meets in Labasa under the chairmanship of the District Commissioner Northern. All agencies involved in the scheme are represented on both committees. An independent Project Manager implements the policies determined by the coordinating committees.

2.5.2 Progress of the scheme. A major target of the scheme was to produce 224,000 tonnes of cane by the 1979 season.[10] Eight hundred farm families were to cultivate a total of 4,800 hectares of cane. An average farm size of 20 hectares was considered necessary to ensure adequate

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[9] Field Officers coordinated the work of the Farm Advisors. They did not have as much direct contact with farmers as did the Farm Advisors.

[10] Targets were stated in Imperial measures e.g. 200,000 tons. During the 1978 harvest the FSC changed to the metric system of tonnes and hectares. For consistency, targets have been converted to their metric equivalents.

land suitable for the cultivation of subsistence crops in addition to the 6 hectares of cane. There were to be 400 Fijian and 400 Indian farmers.

Planting commenced in December 1973. By the end of 1974, 800 hectares were to be under cane, with an additional 1000 hectares planted each year from 1975-78 inclusive. During 1975 however, only 324 hectares were planted and by the end of August 1976, a total of 600 hectares had been planted. Planting was still behind schedule during 1977 with less than 800 of the projected 1000 hectares planted. Much of this delay can be attributed to contractors failing to clear land at the specified rate. By the end of March 1978 for example, almost 30% of the 1977 clearing contract had not been completed. As a result of these delays only 110,880 tonnes were harvested in 1977 from 2205 hectares, compared with the 131,040 tonnes from 2800 hectares implied in the plan.

Four hundred farms were to have been settled in 1974, with a further 250 and 100 in 1975 and 1976 respectively. By the end of 1974, 334 blocks had been allocated, less than 400 by the end of 1975 and 664 by December 1977. Only 481 of these sent cane to the mill for the 1977 crush. The final farms eventually were allocated early in 1979.

The intention was that the selection of settlers should be controlled by a subcommittee of the LCC. The mataqali was permitted to allocate up to half the blocks to its members, with the committee filling the remaining places. In an attempt to alleviate rural unemployment, all settlers (mataqali nominees and those chosen by committee) were supposed to meet strictly defined criteria. Preference was given to sons of local farmers with inadequate land, mostly Indians. Otherwise, settlers were to be selected from persons who owned no land, were between the ages of 18 and 45, and had no alternative employment. They had to be willing to live permanently on the farm. The selection committee was charged with ensuring that an equal number of Fijians and Indians obtained farms.

The method of selecting settlers did not proceed as planned. A system evolved whereby a high proportion of the blocks were allocated by the head of the mataqali, and the restrictions designed to benefit the less privileged members of society were not enforced. Two illustrations of the breakdown in the selection system can be offered.

In the early years there was difficulty in finding an adequate number of Fijian applicants to maintain the racial balance. To overcome this, 36 blocks were given to the NLTB to run as an estate for the benefit of the Fijian people, and another 4 farms were allocated to the Macuata District Council, a Fijian body. By this means Fijian participation was brought to 50% by 30/3/76, although only 42% of blocks were in the hands of individual Fijians. After the final allocation of farms in 1979, 57.9% of farms were being leased by Fijian families. Much of this change in ownership ratios can be explained by an increasing resistance from the mataqalis to allowing their land to be leased to Indians. The selection committee bowed to this pressure.

The second illustration concerns the rule excluding settlers with employment. Late in 1977 it was estimated that 104 of the 644 settlers were engaged in regular outside employment.[11] Some were well paid government officials. The plight of people from economically depressed groups would have been helped to a greater extent had these people been excluded. The failure of the selection procedure thus seriously impeded the provision of employment opportunities for under-privileged members of society, and the maintainence of the 50/50 racial balance within the scheme.

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[11] Estimated by the Independent Project Manager.

Thus, though many of the teething troubles with the project have been overcome, the rate of progress has been less than originally planned, and the project's contribution to the less privileged has been impaired. These statements do not represent an attempt to judge the success or failure of the project. They are simply observations that the scheme developed in ways that were incompatible with some of its objectives.

2.6 Farming in Seaqaqa

Although the structure of the cane industry is similar throughout Fiji, conditions facing Seaqaqa farmers differed from those confronting their counterparts in other areas in a number of ways. Some can be regarded as placing participants in the scheme at a disadvantage, while others were advantages designed to ease the transition to a cash oriented lifestyle.

2.6.1 Disadvantages.

Total Fertiliser Costs generally were higher due to the lower quality of the soil. Recommended fertiliser applications were up to 212% higher than in other areas.[12]

Farm Development Costs were high due to the necessity to clear virgin bush before planting. Clearing costs varied according to the type of vegetation - dense forest being more expensive than grassland - but have averaged about $662.50 per hectare. If 6 hectares were cleared, the average family would have been almost $4000 in debt before

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[12] Personal correspondence (5/4/79) with Mr K. Krishnamurti, Director of Sugar Cane Research, FSC Agricultural Research Station, Lautoka, indicated that some soils in Seaqaqa might have required up to 24 bags (1200 kgs) of fertiliser per acre, while farmers in other areas may have needed to apply only 8 bags (400 kgs). However, detailed soil analysis for each farm in Seaqaqa had not been undertaken, and the FSC in the project area recommended a maximum application of 17 bags (850 kgs) an acre during the period of fieldwork.

any cane was planted. With the costs of seed cane, fertiliser and land preparation, farm development costs could exceed $10,000. These debts seem especially high given that many settlers were earning between $50 and $200 per annum before the project began.[13]

Income from Cane Cutting. To encourage settlers to spend as much time as possible tending cane, a system of contract cutting was introduced in Seaqaqa whereby farmers were encouraged not to cut cane. People from outside the region were imported to cut a contracted area at the rate determined by the FSC. The total cost of harvesting a farm was the same whether or not family members belonged to the harvesting gang. The cash income received by the family, however, was lower.

By 1978 the contract system was being replaced in some parts of the scheme by the traditional gang method, a development which can be traced to three factors. Firstly, contract gangs often were difficult to obtain. Secondly, contract cutters sometimes failed to harvest the contracted area, requiring the farmer's participation in order to complete the harvest. Thirdly, because of the debt repayment system described later, many settlers had no other means of earning a cash income which did not add to their debts, and were eager to become involved in cane gangs. To date, then, the average cash income of Seaqaqa farmers has been lower than it could have been had the traditional method of harvesting been adopted.

Transport Costs. The distance from Seaqaqa to the mill by road was about 57 kilometers before the scheme began. It was about 29 kilometers from the closest part of the project area to the tramline terminal (railhead). After considering a number of alternative methods of transporting cane to the mill, planners decided to extend the tramline toward Seaqaqa

[13] MAFF survey undertaken in December 1973 (unpublished).

by 10 kilometers, and to reroute the road to reduce the distance to the new railhead by about 9.5 kms. The FSC purchased five semitrailers, each capable of carrying five tramtrucks, and two smaller lorries, each carrying two tramtrucks, to haul cane from the collection points in the scheme to the railhead. These proved insufficient to cope with the quantity of cane, and a large proportion has been carried by private transport contractors.

Farmers were charged with the cost of transporting cane from the field to the tramline. This distance was greater in Seaqaqa than in cane growing areas with extensive tramline networks, and farmers accordingly faced higher transport costs. During the period of fieldwork there was considerable dissatisfaction among farmers with the transport system, with many expressing the view that it was designed to minimize costs to the FSC rather than to settlers.

Thus, Seaqaqa farmers faced higher fertiliser and transport costs than did sugar producers in other parts of Fiji. Farm development costs have been high and the average cash income derived from cutting cane has been low. There were however, some special advantages of farming cane in Seaqaqa.

2.6.2 Advantages. The Project Administration was concerned that the high fertiliser and transport costs might reduce the returns from cane farming to the extent that families would be discouraged from applying inputs to cane production. This would have inhibited the movement into stage 3. A system designed to provide more incentives for households to put effort into cane was therefore introduced. To reinforce these incentives, a penalty for families whose cane farming performance proved to be poor was included. The main features of the system are described in this section.

FSC Extension Services. These services, though similar to those provided in other areas of Fiji, were crucial to the success of the scheme. In traditional cane producing areas where families often had generations of cane farming experience, FSC services were limited in the main to the supply of some inputs, cane marketing, disease control, and the dissemination of information provided by the Agricultural Experiment Stations about new techniques and new varieties of cane. In addition to these tasks, FSC officers in Seaqaqa had to teach inexperienced farmers how to grow cane. Extension officers in Seaqaqa were of necessity more involved in day to day farm operations than was usual in other areas.

MAFF Extension Services for crops other than cane were introduced in the belief that the more efficiently these crops were produced, the more inputs would be available for cane. The services also were intended to promote the establishment of other cash crops in the region, but a satisfactory crop had not been found by the time the MAFF withdrew its extension staff early in 1978.

Land Tenure. It has been claimed that leases guaranteeing a tenure of only ten years discouraged farmers from developing land to its full potential. For example, investment in irrigation or erosion control, likely to yield returns over a relatively long period, was unlikely to be undertaken by households fearing that they would be evicted before a large part of the returns had accrued. To provide the necessary incentive for investment, instead of the usual minimum tenure of ten years, Seaqaqa settlers were guaranteed a 30 year lease with two further optional renewal periods of 10 years.

In each lease there was a provision that a family could be evicted if its farming performance was unsatisfactory. This clause was designed to affect the households which had failed to respond to the policies aimed at encouraging a strong commitment to the cash crop.

Land Rent was at a concessional rate for the first five years, reducing to some extent the impact of high fertiliser and transport costs. Contracts between the FSC and farmers were signed for 6 hectares of cane. Households were charged $18.75 per hectare each year for the six hectares regardless of the area they had planted to cane, and $1.25 per hectare for the remainder of the land they had leased. Rents on cane land in other areas of Fiji were considerably greater. However after five years, rents were to be increased to approximately the same level as in the other areas, although at the time of fieldwork, no decision about the size of this increase had been made.

Credit. One of the aims of the scheme was to provide opportunities for disadvantaged members of the community. Settlers in this category had insufficient funds to bring land into cultivation without substantial access to credit facilities. Until the World Bank agreed to finance a large part of the scheme beginning early in 1976, the FSC provided credit for land clearing, preparation and planting. In 1976 the World Bank provided the Fiji Development Bank (FDB) with $6 million to lend to settlers and agencies participating in the scheme.[14] All land development debts incurred on the behalf of settlers by the FSC were paid by the FDB, which became the sole financier of development costs. Funds also were made available for selected settlers to purchase tractors needed for land preparation, for cane maintenance and to haul cane from the fields to nearby collection points during each harvest.

Farm development loans were to be repaid over ten years in a majority of cases. A concessional interest rate of 4.25% per annum was levied on the amount of the loan that had been approved, rather than on the funds actually used. Interest on tractor and equipment loans was 6.25% per annum for the first $8000 and 10% on any excess. These loans were to be repaid in 4 years.

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[14] All monies are quoted in Fijian dollars unless stated otherwise.

The proceeds from cane sales to the FSC were retained by the FSC to recoup the cost of inputs advanced to each farm. Any excess was transferred to the FDB which under the terms of the loan, retained 100% for the first three years, and 75% thereafter until the loan was repaid. Payment for tractor services, except on the rare occasions when cash work was available, also was channelled through the Bank, which retained a third of gross proceeds and returned two thirds to the owner to cover operating costs.[15]

The FDB provided finance for an additional purpose. Settlers who had repaid more than $1500 could apply for housing loans. Although these loans were available in other areas of Fiji, they were easier to obtain in Seaqaqa.

Subsistence Allowance. The debt repayment system ensured that families were unlikely to receive a cash income from cane during the first three years of production. To provide households with some of their cash requirements during this time, thereby reducing the need for household members to spend time in other forms of cash earning activity, a cash advance of $400 a year for the first two years, and $500 for the third year was made available. Advances were debited against the family's farm development account with the FDB.

Other Benefits. Two other special benefits applied to Seaqaqa settlers although they were not elements in the official system of incentives and disincentives. Firstly, although the FSC deducted tax from cane payments at the normal rate, the Inland Revenue Department made no attempt to collect tax on tractor earnings until the 1977 harvest,

[15] Since the project began there had been criticism of the system of debt repayment. Toward the end of 1978 a new system was introduced whereby farm development loans were rescheduled from 10 to 15 years and families had to repay a fixed amount from each harvest. Any excess cane proceeds could be refunded to the household at its request. Tractor loans were rescheduled over six years, but the Bank decided to return only 50% to the operators. Interest rates did not alter.

and families involved in cutting cane have paid no tax on these earnings to date.[16] Although the failure to collect these taxes can be attributed to the problems of collection, it represented a form of subsidy to some families. Secondly, the FAO under its World Food Programme began providing food to Seaqaqa families on a two weekly basis in 1977. The quantity received depended on the number of years the household had been producing cane. To buy equivalent food at local stores would have cost about $6.00, $4.00, and $2.00 a fortnight for first, second and third year farmers respectively.

In some ways then, the project was designed to give more encouragement to Seaqaqa farmers than was usual in the Fiji sugar industry. Large amounts of credit have been made available for farm development at concessional interest rates, and credit for housing and tractors have, for some, been easier to obtain. A minimum standard of living was assured through the support of the FAO and the subsistence allowance provided by the FDB Tax collection was incomplete and land rents were lower than usual in Fiji. However, these advantages have been offset to an extent by the higher transport and fertiliser costs that Seaqaqa households have had to meet, and the necessity to become heavily indebted to the FDB.

2.7 Conditions Prevailing in Seaqaqa During the Period of Field work

Seaqaqa was in an isolated position (Map 2.1). The journey to Labasa, the only sizable township on the western side of Vanua Levu took an hour and a half by bus and there were about six bus services a day. The closest hospital,

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[16] An attempt was made during the 1979 harvest to force gang leaders to deduct the tax owed by each cutter from every three weekly payment. The move was not very successful largely due to the difficulties involved in calculating tax payments.

pharmacy, cinema, hotel, police station and jail were situated in Labasa. The NLDC however, was in the process of constructing a township at Natua, and by July 1978, a store, a garage and vehicle repair shop, and the offices of the FDB, MAFF and the PWD had been built there. Long term plans existed for the construction of a police station, cinema, hotel, hospital and a number of churches, although by the beginning of 1980, only the police station had been completed.

Wage labour opportunities within the scheme were limited. The FDB refused to provide finance for farm tasks the farm family could undertake, and few households had sufficient savings to pay labourers in cash, so settlers rarely could obtain paid work on other farms in the project area. The FSC actively discouraged the formation of traditional harvesting groups. During the harvesting season, family members had to join cane gangs if contract cutters could not be found for the area in which the family lived, but conversely, if contract gangs were found, household members could not get work cutting cane.

About 50 leaseholders were permanently employed within the scheme as labourers for the PWD, the MAFF, the FSC or at one of the two privately owned Timber Mills. However, they had been employed either before or in the early years of the scheme, and only two new opportunities for regular employment of this nature became available between 1st July 1977 and 30th June 1978. One position was filled by the son of a leaseholder, who himself was a labourer with the PWD, and the other by someone from outside the project area. Moreover, there were no opportunities due to replacement of workers through natural wastage. Retirements in the PWD, the largest employer, were being delayed due to insufficient funds for pension payments, and no cases of workers leaving employment voluntarily were reported.

The FSC and the MAFF also offered limited casual wage employment. However, they had traditionally employed the same people since the early years of the project. There therefore were no wage labour opportunities open to leaseholders who did not have these contacts with employers, and who lived in areas where contract cutters were provided.

The wages paid also indicated serious imperfections in the labour market. Unskilled labourers with the PWD for example, were paid between $1.00 and $1.20 per hour. On the other hand, a cutter could harvest about a tonne of cane in a six to eight hour day, for which he was paid $3.50 - between 44 and 58 cents per hour. In a competitive labour market, such wide disparities in wage rates would not be expected. A competitive labour market therefore did not exist in Seaqaqa.

Some services however, could be obtained within the project area. Thirteen stores, of which nine had been established before the project began, were operating during the period of fieldwork. A similar range of foods to that available in Labasa was sold at prices between 15% and 30% higher than Labasa retail prices. Because the cash flow to settlers was lumpy - cutters were paid once every three weeks during the harvest, and families could draw freely on their subsistence allowance about four times a year - the stores provided goods on credit, to be repaid the next time the family obtained a cash payment.

Transport within the boundaries of the project had been improved with the construction of over 200 kms of access roads, over which ten unofficial taxi services operated irregularly. When these vehicles were not available, families had to seek rides with passing traffic or walk. The distance between farms and the nearest bus route was as much as fifteen kilometers.

At the beginning of the 1978 school year, some farmers experienced difficulties enrolling children in primary schools. In previous years, the area had been well served by three Indian committee schools within the scheme, and two Fijian district schools within relatively easy reach. The schools were situated either on main bus routes or in outlying subdivisions, and at that time provided adequate primary school facilities to all households.

The closest secondary school was situated about 15 kms from the scheme. It did not have a high scholastic reputation, especially among Indian families who preferred to send their children to Labasa. Buses from Seaqaqa did not reach Labasa in time for the beginning of classes each day, so these children had to board away from home.

Most families in Seaqaqa were self sufficient in subsistence crops. Accordingly there were only limited opportunities for settlers to sell fruit and vegetables within the scheme - to people travelling through the area or to the few government officials living in Seaqaqa who did not have their own gardens. Most sales therefore had to be made at the Labasa market. However, it was rare for settlers to make the journey especially to market produce, and such sales generally were associated with trips undertaken for other purposes.

In sum, Seaqaqa was in a rather isolated position. Opportunities for the sale of non-sugar produce, for wage employment, entertainment, medical care and secondary schooling were limited, with considerable travel involved. On the other hand, the project area was well served as far as primary schooling, shopping, and, apart from some outlying subdivisions, transport facilities were concerned.

2.8 Summary and Conclusions

The Seaqaqa project was a land resettlement scheme, set in one of the relatively depressed districts of Vanua Levu, designed primarily to increase national cane production. A subsidiary aim was to provide cash earning opportunities for less privileged members of society, particularly for unemployed rural Indians and for Fijians who had been engaged mainly in subsistence agriculture.

The project did not develop as quickly as planned, and some of the selection criteria aimed at helping the underprivileged were circumvented.

Cane farming in Seaqaqa was organized in a similar manner to the traditional cane producing regions in Fiji. However there were some disadvantages of being a cane farmer in Seaqaqa. Fertiliser and transport costs were higher than in other areas, and large distances often had to be travelled to obtain services. To counteract the impact of these disadvantages, a system which provided settlers with special incentives to produce cane was introduced. Central to this system were the FSC extension services which of necessity were more thorough than those in other cane producing regions. They had to provide the information and technology to bridge the gap between the generations of cane farming experience of families in other areas of Fiji and the lack of experience of Seaqaqa households.

Other incentives included the provision of abundant credit for cane development at concessional interest rates, and a cash allowance during the time households would receive no income from cane. Rents were lower than in other cane producing areas, and leases were granted for longer periods. Land tenure arrangements also provided penalties for poor performance.

These policies were designed to facilitate the transition of participants in the project from a subsistence orientation with limited participation in the cash economy to a commercial orientation with some supplementary subsistence production. In this thesis an attempt is made to discover whether the policies were likely to induce families to move into stage 3. For this purpose it will be necessary to identify factors influencing the response of farm families to the economic incentives offered in Seaqaqa. Accordingly previous attempts by economists to understand this type of situation are considered in Chapter 3.

CHAPTER 3

NEO-CLASSICAL THEORIES OF THE BEHAVIOUR OF THE TRADITIONAL FARMER

3.1 Introduction

In the first part of this chapter the ways in which neo-classical economic theory has been used to explain the behaviour of traditional farmers in developing countries are discussed.[1] The resulting theoretical models are complex, and testing would require information which normally is not readily available. A focus of the chapter therefore is to highlight the assumptions and simplifications which have had to be made to derive testable hypotheses. In later chapters relevant parts of these theories are selected to explain the behaviour of farmers in Seaqaqa where there is a choice between cultivating semi-perennial and annual crops.

Pioneering work on the traditional farmer in the Pacific was undertaken by Fisk (1962, 1964, 1966, 1975) with much of his work an attempt to understand behaviour in stage 2 of the development process. Sen (1966) and Nakajima (1969) developed models similar to Fisk's when considering the problems of Asia.[2] A brief outline of one of Nakajima's models will be presented to illustrate a number of factors common to neo-classical models of the behaviour of the traditional farmer. Many of these concepts are used when considering behaviour in Seaqaqa.

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1 Only brief attention is given to other types of theories. To some extent the thesis is an attempt to discover whether neo-classical theory can be used to explain the behaviour of traditional farmers.

2 Fisk (1975) discusses the similarities between his models and those of Nakajima.

3.2 Nakajima's Model of a Pure Commercial Family Farm Without a Labour Market

The decision making unit is the farm household. A utility function, with arguments income and family labour input, exists for each household:

$$U = U(A,M) \quad , \tag{3.1}$$

where A = labour hours supplied by the family

M = family income

$U_A = \frac{dU}{dA} < 0$

$U_M = \frac{dU}{dM} > 0,$

The slope of the indifference curve $\left(\frac{-U_A}{U_M}\right)$ represents the valuation of a marginal unit of family labour - "the marginal valuation of family labour".[3] $\bar{A}$ is "the physiologically possible maximum of labour hours for the whole family" and M_0 "the minimum subsistence standard of income for the whole family" for a given price level (Nakajima 1969, p167).[4] Indifference curves are defined for $M \geqslant M_0$ and $A \leqslant \bar{A}$ and are shown in Figure 3.1. These indifference curves are assymptotic to the minimum subsistence line M_oM_o' and the maximum labour line $\bar{A}H$ i.e. the family will not be willing to produce less than its minimum requirements under any circumstances, nor can it supply more labour than the physiological maximum.[5]

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3 Hicks called this the "marginal rate of substitution of family labour for money" (Nakajima 1969, p167).

4 These concepts are discussed further in Section 3.3.

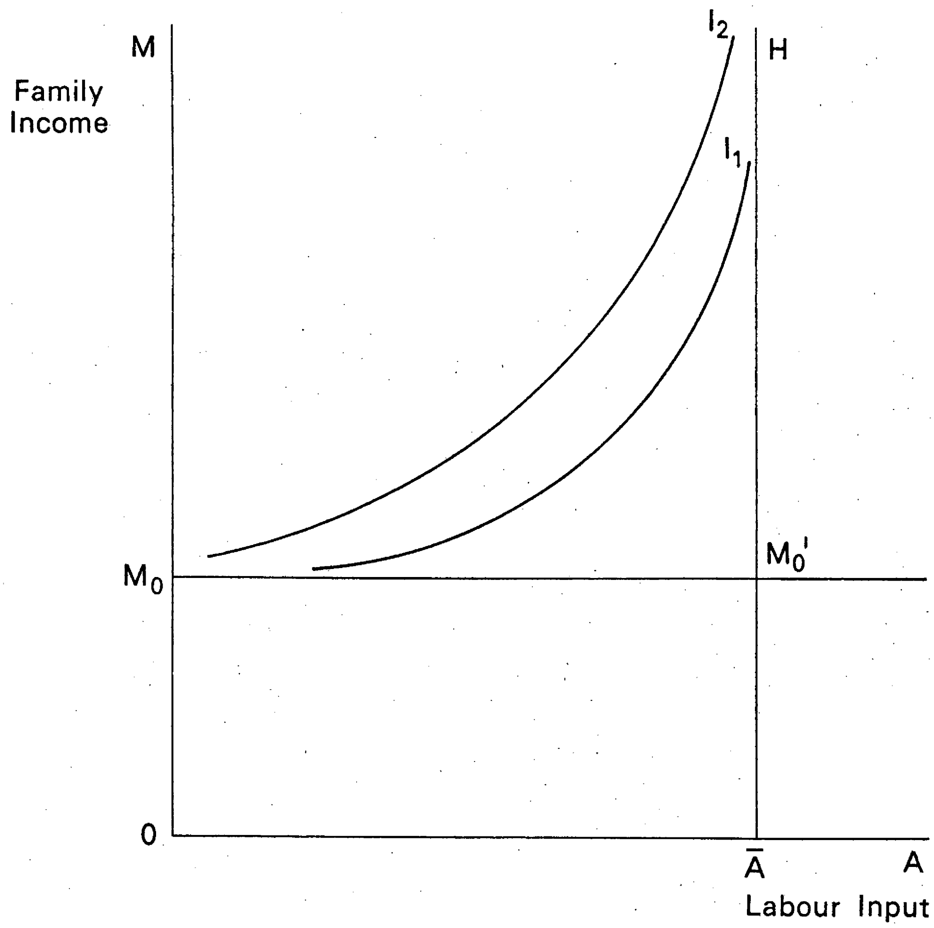
5 Formally, the assumptions are

(a) $\frac{\partial}{\partial A}\left(\frac{U_A}{U_M}\right) > 0$

(b) $\frac{-U_A}{U_M} = +\infty$ when $A = \bar{A}$

(c) $\frac{\partial}{\partial M}\left(\frac{-U_A}{U_M}\right) > 0$

(d) $\frac{-U_A}{U_M} = +0$ when $M = M_o$



(Source: Nakajima, 1969, p167)

Fig. 3.1

The Impact of Minimum Requirements and Maximum Possible Labour Inputs on Household Indifference Curves

Family income (M) is

$$M = P_xF(A,B) + E \qquad (3.2)$$

given the following assumptions:

a. the farm produces a single product whose price p_x is market determined;

b. the technology of the farm is given by the production function $F(A,B)$[6] where B is the fixed quantity of land which is owned and operated by the family. No land is leased;

c. no labour market operates;

d. E is exogenous income from non-farm assets (asset income).

The household maximises utility (equation 3.1) subject to the income equation (3.2), which yields the equilibrium condition

$$P_xF_A = -U_A/U_M \ . \qquad (3.3)$$

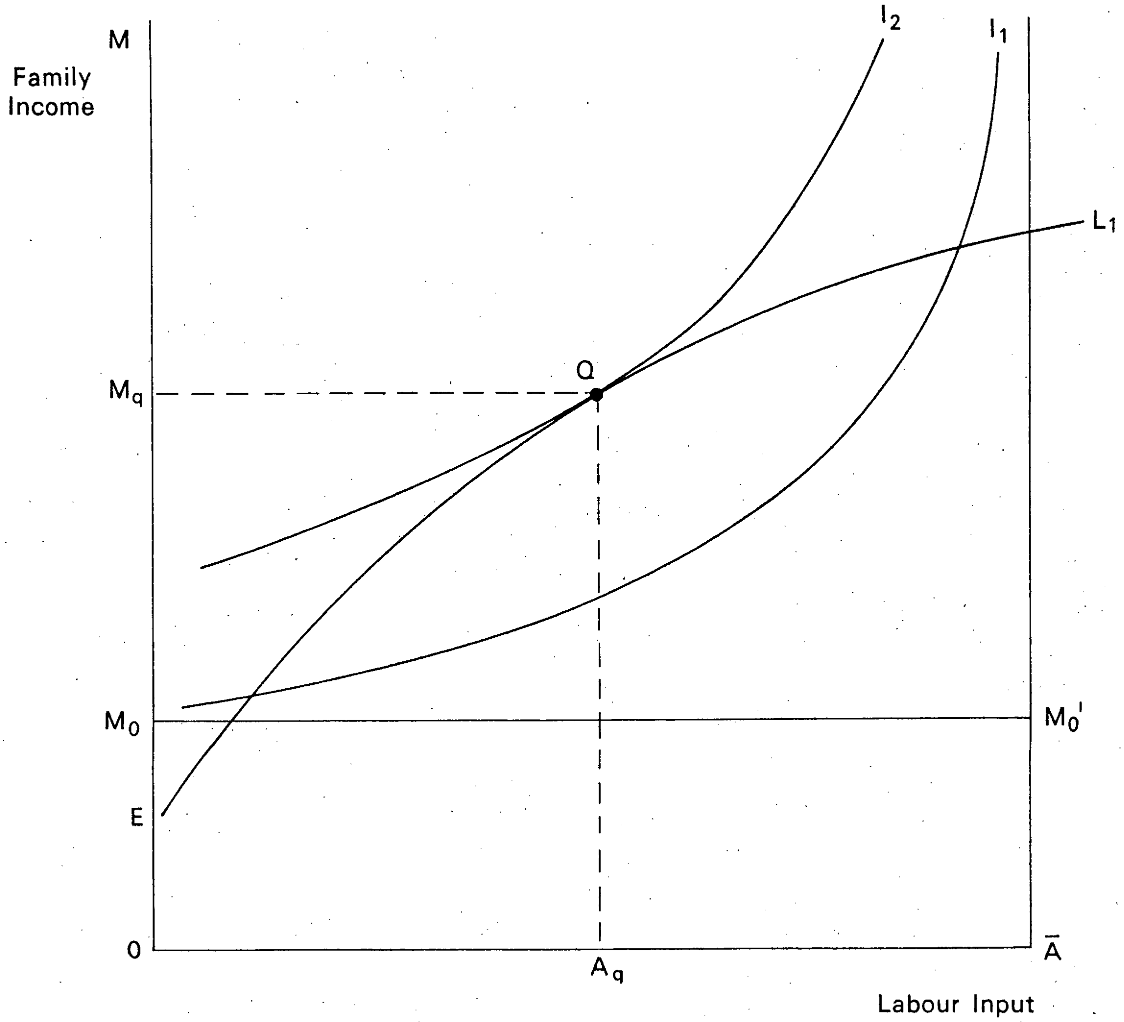
To reach its optimum point, the household supplies labour until its marginal value product equals the family's subjective marginal valuation of this labour. The optimal position is represented in Fig. 3.2.

OE is the exogenous non-farm income which accrues to the farmer during the period under consideration - in this case a positive quantity. The family income curve EL (equation 3.2), depicts the maximum income the household could obtain for any given input of family labour, and is determined by the production function and the price of the farm products. Its slope is the marginal value product of labour (P_xF_A). Equilibrium occurs at the point of tangency between the family income curve and the highest indifference curve (point Q) where A_q units of family labour produce an income of M_q.[7]

The basic model can be extended in a number of ways. An "achievement standard of income" is introduced, defined

6 The marginal productivity of labour, A, is assumed to be non-negative and decreasing i.e. $F_A > 0$, $F_{AA} < 0$.

7 where $P_xF_A = \dfrac{-U_A}{U_M}$.



(Source: Nakajima, 1969, p169)

Fig. 3.2

The Subjective Equilibrium of a Family Operating a Purely Commercial Family Farm as the level of income beyond which the slope of the indifference curves becomes nearly vertical. At this stage the family is not willing to provide any extra labour regardless of the rewards offered. Figures 3.3a and b illustrate the effect of the achievement standard of income ($\bar{M}\ \bar{M}'$) on the slope of the indifference curves. The point of equilibrium must be closer to the minimum subsistence income level, the lower is the achievement standard of income. When $\bar{M}$ is close to M_o, attempts to raise rural income by making agriculture more productive, for example, (shifting the transformation curve upward) would have little effect on income if the achievement standard of income remained unchanged.

With the introduction of a competitive labour market the household's utility function is unchanged, but the family income curve becomes

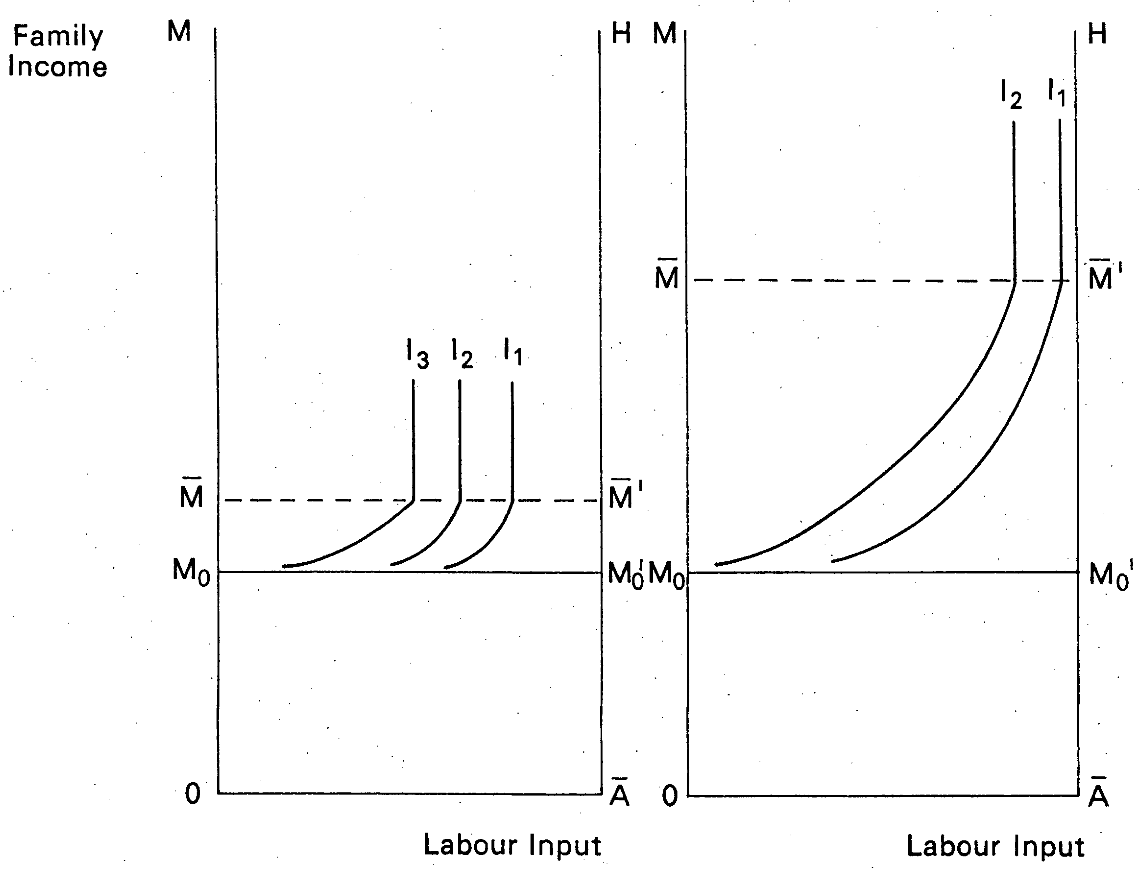
$$M = P_x\ F\ (A',B) + W\ (A - A'), \tag{3.4}$$

where A' is total labour input to the farm and W is the market determined wage rate. If A' is greater than family labour input A, the household employs non-family labour on the farm and if A' is less than A, some of the family's labour is sold off the farm. Equilibrium conditions for utility maximisation are

$$P_x\ F_{A'} = W\ , \tag{3.5}$$

and $$\frac{-U_A}{U_M} = W\ . \tag{3.6}$$

The household demands labour (either family or hired) for use on the farm to the point where its marginal value product equals the marginal cost of hiring labour - the market wage rate (Equation 3.5). This is the familiar profit maximising condition. However equation 3.6 indicates that family labour is supplied until the household's subjective marginal valuation of family labour equals the marginal return the family could obtain from selling further increments of its labour (W). Where a competitive labour



(Source: Nakajima, 1969, p177)

Fig. 3.3a Fig. 3.3b

The Impact of Variations in Aspirations on Indifference Curves market exists profit maximisation is a prerequisite for utility maximisation. In the simple model where no labour market existed, both the demand for and supply of labour were determined by the household's subjective marginal valuation of family labour.

The influences on the indifference curves are separated clearly from those on the family income curve in Nakajima's models. The minimum subsistence level of living, for example, is a constraint on the utility function, while the introduction of new farm technology would affect production possibilities, thereby shifting the family income curve. The models therefore provide a basis for examining differences in behaviour among farm families. For example large families might require a high subsistence income, which would constrain the shape of their indifference curves. Educated farmers may have access to more modern technology than other farmers, and therefore face a higher family income curve.

The impact of changes in exogenous variables, including policy decisions, can be examined. Using the simple model, Nakajima considered the comparative static effects of changes in a number of these variables on the household's equilibrium labour input. He concluded:

a. an increase in asset income (E) causes the family to reduce its total labour input;
b. an increase in the price of the farm product (P_x) has an indeterminate effect on the supply of family labour because it is not possible to determine on a priori grounds the relative strengths of the substitution and income effects;
c. for the same reason it is not possible to determine the effect of an increase in farm size (B);
d. an increase in either the number of dependents or workers in the household will result in an increase in the family's total labour input.

This model however, describes a fully commercial family farm in stage 4 of the development process, and modifications must be made before it can be applied to earlier stages.

Nakajima extended it to consider a semi-subsistence farm which still produced one product, but retained X units for home consumption. The utility function became

$$U = U(A_1 X_1 M) \quad , \tag{3.7}$$

where X was income in kind and M in cash income. In the absence of a labour market, the family income curve was given by

$$M = P_x \; [F(A_1 B) - X] + E \; . \tag{3.8}$$

Equilibrium conditions were

$$P_x \; F_A = \frac{-U_A}{U_M} \; , \tag{3.9}$$

identical to the first model and with the same meaning, and

$$P_x = \frac{U_x}{U_M} \quad . \tag{3.10}$$

This condition implies that the family consumes the farm product until its subjective marginal valuation of the good (U_x/U_M)[8] equals the cost of keeping a unit of the good off the market - the price which could be obtained.[9]

In this model a market for subsistence commodities exists, and the goods retained for home consumption can be valued at market prices. Farm output is retained only if it pays the family to do so. The model therefore is applicable to stage 3 of the development process. In stage 2, Fisk argues that prices for subsistence staples cannot be imputed because markets for these crops either do not exist or are not used. The quantity of subsistence output Q is

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8 Nakajima (p182) called $\frac{U_x}{U_M}$ "the marginal valuation of X" as opposed to Hicks'" marginal rate of substitution of X for money."

9 Fisk (1975) argued that subsistence output cannot be priced where imperfect markets for farm produce exist. The relevance of this argument to Seaqaqa is discussed in Chapter 6.

not related to M by any price. Each farm consists of two related sectors, the monetary and non-monetary, which "we should do better to analyse ... separately, taking into account ... the main cross-effects ..." (Fisk 1975, p68).

Instead of Fig. 3.2, Fisk draws a diagramme for both sectors, reproduced in part as Figs. 3.4a and 3.4b. Family production in the subsistence enterprise is

$$Q = F(A,B) \quad , \tag{3.11}$$

and the first order equilibrium condition is

$$F_A = \frac{-U_A}{U_Q} \quad . \tag{3.12}$$

Fisk observed that in the early stages of commercialisation, traditional farmers placed great importance on the subsistence sector, to the extent that they contemplated commercial production only after they had produced some subsistence output. In the model therefore, the family is assumed to give priority to the non-monetary sector to the point A_Q in Fig. 3.4a. Thus the amount of labour available to the monetary sector is $\bar{A}-A_Q$ - the length of the horizontal axis in Fig. 3.4b. Equilibrium in the cash sector is reached as a second stage.

There, the family income curve is

$$M = P_x \; F(A^{*1},B^*) + W(A^*-A^{*1}) \quad , \tag{3.13}$$

where A^* and B^* are the total quantities of family labour and land employed, A^{*1} is the total labour input (both family and hired) to the farm component of the monetary sector, and

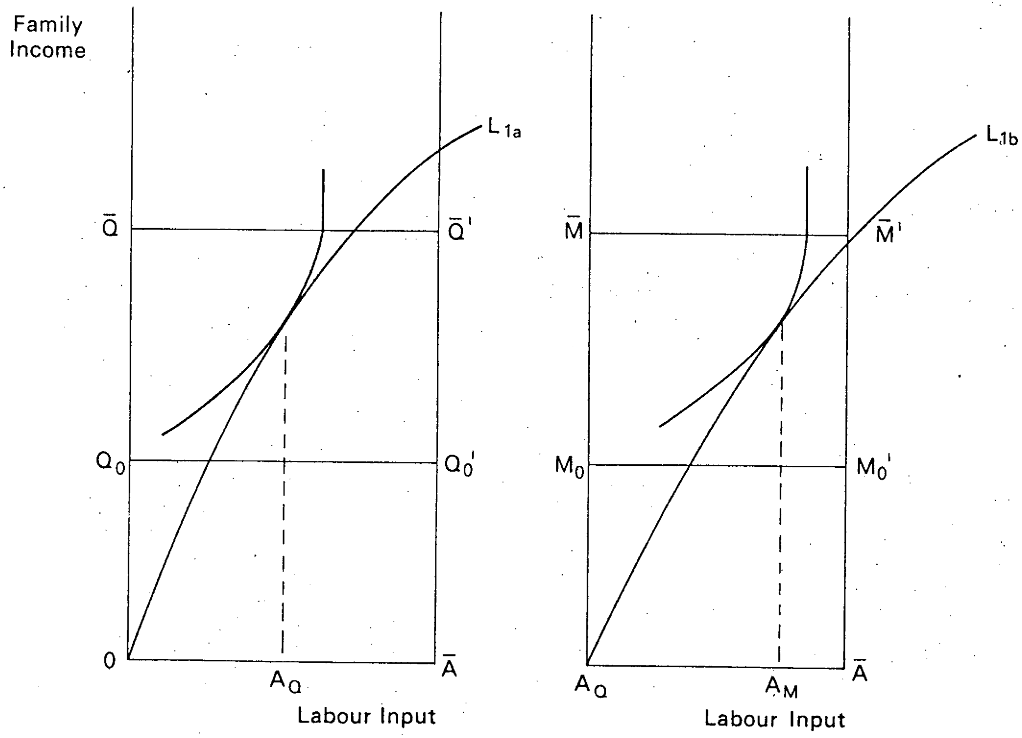
$$A^* \leqslant (\bar{A}-A_Q) \quad , \tag{3.14}$$

$$\text{and} \quad B^* \leqslant (B-B_Q) \quad , \tag{3.15}$$

First order equilibrium conditions are

$$P_x \; F_A^{*1} = W \quad , \tag{3.16}$$

$$\text{and} \quad \frac{-U_A^*}{U_M} = W \quad . \tag{3.17}$$



(Source: Fisk, 1975, pp69-70)

Fig. 3.4a

The Determination of Labour Inputs to the Subsistence Enterprise when Subsistence Crops are not Marketed

Fig. 3.4b

The Determination of Labour Inputs to the Commercial Enterprise when Subsistence Crops are not Marketed

Fisk argued that the shape of the indifference curves in Figs. 3.4a and 3.4b ($-\frac{U_A}{U_Q}$ and $-\frac{U_A^*}{U_M}$ respectively) will be independently determined until stage 3 is reached and large scale substitution between market and subsistence goods begins. This is because there is not necessarily any measurable relationship between U_Q and U_M when Q is not marketed. The model however presents some difficulties. For example, the marginal disutility of work is likely to be the same in each sector unless there is reason to believe that families disliked work more in one enterprise than in the other. In this case U_A is related to U_A*, even if there is no relationship between U_Q and U_M, and indifference curves will not be independently determined. Moreover, some of the assumptions on which the model is based are not entirely applicable to Seaqaqa.

Two important modifications to the Nakajima model were, however, suggested by Fisk. He recognised both the importance of the subsistence sector to farmers in early stages of commercialisation, and the fact that much of the output of this sector is not marketed. In Chapter 6 the model is adapted to explain behaviour in Seaqaqa in such a way that it retains these crucial elements.

A criticial characteristic of the models that have been discussed is that the farm family is both producer and consumer. These decisions are made interdependently. The household seeks to maximize utility subject to income producing opportunities expressed in the family income curve. The minimum subsistence level of living, the physiologically maximum possible family labour input, and the achievement standard of living impose constraints on the working of this equilibrium.

Although the simple Nakajima model is not directly applicable to early stages of commercialisation, many of its features are common to other neo-classical models of the behaviour of the traditional farmer. However, the utility function, the family income curve, and the exogenous constraints at times have been specified in different ways. Some of these are discussed in the following sections.

3.3 The Utility Function

3.3.1 The decision making unit.

The household is assumed to be the decision making unit in most theories of the behaviour of the traditional farmer. For a household utility function to exist, Fisk (1975) argued that it was necessary to assume that goods and labour, and therefore utilities and disutilities, were equally shared among household members. A similar justification used by Barnum and Squire (1979) was that individual utility functions must be identical for each family member, and additive across individuals. The problems involved in aggregating utility across individuals have been well discussed by Lancaster (1975).

Lloyd (1977), drawing on the work of Heckman and Willis (1975), argued that further difficulties are encountered where a commodity is consumed or supplied by only one household member. In an attempt to accommodate this problem, Rosenzweig (1978) included the labour input of husband and wives as separate arguments in a family utility function, but if this principle were applied to each commodity and household member the utility function would become difficult to manipulate. An alternative approach was followed by Lau, Lin and Yotopoulos who derived a household utility function using Hicks' aggregation theorem, in which nothing is assumed about the intra-family distribution of commodities and labour other than that it was optimal from the point of view of the family.[10]

[10] For details, see footnote 11.

In Seaqaqa leases generally were granted to nuclear families rather than to extended groups. There was an identifiable head of each household who, sometimes in consultation with family members, made farming decisions. Friends and relatives who visited the farm, often for long periods, did not appear to participate in decision making and rarely became involved in farm activities. The convention that the farm household was the decision making unit will therefore be applied to Seaqaqa. The intra-family distribution of consumption and work, however, will not be considered in any detail.

3.3.2 The consumption of goods and services. The question of what the traditional household attempted to maximise has been debated since Schultz's (1964) conclusion that farmers behaved as if they maximised net income. Although a number of studies of cross-sectional data using production function analysis have found support for this hypothesis, (Dillon and Anderson 1971), Nakajima's model illustrated that profit maximisation need be consistent with utility maximisation only when a competitive labour market existed. Accordingly, studies of the behaviour of the traditional farmer generally have included in the utility function variables such as the family's labour input in addition to net income (e.g. Sen 1966).

In any case income is included as a proxy for the goods and services which are consumed (Winkleman) and a more correct specification is to include the household's consumption of these goods and services directly in the utility function. Leisure can be included as one of the commodities. Lau, Lin and Yotopoulous (1978) provide an elegant example.

For a household consisting of m individuals with n possible consumption commodities, a utility function W is defined over the m x n quantitites of commodities consumed by the household

$$W = W(X_{11}, X_{12}, \ldots\ldots, X_{1n}, X_{21}, \ldots\ldots, X_{m1}, \ldots\ldots, X_{mn}) \ . \tag{3.18}$$

This is maximised subject to a budget constraint

$$\Sigma_{j=1}^{n} P_j \; \Sigma_{i=1}^{m} X_{ij} = M , \qquad (3.19)$$

where P_j = price of the j^{th} commodity

and M = total money expenditure.

If β and M are exogenously determined, normalised prices $P_i^* \equiv P_i/M$ can be defined, and the budget constraint becomes

$$\Sigma_{j=1}^{n} P_j^* \; \Sigma_{i=1}^{m} X_{ij} = 1 . \qquad (3.20)$$

The prices of X_{ij} are identical for any j, so by Hicks' aggregation theorum, the agricultural household can be assumed to behave as if it were maximising a utility function

$$\bar{W} = \bar{W}(X_1, \ldots\ldots X_n) , \qquad (3.21)$$

where $X_j \equiv \sum_i X_{ij}$

subject to the budget constraint

$$\Sigma_{j=1} P_j^* X_j = 1 \; [11] . \qquad (3.22)$$

To test empirically this type of specification requires a large data set, so commodity groups often have been highly

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[11] If the utility function in equation 3.21 is twice differentiable, strictly monotonic and exhibits local strong quasi concavity in X_1 "there exists an indirect utility function giving the maximised value of $\bar{W}$ as a function of P^*

$$W^* = W^*(P_1^*, \ldots, P_n^*; a).$$

Demand functions then are

$$X_j = \frac{dW^*}{dP_j^*} \Big/ \sum_{k=1}^{n} P_k^* \frac{dW^*}{dP_k^*} ."$$

The demand functions can therefore be derived without assumptions "concerning the intra-family distribution of commodities other than that it is optimal from the point of view of the household" (p845).

aggregated. Barnum and Squire, for example, specified a utility function

$$U = U(L,C,M) \ , \tag{3.23}$$

where L is leisure, C is the household's consumption of their own agricultural output and M is the consumption of market purchased goods. Philp (1976) divided consumption commodities into leisure, food, and other goods and services, while Lau, Lin and Yotopoulos separated the consumption of leisure, agricultural commodities and non-agricultural commodities.[12]

3.3.3 Labour and leisure. Tanaka (1977, p4) argued that if the "discommodity of labour is not simply the absence of leisure" both labour and leisure should be included in the utility function. To illustrate he quoted from Jennings' description of work "following a brief period of discommodity at the outset, a labourer experiences for a while some pleasure, but soon irksomeness sets in progressively" (Tanaka 1977, p8).[13] Tanaka argued that low levels of labour input could provide utility, but that leisure could never yield disutility. This argument will not be pursued in the thesis.

Two more serious problems with the labour variable exist. Firstly, Jones (1969) claimed that western concepts

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12 An implication of the Linear Expenditure System (LES) is that the ratio of our price elasticities to expenditure elasticities is approximately proportional across commodities. However if the level of disaggregation of commodities is not high, this approximation will not be close (Barnum and Squire 1979, p84). This is another reason why aggregate commodities are used in studies describing consumption behaviour with the LES.

13 Tanaka found the quote from Jennings in Georgescu-Roegen N. "Utility" in International Encyclopedia of the Social Sciences, 16, Macmillan, 1968.

of leisure were not applicable to some areas where many "leisure" activities had a productive component. Events which appeared to be merely social gatherings might have been a means of disseminating information about farm practices, for example. Many activities in developing countries did not fit neatly into the labour/leisure dichotomy, and a definitional problem therefore exists.

The heterogeneity of labour creates a second problem. Winkleman (1972), for example, showed that the pace of work of a group of Mexican farmers varied widely. He argued that the disutility resulting from their labour input would have varied not only with its duration but also with its intensity. Although Winkleman included both the duration and pace of work in the utility function of his theoretical model, data difficulties prevented the pace of work from being included in the empirical model.

The problem of how to aggregate diverse forms of labour into one variable is not unique to utility analysis. A means of estimating production functions which, in some circumstances, can be used to avoid aggregation problems is suggested in Chapter 7. However the definitional and aggregation problems continue to pose difficulties for utility analysis. In most models of the behaviour of the traditional farm family either a labour or a leisure variable is included in the utility function. Generally only the duration of this activity is measured, and that is all that could be done in this investigation.

3.3.4 Assets. In Nakajima's model, asset holdings were an exogenous factor, providing income (E) for the purchase of goods and services. However, assets have non-pecuniary characteristics which yield utility and disutility. Positive asset holdings provide liquidity and risk avoidance, for example, while negative assets can produce worry and the stigma of being in debt. Clements (1976) therefore argued that asset holdings should be included in the utility function.

This may be particularly relevant to societies which exhibit a strong moral aversion to usury.

3.3.5 Precommitted demand. In Fisk's (1975) model, minimum subsistence requirements were the minimum level of income necessary to ensure the physical survival of the household. This minimum limited the feasible region in which equilibrium could occur. Indifference curves were not defined for income levels insufficient to sustain life. Nakajima's minimum subsistence specification included physiological and cultural requirements, and an "economic wellbeing" variable, thereby raising the subsistence quantity "to an acceptable rather than a physically minimal, level" (Philp 1976, p249).[14] The same concept has been applied to utility functions expressed in terms of the consumption of goods and services, when the level of aggregation of commodities is fairly high.[15] Referring to Barnum and Squire's utility function (equation 3.23), the household may have minimum requirements for leisure, agricultural output and market purchased goods. Indifference curves would not be defined for consumption baskets in which any of these goods fell below the minimum acceptable level. In this case, the minimum subsistence requirements could be termed "precommitted demand", (Philp 1976, p249).

Either precommitted demands or minimum survival requirements could be introduced directly into the utility function rather than being included in the manner of Nakajima as an exogenous constraint on the indifference map. For example, Barzel and McDonald (1976) defined the function

$$U = U(C,R) \tag{3.24}$$

where $C = C' - S$, $R = R' - T$, and S and T are the minimum

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[14] Nakajima's definition is based on Wharton (1963).

[15] The concept of a precommitted demand for aggregate commodities such as food and leisure can be accepted more readily than that of a precommitted demand for all goods and services.

levels of consumption of goods and leisure respectively, required for physical survival. C' and R' are the actual consumption levels of goods and leisure in turn. This utility function is defined only for above-survival levels of consumption.

Alternatively, Philp's utility function was

$$U = \sum_{i=1}^{n} \beta_i \log (q_i - \gamma_i) \ , \qquad (3.25)$$

where q_i is the actual consumption of the i^{th} commodity (leisure is included in the commodity space) and γ_i is the precommitted demand for the i^{th} good, including both a biologically determined survival requirement and a culturally determined acceptable component. Again, in common with Nakajima's model, indifference curves are defined only for levels of consumption above the precommitted requirement.

Just as it was shown in Section 3.2 that household size could affect minimum subsistence requirements, precommitted demand also can be influenced by household characteristics. For example households with a large number of single men are likely to have a high precommitted demand for leisure (Philp 1976, p253). Barnum and Squire suggest that the number of workers and dependents in the family, age and education, could affect the precommitted demand for various goods and services. Thus the shape of the indifference map could vary among families according to a number of socio-economic characteristics, and any concept of an average utility function for the different households in a community is meaningless (Dillon and Anderson 1971).

A further rationale for introducing precommitted requirements into models of household behaviour is that demand can be determined in part by habits consumers have acquired (Pollack 1970, 1976). In this case, precommitted quantities are assumed to be the functions of previous levels of consumption rather than of socio-economic variables. Accordingly Lloyd (1977) argues that a more general specification of the utility function is

$$U = U(X_1, X_2, \ldots., X_n; b). \qquad (3.26)$$

Depending on the nature of the study, the shift parameter, b, could be household characteristics, past consumption, the time period in a time series framework, or even the consumption patterns of neighbours (Pollack 1976).

3.3.6 The achievement standard of living. The possible existence of an achievement standard of living provides another explanation of why utility functions might vary between households exhibiting different socio-economic characteristics. Rather than include this standard of living directly in the utility function, Nakajima introduced it as an external restriction. During the early stages of the transition from subsistence to commercial agriculture, when few goods and services other than subsistence requirements were available, households were expected to have limited wants. The achievement standard of income therefore would have been close to minimum subsistence requirements, restricting the shape of the indifference curves (see Fig. 3.3a and b). As development proceeded, Nakajima asserted that the gap would become wider, thereby expanding the region in which subjective equilibrium could occur.

The achievement standard of living could vary for one family over time, as well as among families in the same period. Factors affecting it would include literacy, mass media exposure, mobility (Rogers 1969), education, and the availability of goods and services (Philp 1976). The concept has been applied widely to Pacific economies (e.g. Fisk 1975, Stent and Webb 1975), although Lloyd (1977) showed that it theoretically would be possible to test for the existence of satiation or bliss points in any society.

3.3.7 Conclusions. Although the models of the behaviour of the traditional farm family that have been discussed in this section are similar to Nakajima's model, the utility functions often have been defined in different ways. The more general specification of household utility in terms of the consumption of goods and services allows leisure and assets to be included in the commodity space. Difficulties in defining the leisure/labour variable were noted. It was shown that labour input could not be described adequately simply by measuring the duration of activity. The intensity of work was also important. Although the introduction of a pace of work variable would overcome the problem, data difficulties might prevent its inclusion.

An ideal specification should allow for possible differences in utility functions between households. Two methods of achieving this aim were suggested. Firstly, a shift parameter, varying with such factors as socio-economic characteristics and past consumption levels, could be included in the utility function. An example is the introduction of precommitted or subsistence requirements as a function of a vector of household characteristics. A less general method is to include minimum requirements as an external constraint on the indifference map. Secondly, the achievement standard of living, a constraint on the utility function, could be allowed to vary according to the variables that influenced subsistence requirements.

Some of the factors that Nakajima considered as constraints on decision making have been incorporated into the discussion of the utility function - minimum subsistence requirements, maximum aspiration levels, and constraints imposed by assets and socio-economic characteristics. Other constraints are discussed in the next section.

3.4 Constraints

3.4.1 Constraints on income. Households reach subjective equilibrium by maximising utility subject to the family income curve. If income is used as a proxy for consumption as in Nakajima's utility function, the family income curve (equation 3.2) is determined by market prices (including the wage rate), exogenous income, and production functions for the crops grown on the farm. When the utility function is expressed in terms of the consumption of different commodities, the family income curve becomes a budget constraint. The budget constraint applicable to the utility function used by Barnum and Squire (equation 3.23) is

$$qM + pC = wH + R + pF - \Sigma w_j d_j \qquad (3.27)$$

where M = household consumption of market purchased goods

q = price of them

C = consumption of agricultural output produced by the household

p = price of C

w = wage rate

H = net quantity of labour time sold if $H > 0$, or net quantity purchased if $H < 0$

R = non wage - non crop net other income - similar to E in Nakajima's model

F = total production of C, defined by the production function $F(D, d_j; A)$

D = total labour input to C

d_j = other variable inputs to C

w_j = price of other variable inputs

A = area of land used in the production of C, regarded as fixed in the short run.

Rewriting equation 3.27 as

$$qM = wH + R + p(F-C) - \Sigma w_j d_j \ , \qquad (3.28)$$

the constraint implies that expenditure on market goods (qM) must equal net income. No savings are envisaged. The production function, market prices, and exogenous income determine the possible expenditure. The more the productive activities undertaken by the household, the more the productive processes which must be included in the budget constraint.

<u>3.4.2 Constraints on time</u>. A final constraint must be placed on the system. Nakajima defined a physiologically determined maximum labour input which the family could provide, a similar concept to Barzel and McDonald's minimum amount of leisure necessary for survival. This survival requirement combined with the fact that the total amount of time available is fixed, implies an upper limit for potential labour input. Even if the precommitted demand for leisure is included, some form of time constraint applies, because the total amount of time available must be allocated between competing activities. A simple specification used by Barnum and Squire in the model outlined earlier is

$$T = H + L + D \ . \qquad (3.29).$$

Total time T must be divided between the income producing activities (wage labour H, and farm labour D) and leisure L.

<u>3.4.3 Conclusions</u>. In Section 3.3 it was shown that many of the constraints discussed by Nakajima have been included directly in the utility functions of other models. Both a family income or budget constraint, and a time constraint however, are essential to all models.

Neither of these are exogenous constraints on consumption behaviour. The decision to consume more leisure, for example, cannot be considered in isolation as a consumption decision. It implies a decision to reduce labour input (the time constraint) which in turn reduces the income available to purchase other goods and services (the family income or budget constraint). It is essential therefore that this interdependence of production and consumption decisions be incorporated into models of farmer behaviour.

3.5 Empirical Models of the Producer-Consumer

In the preceding sections it was shown that, if a model of the behaviour of the traditional farmer is to describe accurately the conditions under which the household operates, a number of conditions must be satisfied. Because the traditional household is a unit both of consumption and of production, these decisions must be integrated in the model. Ideally the utility function should be expressed in terms of the consumption of goods and services rather than income, with leisure, the pace of work, and assets, elements in the commodity space. The model must be consistent with the fact that households exhibiting different characteristics value consumption in different ways.

The two major empirical models designed specifically to explore the interdependence of production and consumption decisions of the traditional farmer meet many of these requirements. Households are assumed to maximise utility which is a function of the consumption of a number of commodities including leisure.[16] Both models recognize that utility functions differ among households. Barnum and Squire introduced subsistence or precommitted requirements as a function of household characteristics whereas Lau, Lin and Yotopoulos allowed household characteristics to enter the utility function directly without specific reference to precommitted consumption. The effects of differing numbers of workers and dependents in the household were considered in both studies while

[16] The commodities included in both models were outlined in Section 3.3.

Barnum and Squire included an education and an age variable in addition. Both studies found that the number of workers did not have a statistically significant impact on the demand for commodities other than leisure. The number of dependents had a significant effect on the demand for agricultural commodities in the study by Lau, Lin and Yotopoulos, and on all commodities in that of Barnum and Squire. In the latter, education was found to affect the demand for leisure and purchased commodities, but age proved insignificant in all cases.

Benus et al (1976), by modelling the demand for food as a quadratic function of the number of household members in specific age groups, showed that economies of scale in food purchases could exist. A problem with their specification, admitted by the authors, is that economies of scale were assumed to be created by the presence of multiple members of a given age group only. The addition of the first member of any age group would not create any economies. Another problem is that the single equation approach considers the demand for food in isolation from both the demand for other commodities and production decisions. Manser (1976) showed that estimated demand elasticities were sensitive to both the choice of functional form and whether cross-equation restrictions were imposed. Estimates emerging from single equation models thus are likely to be biased.

Despite these problems, the work of Benus et al illustrated that models of the behaviour of the traditional farm family should be flexible enough to allow for possible economies of scale in food purchases. The models of both Barnum and Squire, and Lau et al are consistent with the concept of economies of scale. However, by subdividing the household into only two groups, dependents and workers, both sets of authors were forced to make assumptions about "units of equivalent productive and consumptive capacity"

(Lau et al, op cit, p850).[17] Had the number of family members in a larger number of age groups been introduced into the analysis in the manner of Benus et al, the demand for each commodity could have been considered in conjunction with both production decisions and the demand for other goods, without the need to estimate adult equivalent units.

To describe consumption behaviour, Barnum and Squire used a Linear Expenditure System (LES) while Lau, Lin and Yotopoulos employed a Linear Logarithmic Expenditure System (LLES).[18] Barnum and Squire characterised

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17 "Dependents are assumed to consume all their available time in the form of leisure and to consume the same quantitites of other goods as do working family members" (Barnum and Squire, p86). Lau et al, p850 defined family members aged between 15 and 60 as adults. Those above 60 were classified as old and those below 15 classified as infant. They then defined the number of workers as the number of adult males plus 0.8 times the number of adult females. The number of dependents was measured as 0.95 the number of old people plus 0.55 times the number of infants.

18 The LES is based on the maximization of a Stone-Geary utility function

$$U = \sum_{i=1}^{n} \beta_i \log (x_i - \gamma_i)$$

subject to the budget constraint

$$\sum_{i=1}^{n} P_i x_i = E ,$$

where x_i = the quantity of the i^{th} commodity

γ_i = the precommitted demand for the i^{th} commodity

P_i = the price of the i^{th} commodity

and E = total income or expenditure.

This maximisation yields expenditure functions of the form

$$P_i x_i = P_i \gamma_i + \beta_i \, (E - \sum_j \beta_j \gamma_j).$$

According to Lau et al (p846) the LLES is derived "assuming that the indirect utility function is a homogeneous ..... transcendental logarithmic function:

$$\ln W^* = \alpha_o + \sum_{j=1}^{n} \alpha_i \ln P_j^* + \tfrac{1}{2} \sum_{j=1}^{n} \sum_{k=1}^{n} \beta_{jk} \ln P_j^* \cdot \ln P_k^*$$

agricultural production with a Cobb-Douglas production function estimated for the single crop cultivated in the region they studied. Lau, Lin and Yotopoulos estimated a composite Cobb-Douglas profit function for the variety of crops grown in a region of Taiwan.

There are weaknesses with both the LES and the LLES. The latter, based on an indirect transcendental logarithmic utility function, implies a unitary total <u>expenditure</u> elasticity for all commodities. Lau et al emphasised that this should not be confused with a unitary <u>income</u> elasticity because their definition of expenditure included an imputed price of leisure. Barnum and Squire used the LES, based on a generalisation of a Cobb-Douglas utility function, in order that expenditure elasticities might differ from unity. They claimed that this specification was justified by demonstrating (Barnum and Squire, p84)

> "the crucial role of the expenditure elasticities in linking the consumption and production sides of the farm-household model and, thus, the importance of using an expenditure system which allows the budget shared to vary."

Two problems however, are encountered with the LES. Firstly, it implies that the ratio of own price elasticities to expenditure elasticities will be approximately proportional across commodities. This approximation is close only if the level of commodity disaggregation is high. This is a reason why Barnum and Squire considered only highly aggregated commodities.

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18 (cont.)

where $\beta_{jk} = \beta_{kj}$, $\forall$ j and k;

$$\sum_{j=1}^{n} a_j = -1; \quad \sum_{k=1}^{n} \beta_{jk} = 0, \ \forall_j \ . "$$

W^* and P^* were defined earlier in the thesis. Using Roy's identity the commodity expenditure functions are derived in the form:

$$-P_j^* X_j = \alpha_i + \sum_{k=1}^{n} \beta_{jk} \ln P_k^*, \ \forall_j \ .$$

More seriously, the LES is based on an additive utility function which Lau, Lin and Yotopoulos claim imposes more restrictions on the system than their assumption of homogeneity.[19] Christensen and Manser (1977) quoting from Deaton (1974, p346) argue that "the assumption of additive preferences is almost certain to be invalid in practice, and the use of demand models based on such an assumption will lead to severe distortion of measurement". Accordingly, Manser (1976) claims that specifications employing a priori restrictions on additivity should be rejected in favour of a more flexible form in which the additivity hypothesis can be tested. A number of functional forms are appropriate and both Manser, and Christensen and Manser produce evidence that the hypothesis of additivity should be rejected.[20] However a practical problem with these specifications is that estimating equations are non-linear.

A further criticism of the equations tested by Barnum and Squire and Lau, Lin and Yotopoulos is that production is modelled according to a Cobb-Douglas function. The problems with this specification are well known and will not be discussed here. There is no reason however, why more sophisticated production models could not be incorporated into either framework.

In each model a constrained maximisation of the utility function produces a set of commodity demand curves, including the

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19 Lau et al, p849 "Under homogeneity, the number of restrictions on the second order derivatives of a function is of the order of n, where n is the number of independent variables. Under additivity, however, the number of restrictions is of the order n^2".

20 Manser suggested the indirect or direct translog utility function, Diewert's generalized Leontief function and Diewert's generalized Cobb-Douglas utility function. She tested a non-homogeneous indirect translog function.

demand for leisure. Household labour supply can be estimated as the residual of the demand for leisure (Lau, Lin and Yotopoulos) which necessitates an arbitrary assumption about minimum leisure requirements. To avoid this problem Barnum and Squire estimated the labour supply function directly, using a transformation suggested by Abbot and Ashenfelter (1976).[21] Labour supply can be examined in either of these ways only if a competitive labour market, in which all households participate, exists. In this case, the household's subjective evaluation of work determines the quantity of household labour supply, but the household's total demand for labour in farm production is determined purely by market forces. Hence consumption and production equations can be estimated separately (Barnum and Squire 1979, p50). However, demand elasticities can be calculated allowing the separately estimated farm profit to be endogenous, thereby integrating the production and consumption parts of the model.

It must be emphasised that the assumption of a competitive labour market is crucial to both models. It allows production and consumption activities to be estimated separately. When no effective labour market exists, the household demand for labour is affected directly by its subjective valuation of work, not simply by the market wage rate, and production can no longer be estimated separately from consumption. To test an empirical model in an area in which no effective labour market existed such as Seaqaqa, would require knowledge of each household's marginal valuation of family labour. No empirical model has confronted this problem successfully.

A rare attempt to consider explicitly the possible impact of different levels of the marginal valuation of family labour, examined the choice of various forms of

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[21] The method is outlined in Barnum and Squire 1979, p87.

mechanization in Mexico (Winkleman 1972). However, marginal valuations were selected arbitrarily in a linear programming model in which the family was assumed to maximise net income. The gain from introducing the marginal valuation of family labour directly into the analysis is offset by the loss incurred by specifying the utility function in terms of a single argument.

Thus the empirical models constructed to examine the interaction of production and consumption decisions of the traditional farmer meet many of the criteria established in the last section. The functional forms tested, however, suffer from a number of weaknesses. Moreover in both models, a crucial assumption is that a competitive labour market in which all households participate exists. Two additional problems can be identified. These are discussed in the next two sections.

3.6 Time

In the discussion to date a one period planning horizon has been assumed implicitly. Some household decisions could fit into this framework - for example, the decision about which crops to plant on a fixed quantity of land when the crops historically considered by the farmer are non-perennial (Abalu 1976). However, the assumption is not appropriate to many farm decisions. For example, models in which utility is defined in terms of consumption in the current period alone, imply that all family income is spent in that period. Savings and the purchase of consumer durables cannot be explained. The decision to allocate labour between competing activities also could involve a time component. Labour can be allocated to perennial or semi-perennial crop cultivation, or the farmer could begin to cultivate new land which would not produce income in the current period. Soil preparation can effect yield over a number of periods even for annual crops. Any decision therefore, which the household realises would continue to affect it after the end of the current period, cannot be explained adequately by models in which a one period planning horizon is assumed.

The concept of intertemporal utility maximisation overcomes these problems. Most commonly it is assumed that the planning horizon for the household consists of a finite number of discrete periods, often a "life time".[22] The planning horizon or lifetime can be defined as the period within which it is necessary to plan in order to make a decision in the first period.[23] Its length can vary according to the decision being considered.

If $$x^t = (x_1^t, \ldots, x_n^t) \tag{3.30}$$

is the vector of consumption in period t and

$$x = (x^1, \ldots, x^T) \tag{3.31}$$

is the intertemporal consumption vector for period $t = 1, \ldots, T$, the household maximises

$$U = U(x) \tag{3.32}$$

subject to an intertemporal budget constraint

$$\sum_{t=1}^{T} \sum_{i=1}^{n} p_i^t \, x_i^t / d^t = \sum_{t=1}^{T} m^t / d^t \, . \tag{3.33}$$

The vectors of period commodity prices and discount factors are represented in turn, by $p = (p^1 \ldots p^T)$ and $d = (d^1 \ldots d^T)$.[24] Family income in time t, (M^t) is given by the equation

$$M^t = w^t H^t + R^t + q^t F^t - \Sigma w_j^t \, d_j^t \, . \tag{3.34}$$

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[22] An example of a theoretical model applied to a developing country, in which time was considered as a continuous variable is Benito (1976).

[23] This definition, proposed by Modigliani, was used by Boussard (1971).

[24] This specification is based on one used by Lloyd (1977). Many of the ideas in this section were discussed in Lloyd's paper.

In equation 3.34 most of the assumptions and terminology used by Barnum and Squire, in equation 3.27 have been used. A time superscript (t) has been added and q is used to represent the price of the farm's single agricultural output rather than p, to avoid confusion with commodity prices. Leisure and assets can be included in the intertemporal commodity space. The budget constraint implies that "the discounted sum of the period expenditure, including terminal assets, must not exceed the discounted sum of the sources of expenditure including initial disposable assets" (Lloyd 1977, p4).[25]

This model, though more theoretically plausible than a one period specification, is difficult to apply in practice. Consumption, production and investment decisions are made simultaneously. The demand for leisure, and hence the supply of labour, cannot be considered in isolation from the prices of all other commodities. Data requirements are enormous. Moreover, in order to make a decision the household must know price levels in each period to the end of the planning horizon.

Boussard (1971) in a linear programming approach considered two ways in which families might arbitrate between present and future consumption. Families would seek to maximise the present value of future consumption

$$\sum_{t=1}^{T} C_t/(1+i)^t \qquad (3.35)$$

where C_t is consumption in period t, i is a discount factor and T is the length of the planning horizon. This specification is rejected on two grounds. Firstly consumption is the only argument in the utility function. To cope with observed purchases of capital goods and durables, the planning horizon must be long, at least as long as the flow of consumption produced by the capital

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25 Lloyd (1977 pp 4-5) showed how this model could be extended to incorporate time constraints necessary when the consumption of some commodities involves time.

goods and durables. Secondly, where a finite planning horizon can be identified, first period programmes are shown to be insensitive to variations in the length of the horizon.

Boussard next considered a Keynesian Linear Consumption Function

$$S_t = aI_t \tag{3.36}$$

and $$C_t = (1-a)I_t \,, \tag{3.37}$$

where S_t = saving in period t

and I_t = income in period t .

In this case maximising the sum of consumption in different periods is identical to the objective of maximising the net worth of the household at the end of the horizon. The existence of a planning horizon is guaranteed, and Boussard argues the assumptions are no more arbitrary than those underlying the Present Value criterion. However, the information required for the household to make a decision in the current period still is demanding. Households in a community which has farmed the same land, using the same techniques, for generations, may be able to make reasonably accurate predictions about the future. New farmers, in a new area, could not.

Two possible justifications for collapsing the multiperiod problem to a simpler single period problem exist. If the utility function in equation 3.32 is homogeneously separable with respect to the period consumption vectors x^t, (see equation 3.30) a subutility function for each period can be defined, with arguments the quantities of each commodity consumed in that period. Subutility functions for any given household do not have to be the same in each period. A composite price index for each period can be defined and households maximise utility in two stages. Firstly, total consumption (and therefore savings) for each period in the planning horizon is determined, given the price indexes and the multiperiod budget constraint. The consumption for each period then is allocated between commodities (including leisure) according to the prices prevailing in each period. The savings/consumption choice and the labour/leisure choice can be estimated separately in a way consistent with the multiperiod budget constraint. Although the household is not required to know all future prices of individual commodities in order to make a decision in the current period, it must form an opinion of the price indexes for all future periods (Lloyd 1977,p8)

The second rationalisation of a single period model is to assume that although the consumer attempts to maximise a one period utility function subject to a one period budget constraint, plans for the future are revised at the end of each period. On this basis the multiperiod maximisation problem can be collapsed to a series of one period problems.[26] This justification is difficult to accept in cases where the household consumer realises that decisions will continue to affect it into the future, for example the decision whether to consume leisure or to allocate labour to a cash crop which will not mature for a number of years. Moreover, where uncertainty is relatively high, the assumption is inappropriate (Lloyd 1977,p8) Uncertainty presents further problems which will be discussed in the next section.

Because of these problems, many of the models dealing with the behaviour of the traditional farm family have not considered how current period decision making is affected by subjective perceptions of the future. They therefore have not been able to account for the impact of the subjective rate of time discount on decision making. Empirical models generally have been based on the assumption of a one period

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[26] This rationalization was used by Clements (1976).

planning horizon. Explicit justifications are few. Barnum and Squire provide an exception by separating long and short term decisions. Long term decisions are made at the beginning of each planning horizon, assumed to extend for one cycle of agricultural production. Short term decisions then can be analysed in a one period framework. Migration by household members, rent (affecting total available land supply), and savings, are taken as exogenous factors for the one period model. Only a limited number of decisions can be considered in this manner.

In this section it was shown that one of the problems with intertemporal models is that they require farm households to be able to predict the value of a large number of variables accurately. This information often is not known with certainty. In the next section, some of the ways in which the impact of uncertainty on decision making have been modelled, are considered.

3.7 Uncertainty

An assumption of both the single and multiperiod maximisation models which have been discussed is that the household's knowledge of a variety of variables is perfect. Prices and yields, for example, are known with certainty. This assumption is not valid even for the simplest one period model. If for example, a household aims simply to maximise profit, an input would be used until its marginal value product (MVP) equalled the input price. Lipton (1968) showed that in most cases a single marginal value product does not exist. Because of variations in rainfall, the availability of inputs, prices of inputs and product, and random fluctuations, a range of possible MVPs exists. The decision to apply an input, can be called a 'risky prospect' (Anderson, Dillon and Hardaker 1977, p67) because a probability distribution of possible outcomes (MVPs) can be defined. 'Uncertainty' describes the fact that a single action can have more than one consequence, while 'risk' is a characteristic of the probability distribution of the consequences.[27]

Scandizzo and Dillon (1976) argue that the environment in which the traditional farmer operates is inherently unstable. Given a low quality soil system, high agronomic risk, large family size relative to resources (especially farm size), and the relative lack of social power of the traditional farmers, households operate at incomes close to the minimum subsistence level, (Moscardi 1975). Costs of failure are high. Lipton emphasised that farmers could forfeit their land to creditors, and at the extreme, physical survival could be threatened. Two types of models have emerged from these ideas. Firstly, households are said to be willing to trade higher potential returns for a lower chance of failure i.e. the riskiness of the prospect enters the decision making process explicitly. Under the second approach a dominant motivating force of the family is seen to be the need to provide the subsistence requirements. Only when these are met can the household afford to consider other objectives.

The neo-classical models outlined earlier have been adapted in a manner consistent with the first description of the way the traditional farmer reacts to the "pervasive uncertainty of his environment" (Scandizzo and Dillon 1976, p3). Because the probability distributions of risky prospects are not known the household is assumed to assign subjective probabilities to each possible outcome. To quote Anderson, Dillon and Hardaker (1977, p68) "the utility of a risky prospect is its expected utility value. This is obtained by evaluating the expected value of the utility function in terms of the risky prospect's consequences i.e.

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[27] These definitions were used by Roumasset (1976). He also discussed the other ways in which the terms have been used and why his definitions are preferable.

$$U(a_j) = E[U(a_j)] \ , \tag{3.38}$$

the expectation being based on the decision maker's subjective distribution of outcomes. In the case of discrete outcomes

$$U(a_j) = \sum_i U(a_j/\theta_i) \ P(\theta_i) \tag{3.39}$$

where a_j = the j^{th} risky prospect, and

$P(\theta_i)$ = the subjective probability that a_j will take a particular value (θ_i)."

If $U(a_1) > U(a_2)$, a_1 is preferred to a_2 .

To test how the hypothesis of expected utility maximisation performed,Dillon and Anderson (1971) reassessed data which had previously been used to support the hypothesis of profit maximisation. These data provided only mixed support for profit maximisation and generally were not inconsistent with the expected utility concept.[28]

To test the hypothesis further requires knowledge of the household's beliefs about likely payoffs and their probability of occurrence. For multi-attribute utility functions of the type discussed in previous sections, these data are difficult to obtain, so various methods of simplifying the problem have been proposed. Anderson, Dillon and Hardaker for example, outline a number of ways in which an expected utility function can be calculated by questioning a decision maker directly. The simplest method is based on the assumption of a single attribute utility function usually defined in terms of income or wealth. The respondent is presented with a decision involving two possible payoffs, (specified in terms of the single

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[28] For the Yotopoulos data to be consistent with the hypothesis of utility maximisation it was necessary to assume that "the average Epirus farmer had a nearly linear utility function and saw himself as facing little risk" (Dillon and Anderson 1971, p31). No special assumptions were required for the data of either Chennareddy or Hopper.

attribute), with known probabilities. Questions then are asked to determine the amount the decision maker would "exchange with certainty that would make him indifferent between that exchange and the specified risky prospect" Anderson, Dillon and Hardaker, (p70). This is defined as the certainty equivalent of the risky prospect. Utility values can be allocated to the two initial payoffs using an arbitrary scale, with the corresponding utility value of the certainty equivalent determined by applying Bernouilli's principle.[29] When the certainty equivalent is less than the expected monetary value of the risky prospect the farmer is said to be risk averse.

The authors also outline a number of methods of estimating multi-attribute utility functions, but they become increasingly difficult as the number of observations and attributes increase. They conclude "we could never establish preferences for all the decision makers in a community and the mind boggles even at determining the utility functions of all the farmers in one village" (Anderson, Dillon and Hardaker, p101).

The technique of estimating utility functions by direct questioning has been criticised on a number of grounds. Most importantly, if decision makers do not think in terms of probability the questions may be meaningless. Officer and Halter (1968) for example "reported misuse of the probabilities due either to probability preferences or to the inability of the subject's to use basic elements of probability calculus" (quoted in Scandizzo and Dillon 1976, p3). Scandizzo and Dillon further believed that poor peasants, whose decisions could be shaped by past experience

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[29] $(C^* \equiv C.E.) = P_a\, U(a) + P_b\, U(b)$

where P_a and P_b are the specified probabilities that outcomes a and b will occur, and C^* is the estimated certainty equivalent (C.E.). For more details, see Anderson et al 1977, pp70-75.

and superstitions for example, would not find the elements of probability calculus relevant to their decision making. This belief was confirmed by responses to their questions by a sample of Brazilian farmers. Finally, questions in which the payoff and probabilities are specified with certainty cannot overcome the problem of identifying the subjective probability distribution the household assigns to the payoffs of any risky prospect. Accordingly this method of testing the expected utility hypothesis has not been used to any extent to examine the behaviour of the traditional farmer.[30]

An alternative approach is to assert that a utility function having as its arguments the mean and variance of the random payoff "is (i) either a local approximation of a more general form of utility function or (ii) a proper transformation of such a utility function for a two parameter distribution" (Scandizzo and Dillon op cit, p6). Taking the expected value of a Taylor Series approximation of a quadratic, cubic, negative exponential, logarithmic or power utility of income (or wealth) function, approximates the utility of a risky prospect as a function of its mean and its moments around the mean. Anderson, Dillon and Hardaker claim that in general, inclusion of moments beyond the third add insignificantly to the explanatory power of the model. Omission of the third moment can be justified if the underlying utility of income function is quadratic or if the distribution of the payoff is normal - in which case the mean and variance fully describe the distribution. Porter (1959) defended his theoretical analysis of the choice of technique in Indian agriculture in terms of the mean and variance of a single payoff, on the grounds that it was the best first approximation available. Wiens (1976) assumed an exponential utility of income function with normality of returns.

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[30] The article by Scandizzo and Dillon (1976) is a notable exception. It is discussed at a later stage.

On the assumption that mean variance analysis is consistent with expected utility maximisation, mathematical programming models have been used to derive a set of efficient mean-variance points, or a mean-variance frontier. Their major application has been to test if choice between various risky prospects, often cropping patterns, is consistent with the concept of a tradeoff between the level of the outcome and its associated risk. Wiens (1976), for example, studying cropping patterns chosen by Chinese peasants, compared the solutions of a quadratic programming problem which allowed for risk averse behaviour, with those of a linear programming model which assumed risk neutrality. He concluded that the risk averse model is consistent with observed cropping patterns whereas the linear programming model is contrafactual.

Other authors have applied programming models in which the objective function is specified in terms of the mean and variance of the payoff without reference to the expected utility hypothesis. Abalu (1976) for example, devised a set of plans which would minimise the square of the coefficient of variation of production, defined as $\left(\frac{\sigma_T}{Y_T}\right)^2$, where Y_T and σ_T are the mean and standard deviation of total income respectively. Schluter and Mount (1976) defined risk as the mean absolute deviation of annual net cash income and claimed that farmers sought to minimise risk for given levels of net income. Subsistence constraints were also imposed on the system. They accordingly, defined a set of efficient mean-risk points for different cropping patterns which were compared to actual choices. Both studies concluded that farmers considered both the level of the likely return and the associated risk when making decisions.[31]

[31] Various other models have been used to test similar propositions. They are not discussed mainly because they rarely have been applied to traditional agriculture. For a detailed discussion, see Anderson et al (1977), Chapter 7.

Two problems emerge when trying to use linear programming models to investigate the expected utility hypothesis. Taking the expected value of the linear constraint implies that on average the condition is satisfied. It therefore may be violated often, and unless knowledge exists on the costs of violating a constraint, the approach is not satisfactory. Moreover, as Wiens showed, linear constraints cannot account for non-neutral attitudes to risk. Quadratic programming models, like that of Wiens can account for a general risk aversion among households, at the cost of greater computational difficulty.

Both the general theory of expected utility maximisation and the special case of mean-variance analysis have been criticised. Roumasset (1974) claims the assumptions necessary to derive a mean-variance maximand from the expected utility hypothesis generally are violated. The quadratic utility of income function is at best a local approximation because it implies that at some levels, the marginal utility of income could be negative. Moreover, it implies that the risk aversion of decision makers varies inversely with their income, which seems inconsistent with observed behaviour. The assumption of normality of the payoff, necessary for non-quadratic functions, is not realistic according to Roumasset although Anderson, Dillon and Hardaker use the Central Limit Theoreum to show that the payoff approaches normality if the sample size is large.

A more fundamental criticism concerns the common assumption that there exists an "indirect utility function in period one money". Roumaset (1976, p27) shows that if the expected utility hypothesis is accepted, "the individual has a consistent ranking of consequences which are characterised by consumption levels of different commodities in different time periods, then the indirect utility function of period one money does not in general exist".

The independence axiom of Bernouilli's principles is violated.[32]

A further criticism is that "full optimality" models such as the expected utility hypothesis require the decision maker to obtain and process a large body of complex information. Earlier it was shown that Scandizzo and Dillon argued that traditional farmers have limited capacities to solve complex decision problems. For similar reasons Roumaset contends that simpler rules of thumb are more consistent with actual decision processes.[33] Three of the most common are outlined:

(a) The Safety Principle

$$\text{Min } \alpha \equiv P_r \, (\pi < \bar{d}) \ , \qquad (3.40)$$

where α is the probability that the objective function, often profit π, falls below disaster level $\bar{d}$.

(b) The Strict Safety-First Principle where the objective function is maximised subject to the constraint

$$P_r \, (\pi < \bar{d}) \geq \bar{\alpha} \ , \qquad (3.41)$$

where $\bar{\alpha}$ is the acceptable probability of disaster.[34]

(c) The Safety-Fixed Principle maximises the minimum return d with a fixed confidence level $\bar{\alpha}$ i.e.

$$\text{Max } d, \text{ s.t. } P_r \, (\pi < d) \leq \bar{\alpha} \ . \qquad (3.42).$$

Roumasset (1976, pp41-43) notes problems with each specification and derives two lexicographic alternatives

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32 For details, see Roumasset (1976) p28.

33 Roumasset rejected Friedman's contention that the model is valid if farmers behaved as if they could solve the problem. He argued that the expected utility hypothesis does not guarantee the existence of any decision making process which the farmers could use to behave in the way predicted by the model.

34 Roumasset showed that under realistic assumptions, Baumol's rule (discussed later) is a special case of this principle.

which involve following either a Safety Fixed or Strict Safety First Principle when the constraint is not met. At other times the expected value of the objective function is maximised. The household gives priority to meeting subsistence requirements. These models thus represent the second line of thinking about the traditional farmer's reaction to uncertainty. However, if farmers do not live close to the subsistence level, and if there is no possibility of disaster, the chance constraint of the Safety First rules can be ignored. Farmers then would seek to maximise the expected value of their objective function as they would under the hypothesis of expected utility maximisation.

If the assumptions allowing the expected utility hypothesis to be expressed in terms of the mean and variance of the payoff are not violated, Safety First behaviour is consistent with expected utility maximisation. This is because of a "one to one correspondence between a utility function of the mean standard deviation type and the Safety First requirement that the payoff be not inferior to a minimum with a given probability" (Scandizzo and Dillon p5).[35] The Safety Fixed model can therefore be expressed as:

$$\text{Max } V(\mu,\sigma_\pi) = \mu - K\sigma_\pi \, , \tag{3.43}$$

where

π = net income

μ = mean net income

σ_π = standard deviation of net income

K = a transformation of the safety fixed risk level α, or a measure of risk aversion.

Baumol argues that a better utility representation of Safety First Behaviour is

$$U = U(\mu, \mu - k\sigma_\pi) \tag{3.44}$$

[35] The original idea was attributed to Pyle and Turnovsky (1970). The particular Safety-first requirement is what Roumasset called the Safety-fixed model.

where $\mu - k\sigma_{\pi}$ is the one sided confidence limit for μ. Again k is a function of α. This approach can be used to estimate directly a risk aversion measure. Scandizzo and Dillon calculated the certainty equivalent of a risky prospect by directly questioning Brazilian farmers in the manner outlined earlier. The mean and variance of the prospect were calculated and related to the certainty equivalent under the two Safety First representations outlined above.

$$\text{i.e. } U(X) + E(X) + \phi[V(X)]^{1/2} = CE \tag{3.45}$$

and

$$U(X) = E(X) + \psi[E(X) - k(V(X))^{1/2}] = CE. \tag{3.46}$$

In the first model ϕ is the estimate of risk preference. In Baumol's model (the second), risk preference can be divided into two multiplicative components, a variance preference (ψ) and a probability or Safety First component (k). Obtaining estimates of ϕ, k and ψ for each household, they examined the distributions of risk aversion among families and tried to relate variations to differences in socio-economic characteristics. The measure of risk aversion k was found to be related positively to membership of a solidarity group, ethical convictions against betting and, at times, age and the level of net agricultural income. However, the greater the home produced food consumption the less risk averse was the household. Attempts to relate ϕ to household characteristics proved unsuccessful. Farmers also exhibited different attitudes toward risk depending on whether or not the subsistence level of living was threatened, with some exhibiting risk preference when subsistence was not in danger.

> "The variable most used to measure subsistence showed, however, such a large variation that it was impossible to determine what is the critical element that the farmer considers in determining his survival level. This conclusion calls for a better understanding of the interaction between the production and consumption behaviour of rural household."

(Scandizzo and Dillon op cit, p23). An attempt is made to understand this interaction in the remainder of the thesis.

Moscardi (1975), using similar assumptions to Scandizzo and Dillon, avoids the problems inherent in direct questioning by assuming the only source of variation in the payoff (income) is yield uncertainty. His utility function (equation 3.43) is maximised subject to a stochastic production function which can be estimated separately. Assuming a Cobb-Douglas production function with variable elasticity of production, the first order conditions can be rearranged to yield

$$K_{js} = \frac{\theta}{\sigma_s}\left[1 - \frac{C_i}{P\, f_x(\cdot)\, \left(\frac{E(Y)}{X_i}\right)_j}\right], \qquad (3.47)$$

where

K_{js} = the risk aversion measure for the j^{th} family in the s^{th} ecological region

$(\sigma_{s}/_{\theta})$ = the coefficient of variation in production in the s^{th} region

p = output price

$f(\cdot)$ = elasticity of production of the i^{th} input

$E(Y)$ = expected value of production

X_i = the i^{th} input, so $\left(\frac{E(Y)}{X_i}\right)_j$ is the input output relationship for the j^{th} farm family

C_i = price of the i^{th} input.

The value K can be estimated using any input, and can be regressed on various socio-economic characteristics of the farm household. Like Scandizzo and Dillon, Moscardi found that variations in risk preference could be explained in part by variations in socio-economic characteristics. The quantity of land under the farmers control, membership of a solidarity group, and, at times, off farm income, proved significant, although age, schooling and family size were insignificant.

Whilst not allowing production and consumption decisions to be made jointly, Moscardi's model improves on that of Scandizzo and Dillon in that production is incorporated. This is similar to the programming models discussed earlier which include independently estimated input-output coefficients as constraints on the objective function.

The results of the empirical models discussed in this section provide some support for the hypothesis that traditional farmers actively consider the risks involved in contemplated plans. The expected utility hypothesis appeared to be a reasonable basis for investigating the impact of uncertainty on decision making especially when subsistence level of living was not at risk. However the modifications which have been made to produce a testable expected utility model are not entirely consistent with the specifications outlined in the previous sections. An objective function in terms of income or wealth cannot explain either the labour-leisure choice, or the choice between consumption in different time periods. However, models based on these objective functions provided useful information on the way attitudes to risk influence decision making. Benito (1976) specified a theoretical function in terms of the distribution of consumption over time, but to produce a testable model assumed that the allocation of time between labour and leisure had already been made. This assumption, similar to Barnum and Squire's division of long and short term decisions, enabled attention to be focussed on the allocation of time between competing income producing activities in one period.

Generally, the models considered uncertainty about yields but not uncertainty about price. Wiens' argument, that the omission is not serious because yield variations are far greater than price fluctuations, is likely to be true because the models encompassed only one time period. Over time, price fluctuations may be of crucial importance. Finally the interdependence of production and consumption decisions is not incorporated adequately.

3.8 Summary and Conclusions

In the first part of this chapter Nakajima's model was used as a basis for discussion of the ways in which the behaviour of the farm family has been modelled using a neo-classical framework. The household commonly was assumed to be the decision making unit. It was concluded that ideally, utility functions should be defined in terms of the consumption of goods and services, including leisure and assets. Useful insights however have been gained from models in which income was used as a proxy for the consumption of most of these goods and services.

Utility functions were shown to differ between families and to change over time for any given household. The inclusion of minimum subsistence requirements and maximum aspiration levels were two possible ways of incorporating this variation between households.

In these models, utility was maximised subject to a family income or budget constraint, and a time constraint. These constraints however, were endogenous to the system, illustrating the importance of modelling production and consumption decisions jointly.

In the second part of the chapter, the two empirical models dealing specifically with the interdependence of the production and consumption decisions of traditional farm families were discussed. In some ways these models met the ideal specifications derived earlier. Utility was defined in terms of the consumption of goods and services, including leisure. The interdependence of production and consumption decisions was incorporated. However, because a competitive labour market, in which all families participated, existed in both study areas, the production and consumption sides of the models were estimated separately. In the absence of a competitive labour market, the models could be estimated only if arbitrary assumptions about subjective marginal valuations of family labour were made.

Apart from the problems inherent in specifying a functional form for consumption and production behaviour, both models suffered from two defects. The impact on decision making of neither uncertainty nor perceptions about the future was included.

In the third part of the chapter, the manner in which time and uncertainty have been incorporated into models was considered. The way beliefs about the future have influenced behaviour has proved difficult to model and even more difficult to test empirically. No means of deriving a subjective rate of time discount from observed behaviour has been developed.

Despite employing a less than ideal specification, empirical models of the impact of uncertainty on decision making have met with greater success. There is a consensus that families consider both the outcome and the riskiness of prospects before deciding between different strategies. However, utility was often specified in terms of income alone, and thus both the labour/leisure choice, and the impact of time on decision making have largely been ignored.

It would be possible to derive an ideal theoretical model of the behaviour of the traditional farm family based on the discussion in this chapter. An intertemporal utility function would be defined in which utility is a function of the consumption of a variety of goods and services, including assets and leisure. A variable measuring the intensity of labour input would be included. A means of incorporating both attitudes to risk and expectations could be derived, and the function could be specified so that it could vary with such factors as household characteristics and habits. However, it has been shown that many of these principles have been compromised in previous empirical work, suggesting perhaps that it might not be possible to estimate the ideal specification.

Before any attempt could be made to estimate a model of behaviour in Seaqaqa, data had to be collected. Implications for the type of information it was necessary to gather were derived from the discussion in this chapter, and are considered further in Chapter 5. The field research however, could not proceed until a sample of the Seaqaqa settlers had been selected and a method of eliciting information from these families designed. Sample selection and survey design are the subjects of the next chapter.

CHAPTER 4

SAMPLING AND SURVEY TECHNIQUES

PART A: The Sample

4.1 Introduction

It was not possible to obtain regular detailed information from the entire population of settlers. With the proposed survey technique and the resources available to one fieldworker, no more than about 60 farms could be included in the sample.

An aim of the research was to identify sources of variation in the performance of farm families. Some of the critical influences on performance in Seaqaqa were more likely to be identified if the households included in the sample showed wide variations in performance. A means of ensuring these variations was to select families exhibiting a wide range of characteristics likely to affect performance.

4.2 Population Characteristics

A preliminary visit to Seaqaqa was undertaken in February 1977. The Project Administration then was preparing a list of settlers detailing characteristics which could be used by officials from the World Food Programme (WFP) to decide how much food aid should be allocated to each household.[1] This list became available

[1] From 1977 the WFP provided settlers with tinned fish, milk powder and cooking fat each fortnight. In addition, occasional deliveries of flour were made. The quantity received declined with the number of years since the family had been allocated a block, and was supposed to cease at the end of three years. Equivalent goods purchased locally would have cost no more than \$6 a fortnight for first, \$4 for second and about \$2 for third year farmers. Not all families however collected this food regularly as the flour at times was of inferior quality, and the fish was cooked in an oil which was not regarded highly.

at the beginning of the major period of fieldwork in June 1977, and details are summarized in Table 4.1.

In June 1977, the rate of settlement was behind schedule, with only 703 blocks allocated, 40 to organizations. Over 60 of the 663 farms in private hands had not been cleared. Despite the selection criteria that leaseholders were to live on the farm and were not to hold off-farm employment, 159 did not reside permanently on the farm and at least 93 were in other full time employment.[2] The characteristics of Table 4.1 provided a possible basis for sample stratification. It therefore was necessary to determine if these characteristics were likely to influence family behaviour, in which case the aim of selecting households whose performance varied widely, would have been achieved. Four hypotheses were postulated.

Hypothesis 1 - Family performance was related to racial background. Fijians who performed badly in Seaqaqa could return to the village, where generally there was sufficient land to produce at least subsistence requirements. Indians could not obtain arable land readily, and when it was available leases were short. Few alternative employment opportunities existed. Indians may therefore have been more highly motivated to perform well in Seaqaqa so as to retain possession of scarce land leased for a relatively long period of time.

A supporting argument is that Fijians did not have a long tradition of participation in the cash economy. In terms of the Nakajima and Fisk models discussed in Chapter 3, the maximum aspiration line of Fijian households might have been close to the minimum subsistence line, restricting the feasible region for subjective equilibrium. Indians, who had been involved in the cash economy since their arrival

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[2] As fieldwork progressed, it became clear that more than 93 leaseholders held off-farm employment.

TABLE 4.1

FAMILIES ALLOCATED BLOCKS AS OF 30TH JUNE 1977, SUBDIVIDED BY SOCIO-ECONOMIC STATUS

		Racial Origin		
		Fijian	Indian	Total
Period of Residence on the Farm	≤ 3 years	257	150	407
	> 3 years	95	161	256
Residential Status	Full time resident family	242	262	504
	Non residents employing farm managers	9	12	21
	Non residents without farm managers	101	37	138
Employment Status	Full time farmers	311	259	570
	Holding full time off-farm employment	41	52	93
TOTAL		352	311	663

in Fiji were less likely to have restricted aspirations for goods and services. Indians might therefore have been expected to perform better than Fijians.

Hypothesis 2 - Performance was related to the length of time a family had been resident in Seaqaqa. Few participants in the project were likely to have had previous cane farming experience. Because the project was aimed at helping the less privileged members of society, applications for blocks were not accepted from families already involved in commercial farming. Experienced cane farmers thus were generally not considered. Cane farming performance in Seaqaqa should therefore have improved as previously inexperienced farmers gained experience i.e. as the time a household had been cultivating cane in Seaqaqa increased.

Period of residency also appeared to be linked closely to Migrant Status. According to the Project Administration the first blocks generally had been allocated to people living in the area before the scheme began (Original Residents). Families who had lived on their farms for more than three years would mostly have been Original Residents, and the remainder, mainly people who had migrated specifically to become involved in the project (Migrants). The decision to migrate may have required stronger motivation to farm cane than was necessary to stimulate applications from Original Residents. Moreover some Original Residents may have applied for blocks for reasons unrelated to the desire to grow cane - to prevent outsiders moving to the area, for example. This factor would have counteracted, at least in part, the effect of experience on performance.

On the other hand, there were reasons for expecting Original Residents to perform better than Migrants. Firstly to the extent that general farming conditions were peculiar to that area, Original Residents would have had an advantage over Migrants. Secondly, relatives of Original Residents were likely to reside closer to the project area than those of Migrants. The latter group might have needed to leave the farm for extended periods for social purposes, leaving less time available for farming activities. Although the impact of Migrant Status on performance was ambiguous, the effect of cane farming experience implied that a positive correlation between Period of Residency and performance should have been expected.

Hypothesis 3 - Household performance was related to residential status. Full time residents were expected to perform better than other leaseholders for two reasons. The fact that a family was living on its farm might have reflected a greater commitment to Seaqaqa than would be found in absentees. Moreover, households living close to their cane would have had more time available for farm activities than those which had to travel considerable distances.

The position of farm managers was unclear because the term was used to describe a variety of situations. In some cases, disinterested absentee leaseholders had installed unemployed relatives as farm managers, often to convince the administration that they had serious farming intentions. In other cases, leaseholders were too busy to run the farm on a daily basis, but remained in close contact with their farm managers in an attempt to maintain high standards. From information gained during the preliminary visit, the former case appeared more common, so the hypothesis that residents would perform better than other leaseholders was retained.

Hypothesis 4 - Family cane farming performance was related to employment status. With given family and farm sizes, leaseholders in full time, off-farm employment would have had less time available for farm activities than full time farmers, and their performance was expected to suffer. The fact that many leaseholders in full time employment visited the farm only periodically, or employed farm managers re-enforced this conclusion. The possibility that these families had greater stocks of capital available for farm investment was not likely to be important due to the generous credit facilities provided by the FDB.

4.3 Checking the Hypotheses

There were two ways of checking these hypotheses before selecting the sample. For the World Food Programme, the FSC had estimated the likely gross 1977 cane harvest for each farm, and had categorised families according to whether their performance had been satisfactory or unsatisfactory. The first was not considered to be a useful indicator of performance because it made no reference to the area of land planted to cane nor to any special problems faced by particular households. In the short run the area under cane, and hence gross output, reflected the performance of clearing contractors more than that of farmers. The FSC's subjective assessment of performance at least took these factors into account implicitly. Details of the farmers classified as unsatisfactory are provided in Table 4.2.

These figures supported the hypotheses that leaseholders not residing on the farm and those holding off-farm employment were more likely to be unsatisfactory than full time residents and leaseholders with no alternative full time employment respectively. However, families who had been resident on the block the longest had a greater proportion categorised as unsatisfactory than more recent arrivals. Either the additional motivation of Migrants outweighed the greater experience of Original Residents, or the FSC did not label households unsatisfactory until they had had a chance to prove themselves.

A slightly lower proportion of Indians than Fijians was categorised unsatisfactory, but the greatest differences were found within the racial groups. For example, Fijian families which had resided on their farms for more than three years had over three times the proportion of unsatisfactory performers as Fijian households which had

TABLE 4.2

UNSATISFACTORY FARM FAMILIES

		Period of Residence		Residential Status			Employment Status		Totals
		> 3yrs	≤ 3yrs	Farm Managers	Absentees	Residents	Other job Holders	Full time Farmers	
Racial	Fijian	30 (11.7)†	3 (3.2)	1 (11.1)	23 (22.8)	9 (3.7)	8 (19.5)	25 (8.0)	33 (9.4)
Origin	Indian	12 (8.0)	10 (6.2	2 (16.7)	9 (24.3)	11 (4.2)	10 (19.2)	12 (4.6)	22 (7.1)
	TOTAL	42 (10.3)	13 (5.1)	3 (14.3)	32 (23.2)	20 (3.8)	18 (19.3)	37 (6.5)	55 (8.3)

† Figures in brackets are percentages, representing the proportion of the total number of families in a given category regarded by the FSC as unsatisfactory.

lived in the area for a shorter time. The corresponding difference between Indian househoulds was less than 30%.

These data suggested that differences in performance according to Period of Residency, Racial Origin, Residential Status and Employment Status existed. Stratification of the sample according to these socio-economic characteristics therefore was warranted.

4.4. Stratification. To stratify according to all the categories of Table 4.1 would have presented two problems. Firstly, locating and communicating with leaseholders in full time, off-farm employment, and with absentees scattered throughout Fiji, would have involved excessive travel, severely limiting the time available for intensive farm visits. Secondly, there was no way of assessing performance on farms which had not been cleared, or which had been cleared so recently that no crops had been harvested. Accordingly, the universe from which the sample was selected was restricted to residents of established farms who held no full time, off-farm employment. In effect, only families who complied with the stated selection criteria for the scheme were included. These are the people in whom planners would be most interested when designing similar schemes in the future.

However, Table 4.2 illustrated that other job holders and absentee leaseholders appeared more susceptible to failure than the remainder. It therefore was decided to supplement the main research with some separate case studies of households from these categories if time permitted.[3]

Characteristics of the remaining households are summarized in Table 4.3. A sample of 60 represented 15.7% of this population. Only nine of the families originally

[3] Some case studies were made, but the results are not analysed in this thesis.

TABLE 4.3

HOUSEHOLDS REMAINING AFTER UNCLEARED FARMS, NON-RESIDENT FAMILIES AND LEASEHOLDERS WITH FULL TIME, OFF-FARM EMPLOYMENT HAD BEEN OMITTED

Racial Origin \ Period of Residence	> 3 yrs	⩽ 3 yrs	Total
Fijian	115	73	188
Indian	83	110	193
TOTAL	198	183	381

classified as unsatisfactory remained. They are subdivided by Racial Origin and Period of Residence in Table 4.4, but the numbers in each category are too small to allow conclusions about the relationship between these variables and performance to be drawn.

TABLE 4.4

REMAINING UNSATISFACTORY HOUSEHOLDS

Racial Origin \ Period of Residence	> 3 yrs	⩽ 3 yrs	Total
Fijian	5 (4.3%) †	1 (1.4)	6 (3.2)
Indian	0 (0)	3 (2.7)	3 (1.5)
TOTAL	5 (2.5)	4 (2.2)	9 (2.4

† Bracketed figures representthe proportion of the population in the different categories of Table 5.3 regarded as unsatisfactory.

With the elimination of uncleared farms, leaseholders in full time, off-farm employment and those not resident on the farm, stratification according to Racial Origin and Period of Residence could proceed. During the preliminary visit one of the most common questions from both administrators and farmers concerned the eventual racial composition of the sample. Any selection other than equal representation of Indians and Fijians would have risked alienating members of at least one racial group, thereby threatening the success of the research.

The number of Fijians remaining in the population almost equalled the number of Indians. Equal representation according to Racial Origin could have been achieved by selecting the numbers in each category in proportion to the category's population size, resulting in the distribution of Table 4.5

TABLE 4.5

POSSIBLE SAMPLE SELECTION UNDER PROPORTIONAL REPRESENTATION

Racial Origin \ Period of Residence	> 3 yrs	≤ 3 yrs	Total
Fijian	18	12	30
Indian	13	17	30
TOTAL	31	29	60

A second way of ensuring parity according to Racial Origin was to select fifteen households from each of the categories of Table 4.3. This method was employed for two reasons. Firstly, although proportional representation commonly is used if rigorous comparisons are to be made between groupings, the main purpose of stratification in this study was to ensure that the sample contained families exhibiting a wide range of characteristics likely to affect performance. Secondly, had there been many uncooperative respondents or data difficulties in the group with fewest representatives under proportional representation, the numbers in that category may have been reduced to an extent preventing useful analysis.

To ensure the widest range of performances possible, the remaining nine families deemed unsatisfactory by the FSC were included in the sample. The other places in each category were filled randomly. Details of the final sample composition are found in Table 4.6.

Halfway through the period of fieldwork, it became clear that one Indian family which had been living in the region for many years was not providing accurate information. This household had not been performing satisfactorily in the opinion of the FSC. Despite repeated attempts to gain the family's confidence, it eventually had to be omitted. Two other Indian households which had been living in Seaqaqa for more than three years were omitted from the subsequent analysis. It emerged that both were heavily involved in business activities which yielded substantial income not declared for taxation purposes. Both

TABLE 4.6

THE SAMPLE

	Racial Origin	Indian	Fijian	Total
Period of Residence	Less than or equal to 3 years - unsatisfactory	0	5	5
	- satisfactory	15	10	25
	More than 3 years - unsatisfactory	3	1	4
	- satisfactory	12	14	26
	TOTAL - unsatisfactory	3	6	9
	- satisfactory	27	24	51

were reluctant even to acknowledge the existence of these activities and accurate details never were obtained. These households belonged to the group of satisfactory farmers. Although information was collected from 60 farms, data from only 57 were analysed.

4.5 Summary

The study aimed to identify sources of variation in performance. Because of the large number of farms involved, sampling was necessary. Information on a number of household characteristics which were expected to influence performance became available before sample selection, only some of which could be used as a basis for stratification. Uncleared farms, non-resident families and leaseholders with full time, off-farm employment had to be omitted. The remaining households were stratified according to Racial Origin and Period of Residence, with 15 families chosen from each subgroup. To ensure the widest range of performances possible given the available information, all households categorised by the FSC as unsatisfactory, and which had not been omitted earlier, were included in the sample. The remaining places were filled randomly. Three families, however, eventually had to be omitted from the analysis.

PART B: Survey Technique

4.6 Determinants of the Choice of Survey Technique

Fieldwork began in July, early in the 1977 harvesting season, at a time when ratoon preparation for the 1978 harvest was commencing. Fieldwork was concluded at the end of June 1978, early in the 1978 harvesting season, at which time preparations for the 1979 harvest were beginning. Details of the 1978 harvest were collected during a subsequent short visit to Seaqaqa in August 1979.

Included in the FSC records of each farm were details of all inputs which had been supplied by the FSC, the quantity of cane produced in previous harvests, harvesting and transport expenses, tax deductions and cane proceeds refunded by the FSC to each family's account with the FDB. Information on early land clearing and preparation costs were obtained from the FSC, and subsequently from the FDB. The Bank maintained records of loans advanced to settlers, subdivided according to the purpose of the loan - the subsistence allowance, housing loans and loans for the purchase of capital equipment, for example. The NLTB provided information on the total land area of the farm, the rent applicable and survey fees charged.

However, the only way in which details of the inputs actually used on individual farms during a cane growing season could be obtained was by observing and questioning the family intensively over an extended period. Because virtually no data about non-sugar activities were available from official records, this process of observation and questioning was also the main source of information about these activities.

In considering how the available resources could best be used to obtain this information, three factors had to be balanced carefully. Firstly there was a tradeoff between the completeness of the information which could be obtained for individual farms, and the number of farms that could effectively be included in the sample. Secondly, the more frequent and the more time consuming the visits to each farm, the greater the rapport that could be built between the interviewer and interviewee. On the other hand, it was essential to avoid irritating the respondents by over persistency and by being too demanding on their time. Thirdly, the degree of reliance on official backing had to be judged finely. Farmers might have been less willing to cooperate in research of no interest to the administration and therefore unlikely to affect them. Alternatively, details of sensitive factors such as undeclared income may not have been supplied to someone with close links with the government. The survey technique outlined in the next section attempted to balance these factors.

4.7 The Preliminary Visit

Once the sample had been selected, a preliminary visit to each farm was made in the company of the FSC Farm Advisor responsible for the area. The aims were to become acquainted with the family, to explain the research, to seek cooperation for the subsequent intensive visits, and to obtain information about a limited number of socio-economic details. A schedule of the questions asked on this visit is attached as Appendix 1. This, the only visit made in the company of representatives of the administration, was to establish not only that official approval had been granted, but that the results were of official interest. During subsequent visits, it was stressed that the researcher was not a Government employee, and although copies of the report would be sent to the administration, sensitive information would be kept confidential.

Three lessons were learned from the preliminary visits. Firstly, no family had maintained written records of farm activity, making the accurate collection of historical information difficult. Secondly, no English was spoken on 26 farms. The writer was fluent enough in Fijian to interview people speaking broken English but was never able to interview competently those speaking no English. Assistance with interviewing therefore had to be obtained. Finally the strong interest shown in the racial composition of the sample confirmed the wisdom of the decision to select an equal number of Indian and Fijian families.

4.8 Intensive Visits

In order to avoid burdening the farmers too heavily with questions, and to maintain a relatively large sample size, it was necessary to restrict the frequency of individual farm visits. However, it was important to make sufficient visits to build trust and rapport, and to ensure that the farmers' memories of recent events were not impaired. It was decided therefore to make four intensive visits to each family over the year.

During an intensive visit a farm was visited on each of twelve consecutive days. On the first four days, questions were asked about farm activity since the last visit. (At the first intensive visit, questions about activity since preparations for the 1978 harvest had begun were asked). The next set of questions sought details of all activity on the farm, as well as that of household members off the farm, on each of the next seven days. On the final day, the week's activity was summarized, and questions about the family's plans for the period until the next visit were asked. The answers to these questions provided a useful reference point for the first series of questions of the following intensive visit.

For the intensive visits farms were divided geographically into groups of six to eight. When all the "first round" interviews had been completed, round two commenced. It was planned to leave about eight weeks between the end of one intensive period and the beginning of the next, for each household. Each visit was designed to last for about an hour, although they were at times completed more quickly if the family wished. To minimize disruption of family schedules, visits were made at times when the household was not busy - in the morning, evening or at meal breaks, for example. To foster rapport with families, short, informal visits were made between intensive periods whenever the opportunity arose.

4.9 The Interviewers

Attempts were made to employ interviewers who lived close to the twenty-six farms on which no English was spoken. This proved difficult as many of the people with sufficient education had migrated in search of wage

TABLE 4.7

RACIAL ORIGIN AND EDUCATIONAL ACHIEVEMENTS OF THE INTERVIEWERS

	Years of Completed Schooling				
	12 yrs	11 yrs	10 yrs	Trade Qualification	Total
Racial Origin - Indian	3	1	-	-	4
- Fijian	1	-	1	1	3

employment. The seven helpers that eventually were employed on a casual basis are categorised by racial origin and educational achievements in Table 4.7. None of the four who had completed class 12, the final year of secondary schooling, had met university entrance requirements. One Fijian, a mechanic by trade, was aged about forty-five years. The other six interviewers were younger than thirty.

No interviewer was required to visit more than five farms in any intensive period and each interviewer visited the same families throughout the year. Two agreed to accept employment on the condition that they visited more farms than originally had been anticipated. Eventually assistance was received with thirty two households, twenty-one Indian and eleven Fijian. Wherever possible helpers were sent to families of the same racial origin as themselves. Three Indian households, however, were questioned by Fijians.

It was not possible to accompany each helper to every interview. After initial detailed instruction, at least every second interview during the crucial first intensive period was supervised. Thereafter, interviewers were supervised regularly on the first and last days of each interview period, and once in between. Irregular unscheduled checks were also made whenever possible.

4.10 The Questionnaires

The questionnaires were designed to be flexible enough to allow the interviewer to pursue points of interest. A number of farmers that had not been included in the sample were subjected to a series of test interviews, both with and without the aid of interviewers. During these tests it became clear that the interviewers required a more structured format than was planned initially, and the questionnaires were amended accordingly. The amended questionnaires are included in Appendix 1. The interviewers were encouraged, however, to be flexible, and the system of interview checks described earlier proved effective in obtaining additional information where an interviewer had not pursued a particular topic adequately.

Although the interviewers in general coped well with their duties, three problems were identified. The first, the interviewer's lack of flexibility in questioning, was overcome by close supervision. Secondly, twenty-two households had known their particular interviewer before the research began. At times, interviewers were protective of these respondents and information was not recorded fully. This attitude became less noticable as both the interviewers and the participating families gained confidence in the research. Some interviewers even began commenting on questions they believed households had answered inaccurately. A benefit of this relationship between interviewers and certain households was that the families' fears and suspicions about the research often were allayed faster than would otherwise have been possible.

The final problem was not limited solely to the helpers. In Seaqaqa, males who did not belong to the immediate family were not expected to show any interest in the activities of women. The interviewers proved reluctant to request information about women and only limited data of this nature were collected. This problem is discussed further in Chapter 5.

4.11 Checks on Information

Two additional checks on the details provided by families were made. Some information which was available from official sources was also requested from farmers. Details collected from the two sources generally coincided, increasing the confidence which can be placed in the answers to the other questions.

Secondly, households were aware of most of the activities of their neighbours. Informal discussions, often over a bowl of yagona, proved a useful means of corroborating information provided by other families. Any discrepancies that emerged were checked at subsequent interviews.

4.12 Conclusion

The survey technique was designed to achieve a balance between sample size, data reliability, and the amount of questioning which could be undertaken at each farm. Preliminary visits were made to each farmer in the sample, followed by four periods of intensive visits, each lasting twelve days. Seven interviewers were employed at various times to question households in which no English was spoken. Early tests of the questionnaires revealed that the interviewers required a more structured format than was planned. A number of other problems were encountered, but the system of checks on both the interviewers and the answers provided by households, ensured that errors were minimized.

CHAPTER 5

DATA COLLECTED DURING A FIELD SURVEY OF 57 FARM FAMILIES

5.1 Introduction

In this chapter are set out the main data collected in the field during the period July 1977 to July 1978 concerning the 57 sample families in Seaqaqa. First, however, the basis for selecting the type of data required, will be briefly explained.

A model of household behaviour needs to take into consideration conditions that may be peculiar to the particular area under study. Thus the final specification of the model to be applied in Seaqaqa had to await the opportunity for those conditions to be observed during fieldwork. However the models discussed in Chapter 3 had been applied in other practical situations, and provided useful indications of the type of data that would need to be collected. Applied to the Seaqaqa situation, it was clear that labour (or leisure) was one variable to be assessed, and that the indebtedness of the farmer was a second; the third would be a complex of income and expenditure data for the farms. This, together with the socio-economic variables that might explain farm characteristics and attitudes, set the general pattern for the field investigation plan.

After this introductory section, the chapter is divided into two main parts. Part A sets out the data concerning the main parameters of the farmers' performance, as seen by themselves, and as seen by the Project Authority. Part B then sets out the details of the socio-economic characteristics of the farm households, and discusses the relationships of these with their performance from the two points of view, and with the individual components from which that performance is achieved.

The labour input of the farm households is detailed in Section 5.2, at the beginning of Part A, but in Seaqaqa the labour decision is a complex one. There are really two separate decisions of interest; the first concerns the total time to be put into labour instead of leisure; the second concerns the distribution of that labour between three main kinds of application, viz. subsistence farming, cane cultivation, and other (such as wage labour). This distribution of the labour input is discussed and recorded in Section 5.3.

On the assumption that farm families would seek to maximise utility, the households would be expected to offset the disutility of their labour against the utility gained from their activities, and one of the major sources of such utility would be, in their own eyes, the level of consumption (and thus expenditure) achieved. Therefore extensive details of household consumption and expenditure were collected from the sample, and this is detailed and discussed in Section 5.4.

However, current consumption would not be the only source of satisfaction and utility to the Seaqaqa settlers. Indeed one of the main reasons for entering the scheme and undertaking the task of opening up a cane farm was to gain title to the land offered in the allotment. Land in Fiji, as has been explained in Chapter 2 is a scarce commodity, and a long term title, such as offered in Seaqaqa, is highly valued. The asset situation of the farmer, in which his rights to the land, and his debt to the Project through the Development Bank and the FSC were the major components, is outlined in Section 5.5.

Finally, although to the farmer the maximisation function would be related to labour cost, income and his asset/debt situation, and he would assess his performance by reference to those variables, the Project Authorities appeared to take a narrower view. For them the main criterion of performance was the output of cane achieved, and as the Authority could terminate the title of unsatisfactory settlers, it was a matter of considerable importance to the farm households to avoid being classified as unsatisfactory in that sense. This complicating factor in the farmers' situation and motivation is discussed in Section 5.6.

The models in Chapter 3 also suggested that certain socio-economic characteristics of the farm households affected the values upon which the operational decisions of the households, and their preferences, were based. Accordingly a range of socio-economic data were also collected concerning the farm households, and these are given at the beginning of Part B, in Section 5.7. Then the relationship between these characteristics and the labour inputs, income and expenditure patterns, and the asset/debt situation are evaluated in the next three sections. The chapter then finishes with a discussion of some implications and conclusions.

As most of the data summarised in this chapter is not otherwise available to researchers or government officials, they are presented in full at the end of the chapter.

PART A

OBSERVATIONS OF AVERAGE FARM PERFORMANCE

5.2 Labour Inputs

As explained in Chapter 4, the system of data collection from the farm households was based upon four separate visits to each household for two weeks at a time during the period of fieldwork, the second week of each visit being devoted to the collection of intensive data concerning household activities. It was not possible, therefore, to collect detailed records of the labour input of each member of each family throughout the whole period. This was, however, done for the four periods of seven days intensive investigation with each household.

One method of estimating the household labour input over the whole year was thus to take this intensive data for the four weeks, weight them in accordance with the weighting system set out in Table 5.1, and multiply them by thirteen.

In making these weights reliance was placed primarily on direct observation of performance throughout the year by the researcher, and the results of those observations turned into weighting rules. For example, sick and incapacitated people were omitted from the calculation, as they did not help with farm work. Males older than 55 years were given the same weight as younger males in weeding cane, because people in those age groups were observed on average to weed cane with about equal effectiveness. Similarly, with rice planting - a task requiring little strength - children between the ages of 13 and 17 years were seen to perform equally as effectively as adults, and were therefore given the same weight. On the other hand, children of this age group took more time than adults to apply fertiliser to a given area of land, as they could not carry as much fertiliser at a time. The problems of assigning weights are discussed further in Section 5.7.

Estimation of total labour inputs on this basis was, however, likely to be inaccurate, for labour inputs varied considerably during the year and with different cropping patterns. Rice planting, for example, was concentrated in a short period at the beginning of the wet season, and accurate details of labour inputs for that activity could only be collected for families scheduled for intensive visits at that time. In general, the information taken over the four weeks intensive investigations were unlikely, on their own, to reflect accurately the peaks and troughs of labour activity required by the agricultural cycle.

TABLE 5.1

ADULT EQUIVALENT PRODUCTION UNITS

	Male				Female			
Age	<13 yrs	13-17	18-55	>55	<13 yrs	13-17	18-55	>55
Task								
Cane - weeding	0.7	1	1	1	-*	0.8	1	-
- planting	0.75	1	1	-	0.75	0.9	1	0.9
- interrow ploughing	-	0.8	1	-	-	-	-	-
- harvesting	-	-	1	0.9	-	-	0.8	-
- spraying	-	0.9	1	-	-	-	0.8	-
- fertilizing	0.6	0.9	1	0.9	0.6	0.75	0.9	0.75
Rice - all activities	0.8	1	1	0.9	-	1	1	0.8
Other Crops	-	1	1	1	0.8	1	1	0.9
Off-Farm - paid	0.65	0.95	1	0.9	0.65	-	0.95	-
- unpaid	-	-	1	1	-	-	1	-
Domestic Tasks - males†	-	1	1	1				

* No cases of people of the particular age group undertaking the task were observed.

† No information on the distribution of domestic duties among females was available.

To overcome this problem, a more elaborate method of estimation was employed, making use of the supplementary information collected during the "catch up" interviews conducted in the week before each intensive investigation period with each household. This information was used to construct a picture of all the activities undertaken by each household throughout the year. Responses could be readily checked. For example, the area of land a family claimed to have planted during the period between visits was measured. Reported activities using inputs such as fertiliser were checked by comparing stocks held by the household with details of purchases from suppliers (mostly the FSC).

It was not possible to observe separately the times taken by every household to complete each type of task, but the intensive visits provided enough observations to compute an average standard time for each activity. This average was applied to the size of task reported to expand the observations of the intensive periods over the intervening periods, and thus to calculate a second, and more accurate, estimate of labour input for each household.[1]

This second method of calculating total labour inputs gave an average annual figure of 1300 hours for the Seaqaqa sample, whereas the more simplistic first method gave an average of 1551 hours. Whilst both are estimates, there is little doubt that the former is the more accurate,

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[1] For example, it was estimated that an adult male with a pair of bulls would typically take 15 hours to plough between the rows of one hectare of cane. If it was determined that one household had ploughed 5 hectares in this manner during the year, it was calculated that its labour input for that task had been 75 hours. Differences between household labour inputs thus reflected differences in the work done, rather than in the pace of work.

and that is the one upon which reliance is placed in what follows.

In both these estimates the labour of male members of the household only were included. The Seaqaqa community was a conservative one, and in most cases it was not acceptable for a male investigator to address questions directly to women; for much of the time, and particularly during the early part of the fieldwork, male members of the household were not prepared to give information about the activities of females. The work done by women members of the households could not, therefore, be estimated in the manner outlined above.

However, with growing rapport between researcher and the sample households, towards the latter part of the fieldwork it was possible to break down this reserve to some extent. Eventually a list of the daily tasks commonly undertaken by women was compiled for each household, together with an estimate of the time these tasks generally took to complete. This information, usually provided by one of the male members of the household, was used to calculate the annual domestic labour input of the women in each household. Details of the household labour inputs, including the estimate for female labour, are given in Table 5.2. No detail about the distribution of female labour effort between individual women of the household could be obtained.

One feature of the female household labour supply requires special mention. Even during times of peak farm activity, women did not reduce the time they spent preparing meals and doing other normal housework. Households thus appeared to consider the non-farming work of women as an exogenous constraint. Accordingly, that part of the female labour used in housework is excluded from the household labour available for allocation between subsistence and cash cropping.

TABLE 5.2

ESTIMATED YEARLY FAMILY LABOUR INPUT (IN HOURS)
57 FAMILIES

	Mean	Standard Deviation
Current Consumption		
- subsistence production	357.75	252.84
- unpaid off-farm labour	91.951	184.25
- paid off-farm labour*	316.34	500.01
- male domestic labour	82.22	153.20
- other	122.35	62.46
Total	970.61	325.18
Debt Reducing		
- cane	238.71	197.14
- tractor	90.26	226.76
Total	328.97	632.18
Total Labour	1299.58	732.24
Female Domestic Labour	1986.95	774.91
Total Labour Input Including Female Domestic Labour	3286.53	1280.18

* This includes time spent harvesting cane and wage labour. Much of the wage labour time was contributed by members of four families who gained semi-regular employment shortly after the survey began.

The total labour input of the sample households was remarkably low. If female domestic labour is excluded, total labour use by the sample households for all purposes (on farm and off farm) averaged only 4.65 hours per production unit per week.[2] If female domestic labour was included, the average rose to 11.75 hours per production unit per week. It would appear that, except possibly for occasional peak periods, shortage of available male workers was not a constraint on the average Seaqaqa farm.

5.3 Allocation of Labour Between Competing Activities

The farm households in Seaqaqa had a number of choices regarding the utilisation of their labour capacity. The first, of course, was the choice between work and leisure, covered in Section 5.2. Then there is the choice between different types of work, as between subsistence gardening, cash crop cultivation (cane), and other occupations such as wage labour or unpaid off-farm labour. This latter range of choices can be simplified in Seaqaqa into a dichotomy according to its main purpose. The work could be directed at producing current consumption - e.g. subsistence gardening or off-farm wage labour - or at reducing the farm debt through work on cane production or tractor hire.

This simplification is possible because, at the time fieldwork was undertaken, the Project Authority rules provided that 100% of the cane proceeds for the first three harvests were retained for debt reduction. Even farms producing their fourth harvest could expect no cash return during the current season. Twelve dollars per tonne was credit to their accounts at the time their cane was delivered to the mill. Invariably the entire payment

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[2] The average number of adult equivalent production units per family was 5.35. See Table 5.13.

was retained by the FSC to cover the cost of inputs which had been advanced to the farmer (such as seed cane, fertiliser etc.), to meet cutting expenses and the costs of transporting the cane to the mill. These families were entitled to 25% of any proceeds remaining after all these costs had been recovered. At the earliest, they received some of this money when the second cane payment was made early in the next growing season. For the sample households, therefore, current labour inputs into cane production were for debt reduction and not for current consumption.

A small exception to this may have occurred where the household operated a tractor. In the classification of labour here, the work involved in hiring out tractor services to other farms has been treated as debt reducing labour, despite the fact that 33.3% of the gross earnings was paid to tractor owners in cash. There may, in some cases, have been some small consumption component available from this, although tractor owners consistently maintained that the amount was insufficient to meet current operating costs.

Labour voluntarily provided by household members to other families (unpaid off-farm labour) has been included in the consumption producing activities although there was likely to be a debt reducing or asset building component. In Papua New-Guinea for example it has been shown that people provided such labour in a deliberate attempt to build a set of obligations which they could recall at some time in the future (Moulik 1973). In Seaqaqa this investment component did not appear on the whole to be significant. "Voluntary" labour was provided because it was requested rather than because of a deliberate attempt to build obligations. The supplying family fulfilled social obligations, and consumed goodwill.

Using the assumptions outlined above, activities designed to generate current consumption accounted for

74.7% of the mean total labour input when the domestic duties of women were omitted. If female domestic labour is included, the average family devoted almost 90% of its labour input to increasing current consumption.

In Chapter 1 it was argued that many of the families which had been allocated farms in Seaqaqa had participated only rarely in the cash economy before the project began. Table 5.2 reveals that monetary pursuits (paid labour, cane production and tractor hire) comprised over 49% of the average labour input observed during the period of fieldwork (when female domestic labour is excluded). This suggests a significant change in behaviour patterns as a result of the scheme.

5.4 Income and Expenditure Patterns

a. Income. The allocation of labour described in the last section partly determined the level of income, detailed in Table 5.3. Annual average non-farm cash income consisted of wage labour (\$128.91), income earned cutting cane or acting as a gang leader (\$185.07), and business income (\$141.20). Wage income was relatively high because members of four families obtained semi-regular employment soon after the research began. Members of 33 families joined cutting gangs for part of the 1977 season, and 17 households at times operated small businesses. For example one intermittently ran a small store from the farm, and one owned a chain saw which he sometimes used to cut firewood for sale.

Bank Income includes the subsistence loan (\$532.34) and a planting allowance (\$19.86). The latter payment was made at the rate of \$37.50 for each hectare of cane the family had planted. Costs were debited to the family's account with the FSC. Like the subsistence allowance, this facility increased current consumption at the expense of debt.

TABLE 5.3

SOURCES OF CURRENT INCOME
57 FAMILIES

Source of Income	Mean ($)	Standard Deviation
Non-Farm Cash Income	455.18	504.37
Exogenous Income	109.58	330.40
Sales	54.74	84.24
Subsistence Production	525.25	411.32
Bank Income	552.20	508.31
TOTAL Value of Consumption	1696.94	927.31

Subsistence production and the food component of exogeneous income were valued at the farm gate buying price. This is the price the family would have had to pay if it had purchased food crops in preference to cultivating them. It was not difficult to find families in Seaqaqa who were willing to sell subsistence crops, so the local Seaqaqa price is used and there is no need to impute the costs of travel to purchase these commodities.[3]

Like the evidence of the last section, these data suggest that the average family was more dependent on the cash economy than it had been before the project began. Cash income provided for 62.6% of all consumption requirements.

b. Expenditure. Subsistence production, and most of the exogenous income included in Table 5.3, consisted of

3 This does not invalidate the argument of Chapter 6 that there was no real market for subsistence crops. All farmers grew their own and thus there was no demand to purchase these crops. The few purchases that were observed were made by visitors to the region, or by the government officials and clearing contractors who worked in Seaqaqa. However, it would have been possible for any family to purchase subsistence produce in the area if it had wished.

income in kind. Cash income amounted to $1062.11 for the average family. This is very close to the estimate of average total expenditure found in Table 5.4, and supports the claim made by many settlers during the period of fieldwork that they were unable to save. Farm development costs were advanced by the FDB directly to the contractor providing the service, and are therefore not included in the expenditure details.

In fact, the data suggest that the average family was spending $42 more than it earned. Two qualifications however must be made. Firstly the estimate of cash income may have been understated, either because some settlers were reluctant to provide information on income which they had not reported for taxation purposes, or because a small portion of exogenous income consisted of cash transfers. Secondly, the lumpy nature of income flows forced households to purchase goods on short term credit. This meant that at various times expenditure would appear to be in excess of income. This would have occurred for example, if a significant number of families had not repaid these debts at the time the survey ceased. It cannot therefore be concluded that families were dissaving during the period. The data however, are consistent with the contention that no savings were being accumulated by the average family.

5.5 Debts. Terminal debt is defined as the level of debt that would remain after all payments for the current year's cane activity had been credited to a family's account. Cane payments for the 1978 season were not received in full until late in the 1979 harvesting season (see Chapter 2).

The average terminal debt associated with the levels of consumption and labour inputs described in previous sections is calculated in Table 5.5. The only category which requires explanation is "Income from Previous Harvests". At the beginning of the period of fieldwork, only the first two cane payments for the 1977 harvest had

TABLE 5.4

ESTIMATED AVERAGE YEARLY CASH EXPENDITURES 57 FAMILIES

Recurrent Expenditure	Mean ($)	Standard Deviation
Food	449.58	280.25
Medical	2.99	13.52
Transport	157.29	165.21
Clothing	93.70	198.98
Household†	62.19	75.80
Religious donations	9.30	14.69
Alcohol, cigarettes and entertainment	107.14	117.73
Festivals and ceremonies	42.83	74.60
Schooling	51.54	80.09
Miscellaneous††	105.84	155.73
TOTAL Recurrent	1082.41	604.07
Non-Recurrent Expenditure		
Equipment	4.31	14.26
Live animals	5.88	4.33
Cutters' food	11.82	66.14
TOTAL Non-recurrent	22.01	73.92
TOTAL EXPENDITURE	1104.42	846.69

† Furniture, soap, pots and pans.

†† This includes expenditure for which a breakdown was not available.

TABLE 5.5

ESTIMATED AVERAGE TERMINAL DEBT
57 FAMILIES

	Mean ($)	Standard Deviation
Loans		
Initial tractor loan	2249.09	4469.57
Initial farm loan	9340.57	3190.75
Debts at Beginning of Period		
Tractor	1472.44	3275.44
Farm	6328.16	3851.31
F.S.C.†	1430.20	1512.87
Income		
From previous harvests	1498.53	933.24
From current harvest	3444.94	2191.55
Tractor repayments	139.72	333.66
Total	5083.18	3026.11
Interest	365.69	301.29
Terminal Debt	4513.31	5626.12

† The F.S.C. account is to finance the purchase of farm inputs. It is not a loan with a fixed limit.

been received. Remaining payments were made during the period under consideration, and are included in this category.

Only thirteen families in the sample owned or partly owned a tractor. Terminal debts are calculated in Table 5.6 with these families separated from the remaining households. Bank policy credited all repayments (including cane proceeds) against tractor loans first, where a farmer had borrowed for a tractor. Accordingly, the balance of the farm loans remaining for tractor owners was significantly higher than for other households, although there was no significant difference in the average size of the initial farm loans between the two groups. Despite higher cane proceeds and the extra off-farm income generated by the tractors, tractor owners expected to have a significantly higher debt than other families after the 1978 harvest.

5.6 Performance as Perceived by Administrators.

During the course of fieldwork, the FSC Farm Advisor, FSC Field Officer and FDB official most familiar with each farm was asked to rank each household on a scale from 1 to 5, according to performance. The only instructions given to the officials was that a score of 5 represented excellent performance while very poor performers should be given a score of 1. "Performance" was not defined. The average official score then was compared to the three variables which figured prominantly in a household's assessment of its own performance - labour inputs, income and debt. Simple correlation coefficients are presented in Table 5.7.

Current income, labour input and terminal debt, did not by themselves appear related to the official perception of performance. However there was a relatively high correlation between the official rating of performance (official performance) and the proceeds expected from

TABLE 5.6

TERMINAL DEBT BY TRACTOR OWNERSHIP

	Tractor Owners		Families Not Owning Tractors	
	Mean	Standard Deviation	Mean	Standard Deviation
Loans				
- Tractor	9861.38	2249.09	-	-
- Farm	8301.34	4110.55	9647.61	2849.66
Initial Debt				
- Tractor	6456.10	3900.04	-	-
- Farm	8086.86*	4028.77	5808.58	3684.57
- F.S.C.	850.47**	736.94	1601.48	1642.42
- Total	15393.33		7410.06	
Income				
- Previous harvests	2011.96**	1030.50	1346.83	857.11
- Current harvest	4944.06**	2597.99	3002.01	1868.46
- Tractor repayments	612.60	453.55	-	-
- Total	7568.63	3282.56	4348.84	2549.39
Interest	767.86***	329.77	246.86	156.59
Terminal Debt	8592.56***	6525.61	3308.08	4778.78
Sample Size	13		44	

* Significant difference in means using t-test at 10% level

** Significant difference at 5% level

*** Significant difference at 1% level

the 1978 cane harvest. Subsequent conversations with officials confirmed that they judged performance almost entirely in terms of cane production.

Four possible indicators of cane farming performance are considered in Table 5.8. The first is simply the total quantity of cane harvested in 1978, and the table reveals that this measure was fairly highly correlated with official performance. The second is the total dollar value of the 1978 harvest. The quantity of cane harvested gives seed cane sales the same weight as cane sold to the mill, despite the fact that seed cane produces a higher return per tonne.[4] The value of the harvest on the other

TABLE 5.7

CORRELATION COEFFICIENTS BETWEEN THE OFFICIAL PERCEPTION OF PERFORMANCE AND PERFORMANCE PERCEIVED BY FARM FAMILIES

	Simple correlation coefficient
DEBT	
- debt at beginning of period	0.176
- net cane proceeds from current harvest	0.726
- terminal debt	0.246
CURRENT INCOME	0.261
LABOUR	
- total labour input	0.161
- labour input to cane	0.223

4 The final price of cane sold to the mill during the 1978 harvest was $25.00 per tonne. Cutting and transport charges had to be deducted. From 1/5/79 seed cane sales grossed $28.48 per tonne, and the buyer rather than the vendor paid transport charges.

TABLE 5.8

INDICATORS OF CANE FARMING PERFORMANCE
57 FAMILIES

	Mean	Standard deviation	Simple correlation with official performance
Output			
- total (tonnes)	288.59	167.11	0.717
- per hectare	57.14	12.68	0.406
Gross Value of Output			
- total ($'s)	7809.90	4573.70	0.707
- per hectare	1530.52	336.46	0.414
Output adjusted for age of cane			
- total (tonnes)	294.97	167.64	0.723
- per hectare	58.52	12.71	0.421
Cash Profit from Cane			
- total ($'s)	3444.94	2191.55	0.726
- per hectare	651.79	246.29	0.601
Hectares Harvested	5.01	2.37	0.663

TABLE 5.9

WEIGHTS USED TO ADJUST OUTPUTS OF CANE OF DIFFERENT AGES

	Mean yield (tonnes per hectare)	Weight used in adjusting output
Plant cane	65.880	0.9060
First ratoons	60.310	0.9897
Older cane	52.879	1.1288
All cane	59.690	

hand weights seed cane sales more heavily than sales to the mill, and allows for the possibility that the better farmers might have sold more seed cane.

The third indicator is included in Table 5.8 because other things being equal, older cane will produce a lower yield than young cane. Observed differences in output might therefore have been due to differences in the age of the cane, rather than in performance. The average yield (tonnes per hectare) for cane of three different ages was calculated for the farms in the sample (Table 5.9). The actual output of each farm then was adjusted to reflect what it would have been had all cane harvested been of the average age. For example, if only plant cane had been harvested on a particular farm, total output was multiplied by 0.906 (59.69/65.88). These calculations produced the third indicator in Table 5.8 - output adjusted for the age of the cane.

The fourth indicator of cane farming performance is profit or net cane income, which would capture a family's ability to use purchased inputs better than gross output. Profit was defined as total income less the cost of purchased inputs. No attempt was made to price family labour.

One amendment can be made to each of the indicators. Larger farms would be expected to produce a greater output than smaller farms. Accordingly, the four indicators are also divided by the area of land harvested.

Official performance was more highly correlated with both adjusted output and net farm income than it was with gross output. However the adjustment made for seed cane sales reduced the simple correlation coefficient from 0.717 to 0.707. This probably indicated that seed cane sales generally depended on factors outside the control of the household. When a family wished to purchase seed cane it consulted the Farm Advisor responsible for the area, who chose the farm to supply the seedlings on the basis of such factors as its proximity to the buying farm, and the availability of suitable young cane. Personal preferences sometimes played a role. A family might refuse to purchase seedlings from households with which it was feuding, or Farm Advisors might channel sales to families with which they were particularly friendly. To some extent the quality of the cane was important. However, although seed cane would rarely be taken from very poor stands, most farms produced some cane of a sufficient quality for use as seedlings. Seed cane sales did not, in general, appear to be related to the performance of the household.

Two factors might explain the low correlation coefficients between the indicators of output per hectare and official performance. Firstly some officials expressed the view that although in any given year, output was limited by the area planted to cane, many Seaqaqa households could have increased this area since the project began had they tried. They thus regarded the area of cane harvested as a long term decision variable. The reasonably high correlation coefficient between the area harvested and the official rating of performance, 0.663, provides some support for this hypothesis.

Secondly, a major aim of the project was to increase cane production. In view of this, it is possible that administrators may have made insufficient allowance for physical restrictions on the output of particular farms, imposed by such factors as a slow rate of land clearing by contractors.

Thus the evidence provided by the simple correlation coefficients supports the hypothesis that the Project Administration judged farmer performance mainly in terms of cane output. Some adjustments were made for the age of the cane and for a family's ability to use purchased inputs efficiently, but no account seemed to be taken of seed cane sales, or of physical restrictions on the area of land planted to cane.

PART B

VARIATIONS IN PERFORMANCE ACROSS THE SAMPLE

5.7 Socio-economic Characteristics of the Sample.

In Part A details of factors influencing a household's assessment of its own performance were presented. It was shown that the Administration used different criteria to judge performance. In this section, variations in performance among households exhibiting different socio-economic characteristics are examined. The viewpoints of both farmers and administrators are considered.

The sample had been stratified by racial origin and by the length of time the family had been living in Seaqaqa in the belief that these characteristics may have been related to economic behaviour. In Chapter 4 it was argued that the latter variable might indicate the migrant status of the household, or the number of times the family had harvested cane in Seaqaqa before the 1978 season. Table 5.10 shows that it did not capture either adequately. It therefore is better to test separately whether these two variables were related to performance rather than to use the length of residence in Seaqaqa as a proxy. In addition to racial origin, migrant status, and the number of completed harvests, it was decided to test if the following variables were related to economic behaviour; the age, education and previous work experience of the leaseholder; tractor ownership; and three variables of family size - the number of people in the family, adult equivalent consumption units supported by the farm, and the number of adult equivalent units available for production.

The number of people on each farm varied over the period of fieldwork with visits to the farm by friends and relatives, and visits away from the farm by household members. Short term visitors to the farm rarely helped with farm work and social norms prevented families from requesting such help. Short term visitors therefore could

TABLE 5.10

PERIOD OF RESIDENCE IN SEAQAQA BY MIGRANT STATUS
AND NUMBER OF PREVIOUS HARVESTS
57 FAMILIES

	Period of Residence in Seaqaqa		
	More than 3 years	Less than 3 years	Total
Migrant status			
- local	21	14	35
- migrants	6	16	22
TOTAL	27	30	57
Number of Previous Harvests			
3	14	13	27
2	8	9	17
1	5	8	13
TOTAL	27	30	57

not be included in the number of production units available to the family, but because they were supported by the household, they were included in the number of consumption units. Similarly, household members temporarily away from the farm for essential purposes, such as schooling and ceremonial occasions, were not included as available production units during their absence. If, however, they were being supported by the family during this time they were included as consumption units.

People undertaking journeys for what were considered to be inessential purposes were counted as available production units on the grounds that they were available for productive activity but chose not to participate. Included were social visits to other farms or to a village, and pleasure trips to Labasa, or in two cases, to Suva. If these household members were supported by friends or relatives on such occasions, they were not included in the units of consumption. Finally, household members suffering from an incapacitating illness or injury were not included in the number of available production units until they had recovered.

When allocating weights in their calculations of adult equivalent units, Lau et al (1978) assumed that Taiwanese children of both sexes under 15 years of age consumed and produced 0.55 times the quantity of adult males. People of both sexes over the age of 60 were assumed to be the equivalent of 0.95 adult male consumption and production units, while adult females (15 to 60 years) were the equivalent of only 0.8 units. On the other hand, Philp used a more detailed age classification to compute adult equivalent consumption units, but he did not separate the Papua New-Guineans he studied by sex.[5] The weights he used are reproduced in Table 5.11. The allocation of weights appears to be a somewhat arbitrary process, but it can be made less arbitrary by careful consideration of the social and economic system to which the weights will be applied.

The weights that were used earlier to determine the total adult equivalent labour units <u>used</u> by each family (Table 5.1) could not be used to estimate the total number of production units <u>available</u> to the family, because the specific tasks that any individual would undertake during the year were not known. However, the activities that a 17 year old woman for example, would typically undertake <u>were</u> known. Table 5.1 shows that she would have been unlikely to engage in inter-row ploughing and cutting cane, but would probably have helped to plant rice (if Indian) and to weed cane. The weights of Table 5.12 were based on the particular tasks a person of a particular age/sex grouping was likely to perform, rather than on how efficiently the person could perform every farm activity. The fact that the 17 year old female might have been only

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5 Philp's weights were based on those used by Lockwood (1968).

65% as effective as an adult male cutting cane is irrelevant if 17 year old females traditionally did not cut cane.

TABLE 5.11

PHILP'S CONSUMPTION UNIT COEFFICIENTS

Age	Male and female
0-1	0.0
1-4	0.5
5-9	0.7
10-14	0.8
15-50	1.0
50+	0.8

Source: Philp 1976, p108.

TABLE 5.12

PRODUCTION AND CONSUMPTION UNIT COEFFICIENTS
USED IN THIS STUDY OF 57 FAMILIES

Age		Production weight	Consumption weight
Males	13-	0.70	0.70
	13-17	0.95	1
	18-55	1	1
	55+	0.95	0.85
Females	13-	0.7	0.7
	13-17	0.9	0.9
	18-55	0.95	1
	55+	0.8	0.8
Breastfed children		0	0

TABLE 5.13

SOCIO-ECONOMIC CHARACTERISTICS OF FAMILIES IN THE SAMPLE - DIVISIONS USED FOR SIGNIFICANCE TESTING

	Number of Families
Race	
- Indian	30
- Fijian	27
Migrant Status	
- Local	35
- Migrants	22
Education	
- Less than or equal to 6 years (primary)	32
- More than 6 years (secondary)	25
Experience	
- Cash experience	24
- Non-commercial farming	33
Number of Previous Harvests	
- 1	13
- 2	17
- 3	27
Age of Household Head	
- Older than 44	13
- 30 to 44	21
- Younger than 30	23
Family Size	
- Less than or equal to 6.00	30
- More than 6.00	27
Adult Equivalent Consumption Units	
- Less than or equal to 6.00	34
- More than 6.00	23
Adult Equivalent Production Units	
- Less than or equal to 6.00	37
- More than 6.00	20
Tractor Ownership	
- Own	13
- Did not own	44

The weights used in the calculation of consumption units were based on observed consumption behaviour. While the weights of Table 5.12 are still subjectively determined, they were based on the particular milieu in which Seaqaqa households operated.

In Table 5.13 the number of households in each of the categories used for significance testing are presented. Means and standard deviations of the continuous variables are found in Table 5.14; interactions between variables that are relevant to the remainder of the chapter are described in Tables 5.15a to 5.15e. Young farmers and those with post primary education had smaller families on average than older farmers and those with no secondary schooling respectively. However, family size was not related significantly to race.

The difficulty in attracting Fijian applicants in the early years of the project, described in Chapter 2, is reflected in Table 5.15d. There, it is shown that a vast majority of Indian families compared to a small minority of Fijian households, had harvested cane on their farms three times before the 1978 harvest. Table 5.15e reveals that only 11.1% of Indian leaseholders had ever engaged in full time cash earning activities before the scheme began, compared to 66.7% of Fijian household heads.

TABLE 5.14

SOCIO-ECONOMIC CHARACTERISTICS OF THE SAMPLE - CONTINUOUS VARIABLES

	Mean	Standard deviation
Family size	6.26	2.94
Consumption units	6.12	3.10
Production units	5.35	2.56
Age of household head	35.25	11.26
Years of education	5.91	3.50

TABLE 5.15a

AGE OF HOUSEHOLD HEAD BY FAMILY SIZE 57 FAMILIES

	Family size			
Age of household head	Mean	Standard deviation	t-statistic	Degrees freedom †
Less than 30 yrs	5.04	2.99	$t_{1,2}^{\dagger\dagger}=-2.01^{**}$	
30-44	6.62	2.18	$t_{1,3}=-2.58^{**}$	23.57
More than 44	7.85	3.21	$t_{2,3}=1.22$	18.90

† Degrees of freedom more than 31 are not given in any table.

†† $t_{1,2}$ is the t-test between rows 1 and 2.

** = the means are significantly different at the 5% level.

TABLE 5.15b

EDUCATION BY FAMILY SIZE 57 FAMILIES

	Family size		
Education	Mean	Standard Deviation	t-statistic
Primary	7.19	2.87	2.88^{***}
Secondary	5.08	2.64	

*** Significant at 1%.

TABLE 5.15c

RACE BY FAMILY SIZE
57 FAMILIES

Race	Family Size		
	Means	Standard deviation	t-statistic
Indian	6.59	2.53	0.81
Fijian	5.97	3.28	

TABLE 5.15d

RACE BY NUMBER OF PREVIOUS HARVESTS
57 FAMILIES

Race	Number of Previous Harvests			
	1	2	3	Total
Indian	1	5	21	27
Fijian	12	12	6	30
TOTAL	13	17	27	57

TABLE 5.15e

RACE BY EXPERIENCE
57 FAMILIES

Race	Experience		
	Cash	Farm only	Total
Indian	3	24	27
Fijian	20	10	30
TOTAL	23	34	57

5.8 Labour Input

In Table 5.16 it is shown that the household labour of women, a constraint on the proportion of the total labour input available for either consumption producing or debt reducing activities, was related to racial origin and family size. The greater the number of family members, the more cooking which had to be undertaken and the more clothes which had to be washed for example.

Tables 5.15a and 5.15b showed family size was positively related to the age of the household head, but negatively related to years of schooling. It is not surprising, therefore, that females in families with heads aged less than 30 years spent less time undertaking domestic duties than those in other households. Similarly, the fact that Table 5.16 reveals that female domestic labour was negatively related to years of education might be explained by the differences in family size.

Traditional culinary habits required Indian women to spend more time on domestic duties than Fijian women. Family size did not vary significantly between the two groups (Table 5.15c). The preparation of a meal of curry, rice and roti for a family of six might take up to three hours for example, whereas a meal of cassava and bele for a family of equal size might be prepared in half the time.

This difference by racial origin might also explain the observed differences in female labour inputs to domestic duties by previous work experience and by the number of completed harvests. Tables 5.15d and 5.15e illustrated that households who had completed three harvests and those with no previous full time cash earning experience were more likely to be of Indian descent than other families. Females in these households would therefore be expected to spend more time in domestic duties. The possibility of interactions between socio-economic characteristics is considered further at a later stage.

TABLE 5.16

FEMALE DOMESTIC LABOUR BY SOCIO-ECONOMIC CHARACTERISTIC
57 FAMILIES

	Yearly Labour Input (Hours)			
	Mean	Standard Deviation	t-statistic	Degrees Freedom
Race†				
- Indian	2413.06	545.94	4.67**	
- Fijian	1603.45	755.75		
Education				
- Primary	2238.94	635.51	2.87**	
- Secondary	1664.40	828.52		
Experience				
- Farm	2145.76	788.97	1.88*	
- Cash	1768.58	714.19		
Age of Head				
- Less than 30	1721.85	900.52	$t_{1,2}$=-2.05**	
- 30 to 44	2172.62	528.64	$t_{2,3}$=-0.07	18.71
- Older than 44	2156.04	789.82	$t_{1,3}$= 1.50	27.90
Previous Harvests				
- 1	1572.31	779.77	$t_{1,2}$=-0.80	25.35
- 2	1799.03	745.78	$t_{2,3}$=-2.27**	
- 3	2304.91	675.59	$t_{1,3}$=-2.90***	20.98
Family Size				
- ≤ 6	1666.83	764.93	-3.67***	
- More than 6	2342.63	625.40		
Production Units				
- ≤ 6.00	1760.88	772.15	-3.50***	
- More than 6.00	2405.18	597.12		
Consumption Units				
- ≤ 6.00	1726.13	766.12	-3.50***	
- More than 6.00	2372.50	622.55		

* Significant at 10%.

** Significant at 5%.

*** Significant at 1%.

† Only variables in which significant differences in Female Domestic Labour input were observed have been included in all tables.

It was argued earlier that the time spent providing voluntary labour off the farm provided consumption during the current period. This labour, however, did not appear to be considered as a decision variable. During the period of fieldwork, families were requested to provide help with wedding preparations, to canvas other households on behalf of friends at election times, to help construct living quarters for relatives, and to maintain the compound of a nearby village, for example. Families expressed the view that social obligations prevented them refusing such requests, and they invariably responded, although at times with many complaints. Time so spent therefore was regarded as a factor beyond a household's control.

These "voluntary" activities constrained the time available for other pursuits. This time therefore should be deducted from the total labour input which the family could freely choose to allocate in a manner which maximised its utility. No significant differences in unpaid off-farm labour between the various socio-economic groups were observed.

Total labour input, excluding female domestic labour and unpaid off-farm labour, was related significantly to the number of available adult equivalent production units, and also to the number of consumption units supported by the farm (Table 5.17). Families originally resident in the area allocated significantly less labour to productive activities on average than migrants, despite the fact that the number of production and consumption units available to both groups were similar.[6] No other significant differences according to household characteristic were observed.

Variables significantly related to the proportion of this labour input allocated to debt reducing as compared

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6 The t-statistic for the difference in the mean number of production units between the two groups was 0.34 for degrees of freedom in excess of 31.

to consumption producing activities are presented in Table 5.18. Indians on average spent a higher proportion of their time on debt reducing activities than Fijians. There is some evidence that a family's commitment to the monetary sector was positively related to the number of harvests it had completed. This could have been due to a number of factors. For example, in the early years families may

TABLE 5.17

TOTAL LABOUR INPUT (NET OF FEMALE DOMESTIC LABOUR) BY SOCIO-ECONOMIC CHARACTERISTIC
57 FAMILIES

	Yearly Labour Input (Hours)		
	Mean	Standard deviation	t-statistic
Production Units			
- ≤ 6.00	1148.96	696.38	2.15^{**}
- > 6.00	1578.24	731.81	
Migrant Status			
- local	1068.54	600.80	3.06^{***}
- migrants	1667.16	784.14	
Consumption Units			
- ≤ 6.00	1157.69	658.13	1.75^{*}
- > 6.00	1509.35	798.75	

* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

TABLE 5.18

PROPORTION OF TOTAL LABOUR INPUT (NET OF FEMALE DOMESTIC LABOUR) ALLOCATED TO DEBT REDUCING ACTIVITIES BY SOCIO-ECONOMIC CHARACTERISTIC
57 FAMILIES

	Proportion			
	Mean	Standard deviation	t-statistic	Degrees freedom
Race				
- Indian	0.3067	0.165	2.32^{**}	
- Fijian	0.2035	0.171		
Age of Head				
- Less than 30	0.2200	0.158	$t_{1,2}=2.13^{**}$	
- 30 to 44	0.3400	0.189	$t_{2,3}=3.14^{***}$	
- Older than 44	0.1670	0.127	$t_{1,3}=1.19$	22.40
Previous Harvests				
- 1	0.1384	0.108	$t_{1,2}=1.73$	27.41
- 2	0.2251	0.166	$t_{2,3}=1.89^{*}$	
- 3	0.3245	0.176	$t_{1,3}=4.12^{***}$	
Tractor Ownership				
- Owned	0.4485	0.183	4.70^{***}	15.40
- Did not own	0.1945	0.125		

* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

have spent a large proportion of their time establishing subsistence gardens that would ensure their physical survival, but as these gardens began to produce they could afford to allocate additional time to cane. Alternatively, households might have valued cane production more highly the closer they were to repaying their debts. This could have been particularly relevant for three harvest families who expected to receive 25% of the net proceeds of the subsequent harvest.

However interpretation is complicated by the fact that 77.8% of families that had completed three harvests were of Indian origin. It is difficult to determine if the increased commitment to the commercial sector was caused by factors related more to the length of time spent farming cane in Seaqaqa, or to racial background. Table 5.19 suggests that the number of previous harvests may have been the more important. The number of completed harvests was significantly related to the proportion of time Fijians allocated to debt reducing activities. On the other hand, racial origin was not significantly related to the way labour was allocated when households were separated by the number of completed harvests. However the uneven distribution of families of the different races according to the number of completed harvests (Table 5.15d) meant that the degrees of freedom of these t-tests were low, and the hypothesis that racial backgrounds could also have influenced the distribution of labour should not be rejected completely.

The FDB had been applying pressure to tractor owners to increase their loan repayments. Table 5.18 shows that tractor owners accordingly allocated a greater proportion of their labour to debt reduction, although they did not apply significantly more labour to cane than other households. Tractor ownership may help to explain why families whose heads of household were aged between 30 and 44 years allocated more time to debt

TABLE 5.19

PROPORTION OF TOTAL LABOUR TIME ALLOCATED TO DEBT REDUCING ACTIVITIES BY RACIAL ORIGIN AND NUMBER OF PREVIOUS HARVESTS
57 FAMILIES

	Number of families	Mean	Standard deviation	t-statistic	Degrees freedom
Indians					
- 1 and 2 previous harvests	6	0.257	0.103	1.11	14.57
- 3 previous harvests	21	0.321	0.178		
Fijians					
- 1 previous harvest	12	0.117	0.077	2.86***	24.05
- 2 and 3 previous harvests	18	0.261	0.193		

***Significant at 1%.

reducing activities than other families. More than 61% of tractors were owned by people in this age group.

In conclusion, Indians appeared to be more committed to the cash sector than Fijians, although this could have been related more to the fact that they were closer to receiving some cash income from cane, rather than to racial characteristics. The relationship between number of harvests and the proportion of time spent on debt reducing activities suggests that the scheme may have been successfully inducing families to move into more advanced stages of commercialisation.

Table 5.17 showed that migrants and large households allocated more labour to all activities than local residents and smaller families respectively, yet there were no differences in the proportion of time allocated to the debt reduction according to either migrant status or family size. The final implication of the data presented in this section therefore, is that migrants and families with more than six consumption units to support allocated greater quantities of time than other households to both the monetary and the non-monetary sectors.

5.9 Income and Expenditure

In Part A it was shown that cash incomes on average were very close to estimated cash expenditures. Either variable therefore might be a suitable indicator of the mean level of consumption financed by cash income.

The first step in estimating cash expenditure was to sum the recurrent expenditure reported during the four intensive visits and multiply it by 13. This provided an estimate of the yearly recurrent expenditure of each family. Items considered to be of a non-recurrent nature were added to this total whether they were purchased during or between the intensive visits. The resulting estimate of total expenditure would be inaccurate if purchases made during intensive visits were atypical, or if families failed to remember major items of non-recurrent expenditure purchased between visits. Few checks on reported expenditures were available. Farmers kept no records and storekeepers were unable to provide this information for every household.

Checks, however, could be made on the cash component of income. Details were obtained from the FDB, the FSC, and in a few cases, from employers. Rice, part of the non-cash component, generally was harvested within a relatively short time period and could be valued. There were some problems with exogenous transfers and the home consumption of farm produce other than rice, which had to be estimated in the manner of cash expenditures described above. Thus, although the estimate of cash expenditure was close to the estimate of cash income, the latter is likely to contain fewer measurement errors. In the remainder of this section therefore, attention is focussed on the variations in income that were observed in Seaqaqa.

Differences in incomes between households could have been caused by differences in the total labour input, or in its allocation between consumption producing and debt reducing activities, both of which have been described. They also could have been caused by differences in unearned income, consisting of exogenous income and/or income received from lending agencies for consumption purposes (i.e. Bank Income). The latter form of income, comprising the subsistence and planting allowances, was a decision variable. Households could choose both the proportion of the available subsistence loan they wished to take and whether or not they would claim the allowance for cane they had planted.

No significant correlation between exogenous income and household characteristic was revealed. However, Table 5.20 shows that Bank Income varied with the number of consumption units in the family, and that families which had harvested cane three times in Seaqaqa before 1978 used the subsistence allowance significantly less than

TABLE 5.20

BANK INCOME BY SOCIO-ECONOMIC CHARACTERISTIC
57 FAMILIES

	Mean	Standard deviation	t-statistic	Degrees freedom
Consumption Units				
- $\leqslant$ 6.00	428.90	391.49	2.13**	
- > 6.00	724.47	607.91		
Previous Harvests				
- 1	539.77	713.16	$t_{1,2}$=1.41	19.39
- 2	860.14	460.54	$t_{2,3}$=3.93***	24.84
- 3	364.29	304.13	$t_{1,3}$=0.85	14.14

** Significant at 5%.
*** Significant at 1%.

households which had completed only two previous harvests. These differences could have been due either to personal preference or to external constraints. Families with a large number of consumption units, because of their greater need for current consumption, may have discounted the future more heavily than other households or alternatively may have been forced to draw on the subsistence loan to tide them over periods during which they received no income. Similarly, families who had already reaped three harvests might have valued the future more highly, or they might have felt the need to borrow less than other families because they would receive some of the cash proceeds from the next harvest. Families which had completed fewer harvests would have had to wait longer to receive cash income from cane.

Another explanation, for which some support can be found, is that after three harvests, families were not allowed as much credit as previously. In Section 5.4 it was shown that families generally claimed more on the subsistence allowance than the stipulated maximum loan. Families preparing for their fourth harvest theoretically were not eligible for a subsistence loan, but received $355.96 on average. Although Bank Officers did not fully enforce the loan provisions, they may have placed more restrictions on the amount these households could borrow, thereby accounting for the significantly lower amount borrowed compared with those who had had only two harvests ($823.55).

Reflecting these differences in unearned income, total income showed a significant correlation with the number of consumption units and the number of completed harvests (Table 5.21). The apparent differences in income between households headed by people younger than 30 years and those with a head older than 45 were probably due to the lower number of dependents of the former group, illustrated in Table 5.15a. The t-test on current income per adult equivalent consumption unit between the two groups was insignificant.[7]

Differences in the proportion of total consumption financed by income in kind are presented in Table 5.22. Families which had completed two harvests relied more on cash income than households which had harvested cane three times previously. This might be explained by the restrictions the FDB imposed on the amount of the subsistence allowance available to members of the latter group. When subsistence loans were omitted, the ratio of income in kind to total income was no longer related significantly to the number of completed harvests. The fact that no other socio-economic characteristics were related to the degree of reliance on income in kind suggests that settlers were, on the whole, at a similar stage of commercialisation. What this stage was is considered in Chapter 6.

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7 The t-statistic was 1.32 for degrees of freedom in excess of 31.

TABLE 5.21

TOTAL INCOME BY SOCIO-ECONOMIC CHARACTERISTIC
57 FAMILIES

	Yearly Income ($'s)			
	Mean	Standard deviation	t-statistic	Degrees of freedom
Consumption Units				
- ≤ 6.00	1402.92	725.70	2.93^{***}	
- > 6.00	2131.60	1033.33		
Age of Head				
- Less than 30	2127.89	1281.87	$t_{1,2}=1.01$	16.67
- 30 to 44	1735.34	712.23	$t_{2,3}=1.39$	
- More than 44	1418.32	799.22	$t_{1,3}=1.81^{*}$	17.39
Previous Harvests				
- 1	1463.37	955.11	$t_{1,2}=1.68$	27.61
- 2	2099.82	1120.60	$t_{2,3}=1.79^{*}$	24.16
- 3	1555.75	710.08	$t_{1,3}=0.31$	18.63

* Significant at 10%.
*** Significant at 1%.

TABLE 5.22

RELATIVE IMPORTANCE OF INCOME IN KIND
BY SOCIO-ECONOMIC CHARACTERISTIC
57 FAMILIES

	Ratio of Income in Kind to Total Income		
	Mean	Standard deviation	t-statistic
Previous Harvests			
- 1	0.4059	0.210	$t_{1,2}=1.25$
- 2	0.3248	0.121	$t_{1,3}=0.83$
- 3	0.4640	0.202	$t_{2,3}=2.86^{***}$

*** Significant at 1%.

5.10 Terminal Debt

Table 5.23 illustrates that terminal debt was related to education, racial origin, the number of harvests completed before 1978, and tractor ownership. However, Table 5.24 reveals that almost 77% of tractor owners had some post-secondary education compared to only 34.1% of non-owning families. Tractor owners had higher debts at the beginning of the period, so a positive correlation between terminal debt and years of schooling is not surprising.

Because the impact of tractor ownership on debt was likely to swamp that of other factors, tests on differences in terminal debt by household characteristic were undertaken with tractor owners omitted. Results are presented in Table 5.25. Households with only one previous harvest faced a higher terminal debt than other families once the influence of tractor ownership had been removed, but the mean terminal debt of families who had had three harvests was not significantly lower than that of households who had had two. Education was no longer correlated with terminal debt, suggesting that the repayment histories of educated families was no different from that of other households, but that the former group were more likely to be given loans for tractors.

Indians faced a significantly lower terminal debt than Fijians. This might have been due to the fact that Fijians on average had completed fewer harvests before 1978 than Fijians (Table 5.15d). Some support for this argument is found in Table 5.26. Before the period began, Indian families had repaid almost twice as much as Fijian households, and therefore faced a lower debt at the beginning of the period. They repaid a similar amount during the period, and accordingly owed less than Fijian households at the end of the period.

However, the size of the initial farm loan was significantly lower for Indians than Fijians, despite the

TABLE 5.23

TERMINAL DEBT BY SOCIO-ECONOMIC CHARACTERISTIC
57 FAMILIES

	Terminal Debt			
	Mean	Standard Deviation	t-statistic	Degrees Freedom
Education				
- Primary	2711.45	4540.04	2.81***	
- Secondary	6819.70	6114.72		
Previous Harvests				
- 1	7355.59	3564.06	$t_{1,2}=1.75^{*}$	26.61
- 2	4276.82	6005.54	$t_{2,3}=0.53$	26.56
- 3	3293.71	5875.58	$t_{1,3}=2.70^{**}$	
Race				
- Indian	2759.86	5598.08	2.31**	
- Fijian	6091.43	5254.49		
Tractor Ownership				
- Owned	8592.56	6525.61	2.72**	16.03
- Did not own	3308.08	4778.78		

* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

TABLE 5.24

TRACTOR OWNERS VS NON OWNERS - SOCIO-ECONOMIC CHARACTERISTICS
57 FAMILIES

	Tractor Owners (Number of Families)	Non-Owners
Race		
- Indian	6	21
- Fijian	7	23
Migrant Status		
- Local	6	29
- Migrants	7	15
Education		
- Primary	3	29
- Secondary	10	15
- Mean Years	8.08***	5.18
Experience		
- Cash	8	16
- Farm	5	28
Previous Harvests		
-1	2	11
-2	3	14
-3	8	19
Age of Head		
- Less than 30	5	18
- 30 to 44	8	13
- Older than 44	0	13
- Mean age	32.31*	36.11
Family Size		
- ≤ 6.00	6	24
- More than 6.00	7	20
- Mean	6.54*	6.18
Consumption Units		
- ≤ 6.00	7	27
- More than 6.00	6	17
- Mean	6.67*	5.96
Production Units		
- ≤ 6.00	8	29
- More than 6.00	5	15
- Mean	5.59*	5.28

* Insignificant at 10%.
***Significant at 1%.

TABLE 5.25

TERMINAL DEBT OF NON-TRACTOR OWNERS
BY SOCIO-ECONOMIC CHARACTERISTIC
44 FAMILIES

	Terminal Debt				
	Number of families	Mean	Standard deviation	t-statistic	Degrees freedom
Race					
- Indian	21	1514.53	4094.70	2.50^{**}	
- Fijian	23	4909.07	4899.70		
Previous Harvests					
- 1	11	6832.33	3644.12	$t_{1,2}=2.62^{**}$	22.99
- 2	14	2498.60	4617.08	$t_{2,3}=0.42$	28.34
- 3	19	1819.89	4667.81	$t_{1,3}=3.27^{***}$	25.33

** Significant at 5%.
*** Significant at 1%.

fact that it will be shown in Table 5.29 that the total land area harvested in 1978 did not differ on average between the two groups. Fijians on the whole were more recent arrivals in Seaqaqa than Indians, and it might be thought that their higher farm loans were due to inflationary increases in the costs of land clearing. This does not, however, appear to have been the case.

Bids for the yearly land clearing contract had become increasingly competitive over the years, preventing costs from rising. Average costs of completed clearing were \$694.62, \$770.02 and \$580.15 per hectare in 1975, 1976 and 1977 in turn. However, costs for any given farm varied according to whether the initial vegetation was classified as light, medium, or heavy bush. A breakdown of the total clearing costs into these categories for each year is not available, so the outlined average costs are

TABLE 5.26

FARM LOANS BY RACE
57 FAMILIES

	Indian	Fijian
Farm Loan ($'s)		
- Mean	8581.56	10620.96
- Standard deviation	2419.56	2911.13
- t-statistic	2.53**	
Balance at Beginning of Period		
- Mean	5569.63	9090.45
- Standard deviation	3186.99	4143.81
- t-statistic	3.17***	
Total Repayments During Period		
- Mean	4248.25	4477.28
- Standard deviation	2464.73	2741.16
- t-statistic	0.29	

** Significant at 5%.
*** Significant at 1%.

not strictly comparable. For example, Fijian farms on average might have consisted of a larger proportion of heavy bush than Indian farms. However, the available evidence suggests that costs of clearing did not increase significantly over time. Indian families borrowed less than Fijian households either because they were less willing to enter into debt, or because lending agencies were more willing to lend to Fijians.[8] The latter explanation appears unlikely.

8 Another reason was suggested earlier - there may have been a greater proportion of heavy bush on Fijian farms. There was no way of checking this hypothesis accurately.

5.11 Performance as Rated by Officials

In Section 5.3 it was argued that the total output per farm, after adjustment for the age of the cane, was closely related to the official perception of performance. Adjusted output was determined by the area of land planted to cane and adjusted yield. The ways in which differences in the adjusted output and its components correlated with the socio-economic characteristics of the households are illustrated in Tables 5.27 to 5.29. In Table 5.30 it is shown that variations in net farm income were significantly related to the same socio-economic variables as variations in adjusted output. For the remainder of this section therefore, only the differences in output will be considered.

The Seaqaqa Development Project was designed to increase Fiji's cane production. Households originally domiciled in Seaqaqa planted a smaller area to cane, and consequently obtained a lower output than migrants. Yields were not significantly different. This suggests that it might have been desirable to maximise the ratio of migrants to local residents in Seaqaqa. However, the breakdown of the selection criteria meant that the land owning unit allocated a large proportion of blocks, mainly to local residents. This implication is not particularly useful as far as other schemes in Fiji are concerned. The land tenure system severely restricts the extent to which migrants can participate in projects.

Both the area harvested and adjusted total output were related to the number of consumption units supported by the farm. This result suggests that if the aim of the scheme was simply to maximise cane production, the act of selecting younger families with few dependents, in preference to older households with a larger number of consumption units, might have been counterproductive, at least in the short term. Moreover, in future schemes,

TABLE 5.27

1978 CANE OUTPUT, ADJUSTED FOR THE AGE OF CANE, BY SOCIO-ECONOMIC CHARACTERISTIC
57 FAMILIES

	Adjusted Total Output (Tonnes)			
	Mean	Standard deviation	t-statistic	Degrees freedom
Migrant Status				
- Local	236.02	115.04	2.90***	
- Migrants	370.57	197.56		
Family Size				
- ≤ 6.00	252.08	142.23	1.75*	
- > 6.00	327.81	180.39		
Consumption Units				
- ≤ 6.00	254.61	136.98	2.13**	
- > 6.00	354.63	192.77		
Tractor Ownership				
- Own	421.48	190.57	2.87**	16.15
- Do not own	257.48	142.12		

* Significant at 10%.

** Significant at 5%.

*** Significant at 1%.

TABLE 5.28

ADJUSTED YIELD BY SOCIO-ECONOMIC CHARACTERISTIC
57 FAMILIES

	Adjusted Tonnes Per Hectare			
	Mean	Standard deviation	t-statistic	Degrees freedom
Previous Harvests				
1	52.82	12.52	$t_{1,2}=2.01^{*}$	
2	62.34	13.25	$t_{2,3}=0.88$	26.68
3	58.85	11.91	$t_{1,3}=1.45$	22.74

* Significant at 10%.

TABLE 5.29

HECTARES OF CANE HARVESTED 1978, BY
SOCIO-ECONOMIC CHARACTERISTIC
57 FAMILIES

	Hectares			
	Mean	Standard deviation	t-statistic	Degrees freedom
Migrant status				
- Local	4.24	1.75	2.91***	
- Migrant	6.13	2.71		
Age of Head				
- Less than 30	4.48	2.40	$t_{1,2}=1.71^{*}$	
- 30 to 44	5.74	2.48	$t_{2,3}=1.61$	
- Older than 44	4.57	1.74	$t_{1,3}=0.14$	
Tractor Ownership				
- Own	6.88	2.07	3.76***	19.62
- Do not own	4.40	2.12		
Consumption Units				
- $\leqslant$ 6.00	4.43	1.92	2.06**	
- > 6.00	5.77	2.70		

* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

TABLE 5.30

NET INCOME FROM 1978 CANE PRODUCTION BY SOCIO-ECONOMIC CHARACTERISTIC 57 FAMILIES

	Net Cane Income ($'s)			
	Mean	Standard deviation	t-statistic	Degrees of freedom
Migrant Status				
- Local	3079.69	1850.12	2.76***	
- Migrants	5033.10	2982.80		
Family Size				
- ≤ 6.00	3306.32	2190.14	1.67*	
- > 6.00	4419.54	2759.95		
Consumption Units				
- ≤ 6.00	3284.81	2031.43	1.92*	
- > 6.00	4644.95	2963.45		
Tractor Ownership				
- Owned	4944.06	2597.99	2.48**	16.05
- Do not own	3002.01	1868.46		

* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

it may be impractical to select large families for settlement where the parcels of land to be allocated are small.

Households with tractors harvested a greater area and produced a higher output than others. However, a recommendation that the number of tractors be maximised will not be practical for many projects. By 1978, it appeared that too many tractors had been provided for the work available in Seaqaqa. Three tractors had been repossessed, and the Bank would have taken others had it been more successful reselling the original three.[9]

There is some evidence that yield improved with the first year of cane farming experience. However, this result must be treated carefully. Yields were correlated with experience, but the total area planted to cane was not. Total output therefore would be expected to be positively related to experience. This relationship is not apparent in Table 5.27. For similar reasons, the evidence that households which had heads of family aged between 30 and 44 years planted more land to cane than those with older heads, is weak.

Some of the evidence presented in this section is consistent with the details of labour inputs outlined earlier. In Section 5.8 it was shown that migrants, and families with a large number of consumption units, applied more labour to cane than original residents and small families respectively. This is consistent with the observation that the former two groups planted more land to cane and achieved a greater output in 1978. Although they did not apply more labour, tractor owners planted more land, and achieved a greater output, than families without tractors. This can be attributed to the greater availability of tractor services to the former group, and does not contradict the labour input figures.

Some of the data in this section are, however, in apparent conflict with observed labour inputs. There was weak evidence, for example, that families with two previous harvests attained better yields than those with only one completed harvest, yet both groups applied similar inputs of labour. Yield differences therefore could have been due to differences in the quantities of other inputs used, or to the extra skills acquired during the first two years of cane production.

Further, Indians and families headed by people between 30 and 44 years applied more labour than other families to

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[9] These tractors were from the scheme as a whole, not from families included in the sample.

a similar area of cane, yet produced no greater output. Possible explanations are that the marginal productivity of this additional labour was zero, the first two groups used fewer non-labour inputs on average, or Fijians and households not headed by people between the ages of 30 and 44 had acquired more farming skill. The last explanation is unlikely because not only did Indians have a greater tradition of cane farming than Fijians, but they had, on average, been farming in Seaqaqa for a longer period (Table 5.15d). An attempt is made to arbitrate between the possible explanations of these differences in Chapter 7.

5.12 Some Implications for Sample Selection

In Chapter 4 it was shown that the sample was stratified in the hope of selecting households exhibiting a wide range of characteristics likely to affect performance. It was postulated that economic performance could have been related to racial origin, migrant status, and the number of harvests completed before 1978. These hypotheses were confirmed in this chapter.

Significant differences in the average performance of Indians and Fijians were observed. Because Indian women traditionally took more time to complete domestic duties than Fijian women, Indian families recorded a greater total labour input than Fijian households. The total labour inputs allocated to productive activities were similar for both groups, but Indians on average spent a higher proportion of their time reducing debt than Fijians. No significant differences between races were observed in current income, but the terminal debt expected by Indians was significantly lower than that expected by Fijians. Indian and Fijian families however, performed equally well when measured in terms of cane output variables.

Migrants applied more labour than families originally resident in Seaqaqa, but neither in current income nor in terminal debt were significant differences between the two groups observed. Migrants did however, perform significantly better on average than original residents in the eyes of officialdom.

Farmers with greater experience growing cane in Seaqaqa (those with three completed harvests before 1978) allocated a greater proportion of their time to debt reducing activities than remaining households. They expected a lower terminal debt on average, but did not consume any less than families with less experience. The official rating of performance did not correlate with cane farming experience.

These data therefore confirm the differences in performance expected in Chapter 4. The aim of selecting households with a wide range of characteristics likely to be related to performance was achieved.

5.13 Conclusions

A model of behaviour in Seaqaqa was not developed before the period of fieldwork. However, the models discussed in Chapter 3 which had been applied in other empirical studies, provided useful suggestions for the type of data it was necessary to collect. Most of the data that were gathered were not previously available, and in themselves represent a contribution to knowledge of the Seaqaqa project.

In Part A it was shown that the total labour input of the average family was low. Both the proportion of this labour allocated to the monetary sector, and the proportion of consumption financed by cash income, supported the view that households were more dependent on the commercial sector than they had been before the scheme began.

Moreover, there appeared to be few differences between families in their commitment to the cash sector. When the subsistence allowance was omitted, no significant differences in the proportion of consumption financed by cash income were observed. However, the division of labour suggested that families which had spent the longest time cultivating cane in Seaqaqa were more committed to the commercial sector than more recent participants. Also, tractor owners spent a larger proportion of their time in debt reducing activities than other families, perhaps because of the pressure on them to meet higher loan repayments. Although Indians appeared to spend more of their time than Fijians in debt reducing activities, this could have been due predominantly to the fact that almost 78% of Indians in the sample had harvested cane three times, as opposed to only 20% of Fijian households. Perhaps surprisingly, commitment to the commercial sector was not significantly related to educational background or previous experience in this sector.

One important difficulty was encountered. Despite the evidence that Indian families applied more labour to cane than Fijians, they achieved no greater outputs. In Chapter 7 an attempt is made to discover if this could have been caused by Indians using fewer non-labour inputs than Fijians. However in Chapter 6 a model of behaviour incorporating the conditions observed in Seaqaqa during the period of fieldwork is constructed. It is used to examine the impact, on family commitment to the cash sector, of the set of incentives which the Administration had introduced to improve cane farming performance.

DATA SET A

Var. Farm No.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	6,584	0	3,254.10	0	661.76	609	980
2	15,776	3,500	13,858.20	3,430.10	466,32	2,917	5,450
3	12,648	0	10,701.30	0	2,867.10	1,075	879
4	1,338	15,000	12,975.70	7,751.79	1,095.06	2,111	2,298
5	13,531	0	5,511.75	0	185.02	3,541	7,479
6	9,082	0	5,950.82	0	1,107.11	599	1,581
7	10,491	0	4,054.83	0	162,66	854	2,415
8	14,225	0	8,393.34	0	1,220.63	3,760	6,494
9	9,960	0	4,019.17	0	1,410.68	3,176	5,035
10	8,637	0	6,409.78	0	899.85	2,073	3,584
11	7,270	0	4,471.41	0	700.24	1,249	5,575
12	8,502	4,666	7,156.51	2,749.46	1,409.07	885	1,796
13	12,752	0	9,941.10	0	18.04	1,903	2,616
14	14,257	12,350	3,330.83	6,822.58	354.46	3,107	5,016
15	5,933	7,500	7,282.32	5,251.76	390.02	2,330	6,185
16	12,918	5,800	12,773	1,214.28	100.09	4,269	10,947
17	6,508	15,000	10,416.60	14,173.60	755.12	2,354	440
18	10,270	0	7,226.86	0	62.77	1,578	7,899
19	7,154	0	5,797.44	0	678.19	1,581	1,308
20	6,274	0	2,802.61	0	345.89	1,866	2,814
21	9,433	0	7,582.52	0	2,202.68	1,582	2,677
22	6,190	0	3,546.91	0	1,413.71	899	3,854
23	14,308	0	9,990.15	0	3,532.07	1,942	4,720
24	7,455	0	242.46	0	508.75	1,503	5,340
25	7,367	0	2,507.63	0	942.30	479	442
26	10,800	4,300	4,597.75	2,419.67	0	1,389	3,992
27	3,266	13,700	1,612.93	7,709.66	242.63	2,047	4,774
28	8,470	0	2,454.00	0	1,288.05	512	2,140
29	5,000	0	821.04	0	4,699.35	0	173
30	11,820	0	10,296.30	0	2,596.87	1,713	3,574
31	11,820	0	9,468.81	0	4,236.69	930	4,073
32	11,820	0	9,731.98	0	2,924.47	592	2,998
33	11,120	0	7,882.98	3,325.03	1,978.11	1,333	1,922
34	11,820	0	10,145.00	0	2,037.89	1542	2,411
35	10,682	0	3,816.68	0	895.40	3,066	6,369
36	8,018	0	4,818.79	0	634.47	1,533	2,949
37	10,785	0	4,317.71	0	786.95	1,165	2,520
38	7,980	0	3,568.30	0	737.74	906	2,288
39	18,035	0	16,829.40	0	362.16	2,111	2,743
40	6,000	11,500	4,859.04	10,009.90	752.61	1,935	4,034
41	4,617	0	0	0	466.69	1,630	3,813
42	10,014	14,000	6,104.08	11,778.70	2,446.33	595	4,974
43	8,132	0	4,930.84	0	630.27	1,119	1,963
44	11,367	0	4,253.16	0	34.30	1,524	4,439
45	8,739	0	6,884.79	0	3,102.82	880	2,147
46	4,202	0	2,469.95	0	1,704.76	600	1,192
47	11,620	0	10,129.40	0	1,889.01	512	4,884
48	12,359	0	12,680.30	0	4,017.01	2,130	4,311
49	11,040	17,500	12,277.30	7,292.80	1,066.27	885	8,762
50	8,362	0	1,445.66	0	232.25	1,891	2,063
51	8,533	0	4,383.24	0	2,097.01	169	1,262
52	5,966	0	42.37	0	5,965.99	707	2,280
53	9,082	0	2,758.76	0	7,283.91	601	779
54	11,449	0	9,721.46	0	17.84	943	1,274
55	8,700	0	3,342.14	0	709.77	903	1,395
56	10,724	0	7,966.87	0	519.25	915	3,356
57	10,762	0	5,900.27	0	1,684.88	398	-105

Var. / Farm No.	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1	0	138.30	0	2,465	420	-22	68	0
2	118.58	206.00	589	10,064	165	-15	110	4
3	0	454.81	0	12,069	0	32	75	7
4	258,51	551,47	465	18,172	0	307	88	160
5	0	234,25	0	-5,089	0	-770	0	0
6	0	252.91	0	5,131	42	52	0	0
7	0	172.33	0	1,121	120	146	0	0
8	0	356.72	0	-283	0	-137	133	0
9	0	170.81	0	-2,610	0	-160	30	543
10	0	272,42	0	1,925	0	-52	0	0
11	-	190.03	0	-1,463	170	-120	19	0
12	192.62	304.15	165	8,911	0	-93	33	135
13	0	422.50	0	5,863	0	45	0	0
14	1,030.24	141.56	409	1,906	0	23	3	715
15	288.31	309.50	315	4,746	1,400	-4	236	263
16	289.59	542.88	73	-802	0	29	208	180
17	336.18	442.71	1,097	20,056	0	254	75	327
18	0	307.14	0	-1,879	350	-84	237	0
19	0	246.39	0	3,833	426	110	383	0
20	0	119.11	0	-1,412	0	93	30	0
21	0	322.26	0	5,898	266	333	0	0
22	0	150.74	0	359	25	84	104	0
23	0	424.58	0	7,284	245	18	187	520
24	0	10.30	0	-6,081	750	3	40	0
25	0	106.57	0	2,636	280	65	3	60
26	671.00	195.40	145	1,306	0	861	0	573
27	1,123.19	68.55	463	2,153	0	-240	0	1,177
28	0	104.30	0	1,195	500	707	0	0
29	0	34.89	0	5,382	0	466	0	0
30	0	437.59	0	8,044	123	1,265	71	0
31	0	402.42	0	9,105	175	1,262	0	0
32	0	413.61	0	9,480	1,193	310	0	0
33	234.60	335.03	200	10,231	175	63	1	28
34	0	431.16	0	8,662	235	265	0	0
35	0	162.21	0	-4,560	0	-24	49	0
36	0	204.80	0	1,176	353	46	256	0
37	0	183.50	0	1,603	784	-5	0	0
38	0	151.65	0	1,264	391	0	31	0
39	0	715.25	0	13,053	1,526	534	240	0
40	804.02	206.51	681	9,736	65	-52	33	778
41	0	0	0	-4,976	0	60	100	0
42	1,466.89	259.42	858	14,411	0	-130	0	1,594
43	0	209.56	0	2,689	1,060	59	24	0
44	0	180.76	0	-1,495	140	262	0	0
45	0	292.60	0	7,253	210	-12	10	0
46	0	104.80	0	2,483	350	0	0	0
47	0	430.50	0	7,052	1,340	110	1	0
48	0	538.91	0	10,795	181	-18	1	0
49	1,150.12	521.79	438	10,798	92	401	35	920
50	0	61.44	0	-2,215	155	37	43	0
51	0	186.29	0	5,236	120	-42	125	0
52	0	1.80	0	3,023	854	36	0	0
53	0	117.25	0	8,770	250	390	6	0
54	0	413.16	0	7,935	100	-440	24	0
55	0	142.04	0	1,897	2,225	-101	5	0
56	0	338.59	0	4,554	30	39	6	0
57	0	250.76	0	7,543	676	-2	0	0

Var. Farm No.	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
1	100	1,868	1,574	2,095	154	1,941	3,285	96.71
2	160	117	1,056	808	36	772	1,825	489.96
3	440	123	1,329	637	55	582	1,460	124.89
4	1,131	132	777	686	306	380	1,825	238.29
5	1,850	90	545	381	102	280	0	477.50
6	230	873	1,941	1,013	177	835	2,372	142.88
7	450	1,196	962	1,250	200	1,050	3,102	210.72
8	2,825	545	1,612	1,301	317	984	1,825	259.42
9	1,350	537	332	200	8	192	1,095	395.44
10	780	762	775	786	104	681	1,825	296.66
11	875	514	1,180	761	139	623	2,190	420.40
12	616	542	910	529	251	277	1,642	159.98
13	650	807	1,629	2,638	362	2,276	1,018	211.96
14	313	716	1,157	1,131	689	442	2,555	451.21
15	400	327	1,819	1,723	765	958	1,825	501.30
16	656	757	2,602	1,140	449	691	2,555	825.23
17	18	457	2,185	2,097	989	1,108	2,555	399.96
18	200	682	2,120	2,741	884	1,857	2,920	669.15
19	780	595	1,534	1,175	126	1,049	1,642	141.60
20	760	247	1,351	639	158	481	1,460	271.42
21	665	188	2,506	1,831	597	1,234	2,555	210.32
22	450	474	1,443	998	398	600	2,555	366.79
23	1,160	1,650	1,586	1,546	285	1,261	2,920	478.11
24	715	788	2,308	1,009	257	651	2,555	415.00
25	0	142	1,034	788	68	721	1,825	71.19
26	0	173	974	720	449	271	1,460	248.38
27	1,032	1,302	2,184	1,661	912	749	2,920	368.87
28	0	44	1,407	927	172	755	365	166.84
29	260	355	1,596	547	180	367	1,825	89.44
30	440	739	1,531	1,541	25	1,516	1,825	282.25
31	395	622	1,290	1,104	132	972	1,460	274.58
32	250	314	741	780	71	709	1,825	173.05
33	310	414	2,275	1,107	133	974	2,555	189.27
34	300	20	718	851	77	774	0	177.48
35	1,175	802	2,165	2,142	347	1,795	2,555	490.04
36	800	260	1,074	1,330	371	959	2,008	259.69
37	700	505	2,580	1,353	112	1,242	2,555	183.27
38	450	811	1,450	1,223	484	739	1,460	191.02
39	1,190	1,965	3,597	3,602	419	3,183	2,920	237.99
40	520	526	1,864	2,051	855	1,196	2,555	325.86
41	106	484	1,353	502	208	294	2,372	323.18
42	208	1,063	2,807	2,840	1,718	1,122	3,102	460.05
43	400	228	2,408	1,174	348	826	2,920	161.30
44	0	142	1,749	2,270	492	1,778	2,008	285.79
45	450	306	1,021	634	188	446	2,008	181.80
46	530	210	1,516	964	165	799	2,009	111.76
47	370	277	2,420	1,890	111	1,780	1,825	317.03
48	812	243	1,690	1,521	390	1,131	1,825	445.50
49	570	546	1,284	1,765	1,114	651	1,460	648.64
50	650	947	1,442	1,142	431	711	3,285	261.00
51	85	377	705	656	92	564	1,460	134,60
52	40	353	1,140	1,061	162	899	1,278	173,25
53	100	0	256	396	16	381	0	69.63
54	520	78	462	634	113	521	1,460	114.61
55	215	625	3,179	3,030	58	2,972	2,190	141.68
56	408	269	1,304	736	387	349	2,555	309.61
57	125	203	1,958	2,016	39	1,977	1,825	26.12

Var. Farm No.	(24)	(25)	(26)	(27)	(28)	(29)	(30)
1	0	0	0	96.71	2.8	0	868.20
2	0	185.00	304.96	0	6.4	0	4,878.89
3	0	0	65.00	64.89	4.4	0	1,126.57
4	0	26.00	52.00	160.29	6.4	0	2,234.04
5	0	0	577.50	0	6.1	0	5,336.72
6	0	55.00	40.00	47.88	2.3	0	1,350.46
7	0	56.00	15.00	139.72	3.2	0	2,022.13
8	0	25.00	243 00	191.42	8.0	0	3,711.96
9	128.40	0	195.00	200.44	6.6	0.03	3,161.96
10			0	296.66	6.0	0	2,475.61
11	0	0	229.00	191.40	5.2	0	3,481.03
12	0	44.00	0	115.98	4.0	0	1,458.54
13	0	0	152.00	59.96	3.6	0	1,817.43
14	0	0	80.00	371.21	7.3	0	4,566.45
15	0	0	120.00	381.30	8.9	0	4,817.31
16	660.74	0	525.00	300.23	10.8	0.12	7,761.19
17	0	180.00	0	219.96	6.3	0	3,975.27
18	0	452.15	217.00	0	9.7	0	6,240.03
19	0	40.00	101.60	0	2.0	0	1,401.07
20	0	30.00	125.00	116.42	4.8	0	2,643.41
21	308.16	28.32	182.00	0	3.3	0.07	2,140.68
22	0	245.00	121.79	0	5.2	0	3,857.34
23	128.40	150.00	173.00	155.11	8.1	0.3	4,916.12
24	0	178.00	33.00	204.00	5.8	0	3,318.56
25	0	0	0	71.19	1.4	0	613.98
26	797.44	16.00	49.00	183.38	4.4	0.20	1,936.30
27	0	62.00	142.00	164.87	5.6	0	3,107.35
28	0	0	0	166.84	2.6	0	1,486.02
29	0	89.44	0	0	2.4	0	925.68
30	0	0	282.25	0	4.4	0	2,423.91
31	512.64	59.00	215.58	0	5.6	0.15	2,319.73
32	1,202.72	0	173.05	0	3.8	0.37	1,625.36
33	0	0	189.27	0	4.8	0	1,680.54
34	0	0	177.48	0	6.0	0	1,506.44
35	0	152.00	233.00	105.04	8.4	0	4,093.80
36	115.56	25.00	45.00	189.69	4.8	0.03	2,308.81
37	0	0	63.00	120.27	2.8	0	1,326.63
38	0	82.00	18.00	91.02	4.4	0	1,642.54
39	0	0	123.00	114.99	4.8	0	2,073.16
40	667.68	43.00	41.00	241.86	6.4	0.18	2,921.30
41	0	62.00	55.00	206.18	5.6	0	2,857.57
42	199.36	265.00	161.00	34.05	8.8	0.05	4,215.17
43	0	13.00	0	148.30	2.6	0	1,395.47
44	598.08	42.00	65.00	178.79	5.2	0.15	2,434.59
45	0	75.00	56.00	50.80	3.0	0	1,674.31
46	0	0	0	111.76	2.4	0	959.02
47	1,434.80	93.03	224.00	0	6.1	0.39	3,113.21
48	0	87.00	358.50	0	8.2	0	4,592.38
49	2,492.00	435.00	0	213.64	9.7	0.52	6,379.85
50	0	86.00	175.00	0	5.2	0	3,269.83
51	0	93.00	41.60	0	2.0	0	1,234.48
52	0	45.00	50.00	78.25	2.6	0	1,442.95
53	0	0	69.63	0	1.2	0	758.87
54	0	20.00	94.61	0	2.8	0	1,042.94
55	0	0	0	141.68	3.0	0	1,263.90
56	0	90.00	110.00	109.61	4.9	0	3,075.80
57	0	26.12	0	0	0.4	0	270.08

Var. / Farm No.	(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)
1	109.17	55	3	5	1	1	14	12.39	12.05	1
2	469.43	25	1	8	1	1	8	4.41	7.05	2
3	131.93	46	3	7	2	2	5	4.20	4.30	2
4	255.96	30	2	10	1	1	4	4.71	3.35	2
5	571.55	25	2	8	2	2	1	3.54	1.00	2
6	143.46	40	3	0	1	1	6	5.12	5.05	1
7	223.30	26	3	6	1	2	3	3.45	2.65	1
8	479.22	48	1	10	2	2	5	6.03	4.55	2
9	419.25	64	2	0	1	1	2	8.65	1.75	2
10	334.87	32	2	6	1	1	6	6.99	4.75	2
11	442.69	60	2	6	2	1	7	9.67	5.80	2
12	170.78	29	2	13	3	1	5	4.81	4.05	2
13	218.12	60	2	0	2	2	11	5.57	9.70	2
14	498.20	38	3	5	2	2	14	12.97	11.80	2
15	549.18	28	3	8	2	2	3	3.85	2.65	1
16	858.49	38	3	8	1	2	7	8.73	6.15	1
17	411.37	35	3	8	1	2	5	5.48	4.30	1
18	624.41	21	3	6	1	2	10	9.82	9.05	1
19	136.79	23	2	0	1	1	9	7.87	7.40	1
20	282.31	26	2	7	1	1	5	4.10	4.05	1
21	205.78	40	2	6	1	1	7	8.79	6.15	1
22	342.51	45	1	0	1	1	9	2.61	7.75	1
23	482.21	27	2	6	1	2	9	9.44	7.85	1
24	424.20	37	3	0	1	1	8	5.98	6.60	1
25	80.36	23	3	8	1	1	4	3.32	3.35	1
26	269.99	23	3	8	1	1	4	3.40	3.35	1
27	382.81	40	3	6	2	2	8	5.78	6.80	1
28	188.33	21	3	12	2	1	2	1.18	1.80	2
29	81.03	24	3	8	2	1	5	4.05	5.05	2
30	279.34	34	1	6	2	1	7	9.14	6.25	2
31	266.81	25	1	11	2	1	2	3.05	1.95	2
32	171.27	35	1	6	1	1	4	4.02	3.35	2
33	187.32	24	1	7	2	1	8	7.72	7.75	2
34	175.65	25	1	8	1	2	1	1.00	1.00	2
35	486.88	40	3	6	1	1	6	6.32	5.00	1
36	281.31	26	2	2	1	2	5	4.45	4.05	1
37	198.11	25	2	8	1	1	10	9.31	8.80	2
38	194.85	30	3	6	2	1	5	5.63	4.05	2
39	251.53	53	2	0	1	2	12	17.77	10.90	2
40	352.55	35	3	6	2	1	5	6.26	4.05	2
41	343.34	28	3	0	1	1	5	5.08	4.05	1
42	437.87	39	3	8	2	2	7	6.37	5.65	1
43	179.18	45	3	0	1	2	7	6.03	6.00	1
44	304.20	26	3	6	1	2	4	3.22	3.35	1
45	180.72	24	3	6	1	1	9	7.94	7.65	1
46	126.15	30	3	2	1	1	6	5.30	5.20	1
47	305.98	48	1	8	2	1	9	5.47	7.60	2
48	433.63	36	1	8	2	2	9	5.65	7.50	2
49	635.27	36	2	10	2	2	7	12.23	5.75	2
50	251.11	47	3	0	1	1	8	7.96	6.80	1
51	125.45	60	1	3	1	1	7	7.27	5.85	2
52	178.58	44	2	5	2	2	4	3.91	3.45	2
53	68.91	23	1	8	1	1	1	1.00	1.00	2
54	111.76	39	1	5	2	1	7	5.56	5.80	2
55	159.93	45	2	5	2	1	6	5.59	4.75	2
56	314.13	32	3	7	1	1	7	5.93	5.45	1
57	23.66	26	3	11	1	2	3	2.74	2.65	1

Var. Farm No.	(41)	(42)
1	752.64	0
2	642.90	16.0
3	1009.40	54.0
4	1040.48	157.0
5	1668.68	480.0
6	596.78	0
7	378.00	0
8	2536.96	0
9	905.96	240.7
10	1064.20	0
11	972.48	0
12	1218.50	0
13	1054.36	0
14	1420.20	22.0
15	1963.36	0
16	1547.72	70.0
17	2827.66	0
18	1914.28	0
19	1065.12	0
20	2275.46	0
21	1015.96	0
22	1480.72	8.0
23	1279.00	75.0
24	463.60	0
25	347.12	70.0
26	319.12	0
27	1467.76	0
28	1592.28	27.00
29	861.84	0
30	758.88	0
31	161.78	0
32	970.92	0
33	822.36	0
34	596.32	0
35	1187.48	0
36	840.32	0
37	661.48	0
38	804.44	0
39	1506.64	0
40	1128.44	0
41	413.28	0
42	2498.16	25.0
43	1457.56	10.0
44	493.36	0
45	629.56	0
46	583.56	0
47	1632.24	0
48	1174.96	0
49	2024.16	0
50	617.20	0
51	717.96	0
52	616.80	0
53	70.20	0
54	1144.44	0
55	1234.60	0
56	793.52	0
57	473.96	0

Data Set A

Var.No.	Explanation of Variables
	DEBTS
(1)	Total Farm Development Loan
(2)	Total Tractor Loan
(3)	Balance of Farm Development Loan at beginning of period
(4)	Balance of Tractor Loan at beginning of period
(5)	Amount owed to F.S.C. at beginning of period
(6)	Income still to accrue from the 1977 cane harvest
(7)	Income to accrue from the 1978 cane harvest
(8)	Loan Repayments from tractor earnings during the period
(9)	Interest on Farm Loan during period
(10)	Interest on Tractor Loan during period
(11)	Terminal Debt
	INCOME DURING PERIOD
(12)	Income from Wage Labour including cutting
(13)	Exogenous income
(14)	Sales
(15)	Business Income
(16)	Bank Income (Subsistence plus Planting Allowance)
(17)	Value of home food production
	LABOUR INPUTS
(18)	First Estimate of Family Labour input based only on Intensive Visits.
(19)	Second Estimate based on Activities undertaken (excluding Female domestic labour)
(20)	Yearly labour input (of Variable 19) to debt reducing activities.
(21)	Yearly labour input to Consumption producing activities.
(22)	Estimate of yearly female domestic labour.
	CANE PERFORMANCE
(23)	Tonnes sent to the Mill in 1978
(24)	Value of seed cane sales
(25)	Tonnes of plant cane harvested 1978 (not including Variable 24).
(26)	Tonnes of first ratoon cane harvested 1978
(27)	Tonnes of older ratoon cane harvested 1978

Data Set A (cont.)

Var.No.	Explantation of Variables
(28)	Hectares producing 23
(29)	Hectares producing 24
(30)	Harvesting and Transport Costs of 23
(31)	Total Output (23) adjusted for the Age of the Cane.

SOCIO-ECONOMIC VARIABLES

(32)	Age of household head
(33)	Number of harvests before 1978
(34)	Years of schooling of household head
(35)	Work experience of household head: 1 = No full time cash earning activity 2 = Some previous full time wage labour or commercial farming.
(36)	Migrant Status: 1 = Local Residents 2 = Migrants
(37)	Number of People in the household
(38)	Number of Adult Equivalent Consumption Units supported by the household
(39)	Number of Adult Equivalent Production Units available to the household
(40)	Racial Origin: 1 = Indian 2 = Fijian.

EXPENDITURE

(41)	Yearly recurrent expenditure
(42)	Yearly non-recurrent expenditure

CHAPTER 6

THE SUBSISTENCE AND MARKET ECONOMIES

6.1 Introduction

The people of Fiji, as of many other developing countries, spend a large proportion of their productive time in subsistence activity. They produce many of the basic requirements, especially food, for their own consumption rather than obtaining them through markets. This could partially be due to the extent to which markets have been developed for such commodities, and partly to the extent to which the people are accustomed to markets and rely on them. It might also be attributed to certain institutional aspects of their societies. Accordingly, there may be some difference in the behaviour of the two dominant races which inhabit Fiji, because their attitudes have been shaped by widely different historical backgrounds. The two races also differ in their subsistence production patterns because they produce different crops for home consumption. The Indian diet is based on rice, while root crops provide the staple food for Fijians.

Against this background of subsistence activity, the Seaqaqa scheme is designed to introduce and expand the rôle of commercial production, namely the production of sugar for export. The objective of the present chapter is to build a model of behaviour in Seaqaqa where there was a choice in allocating inputs between a subsistence and a commercial crop. The question of how commercial activity is related to the subsistence economy has been studied in depth by a number of economists, especially Fisk (1975), who built on the framework suggested by Nakajima which was discussed in Chapter 3. The main features of the Fisk model are retained in this chapter in a form which helps to understand recent developments in the Seaqaqa project, and which enables the policy implications of these developments to be studied.

As mentioned in Chapter 1, the process of increasing commercialisation may be divided into four stages. Stage 1 is the stage of pure subsistence in isolation. The second is the stage of subsistence with supplementary cash production. In the third a predominantly cash orientation is supplemented by some subsistence production. The final one, the stage of full commercialisation, has been extensively studied in modern neo-classical economics. In this stage policy relies heavily on the role of markets and the price system. This approach to policy however, is not entirely suitable for application to the earlier stages and modifications have to be made. The Seaqaqa project can be considered as an attempt to move the people in that area from stage 2 to stage 3, and the evidence presented in Chapter 5 suggested that households were approaching the border between the two stages at the time of fieldwork. Therefore the models which have been developed specifically to study factors affecting the transition from stage 2 to stage 3 will be considered by taking account of the special features that characterize these stages. These characteristics are discussed in Section 6.2.

Beginning from the neo-classical premise of utility maximisation a simple model of family behaviour is developed in Section 6.3 which incorporates the features identified in Section 6.2. In Section 6.4 the model is illustrated graphically and it is shown to retain the essential features of the Fisk model. However before the model could be applied to Seaqaqa, one important change had to be made. Cane is a semi-perennial crop, and inputs applied in any given period can yield returns for some time into the future. The impact of perceptions about the future on decision making had therefore to be introduced. The modifications which made the model applicable to Seaqaqa are described in Section 6.5.

The Project Administration had introduced a set of incentives and disincentives designed to encourage participation in the monetary sector. Although the model could not be estimated, it proved a particularly useful tool for analysing whether these measures were likely to have had the effect on labour inputs to the cash sector desired by the Administration. This is the topic of Section 6.6. Wherever possible, the data that were presented in Chapter 5 are used to clarify the discussion.

6.2 Special Features of the Early Stages of Commercialisation

Three special features of stage two economies must be incorporated into any theoretical model. One is the fact that either there are no markets for the goods produced in the subsistence sector, or if markets exist they are not relied on to a great extent. Suspicion about the market's ability to provide basic needs during periods of shortage and the costs, including time, involved in travelling to and from markets may prevent households from using any facilities which exist.

The second feature is that there is a clearly defined concept of the minimum requirements for the goods produced by subsistence activity. Minimum requirements for the goods obtained by the exchange of cash crops in the market may also exist, but in stage 2 they are separated from the requirement of a minimum level of subsistence production. With the increasing commercialisation of stage 3, markets for all goods emerge and are widely used. Subsistence crops are produced only if it pays.

The third feature is that there is a fairly clearly defined concept of satiation levels for the consumption of the goods produced in the subsistence sector. Markets do not exist or are perceived to be unreliable, and production much in excess of minimum requirements benefits the family little.

6.3 Household Optimization in the Absence of a Market for Subsistence Produce

To bring out the implications of these special features it is useful to start with the neo-classical model of individual choice. The convention that the household is the decision making unit will be followed. The fact that the family chooses between leisure, labour input into subsistence activity, and labour input into commercial activity means that its utility function is dependent on three variables:

$$U = U(F,C,Le) \ , \qquad (6.1)$$

where F is the consumption of the foods produced in the subsistence sector, C is the consumption of the goods which can be bought in the market for cash, and Le is the amount of leisure. The family seeks to maximise this utility subject to the conditions of production and the constraints on its budget and on its time. To identify these constraints, let it produce an amount S of subsistence goods with a labour input of L_s, according to a production function

$$S = f(L_s) \ . \qquad (6.2)$$

It also produces an amount Q of commercial goods with a labour input of L_q, according to a production function

$$Q = g(L_q) \ . \qquad (6.3)$$

The amounts of labour allocated to various uses is constrained by the total time $\bar{L}$ available:

$$L_s + L_q + Le = \bar{L} \ . \qquad (6.4)$$

If both the subsistence and the commercial crops are freely traded at market prices p_s and p_q respectively, the usual budget constraint of neo-classical economics applies, namely:

$$P_sF + P_cC = P_sS + P_qQ \ , \qquad (6.5)$$

where p_c is the price of market good C.

However, one of the special features of the early stages of commercialisation is that there is no market for the subsistence commodity, or no reliance on markets which may exist. This means that instead of the budget constraint of the form of equation (6.5), we have

$$P_c C = P_q Q \tag{6.5a}$$

and $$F = S \,, \tag{6.5b}$$

i.e. all consumption of subsistence goods is produced by the consumers themselves. One of the major objectives of the Fisk model is to study the behaviour of households using these assumptions.

Where a market for subsistence produce exists, the usual neo-classical first order conditions, derived from maximising equation (6.1) subject to (6.4) and (6.5), apply:[1]

$$U_{Le} = f'U_F = \frac{P_q}{P_s} g' U_F \,, \tag{6.6}$$

$$U_{Le} = \frac{P_q}{P_c} g'U_c = \frac{P_s}{P_c} f' U_c \,, \tag{6.7}$$

$$P_s f' = P_q g' \,, \tag{6.8}$$

and $$\frac{U_F}{U_C} = \frac{P_s}{P_c} \,. \tag{6.9}$$

Additional F can be consumed either by increasing production of the subsistence crop S, or by increasing production of Q. The cash crop Q can then be exchanged in the market for F at the rate p_q/p_s. Equation (6.6) implies that the household will allocate time away from leisure to increasing the consumption of F until the loss in utility from the lower consumption of leisure (U_{Le}) equals the gain in utility from the higher consumption of F (either $f'U_F$ or $\frac{P_q}{P_s} g' U_F$).

Similarly equation (6.7) implies that labour will be allocated away from leisure to increasing the consumption of the market

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1 These conditions are derived in Appendix 2.

good C, until the loss of utility from the decrease in leisure equals the gain in utility from the higher consumption of C (either $\frac{P_q}{P_c} g'U_c$ or $\frac{P_s}{P_c} f'U_c$).

With two means of increasing the consumption of both F and C, the household will choose to allocate successive increments of labour to the most efficient. Equations (6.6) and (6.7) each imply equation (6.8) - at the optimal point, the marginal value product of labour in both activities must be the same. The partial condition of equation (6.8) can be represented diagramatically. Fig. 6.1 shows the equilibrium division of labour input between S and Q. OL_1 units of labour measured from the left hand axis are allocated to the production of S, and OL_1 units measured from the right hand axis are allocated to the production of Q. Total labour input is given by OL_1O, which equals $\bar{L}$-Le. If the family decided to increase its total labour input (reduce Le) the length of OL_1O would increase.

Because both S and Q are marketed, the usual consumer optimum, given by equation (6.9), applies. The household chooses between the consumption of F and C until the Marginal Rate of Substitution in Consumption (MRS_C) equals the Marginal Rate of Substitution in Exchange (MRS_E).[2] In Fig. 6.2 the absolute value of the slope of the indifference curve is the MRS_C while the absolute value of the slope of the budget line is the price ratio or the MRS_E. The household consumes OF_1 units of F and OC_1 units of C. The budget line F_2C_2 is determined by the cash income received by the family.

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2 This terminology is used by Hirshleifer (1980). The MRS_C is the slope of the indifference curve, or the rate at which a consumer would be just willing to substitute one good for another at the margin, $MRS_C \equiv \frac{d_y}{d_x}/U$. The

MRS_E is the rate at which he can substitute commodities, given total income and market prices, or the negative of the slope of the budget line, $MRS_E \equiv \frac{P_x}{P_y}$.

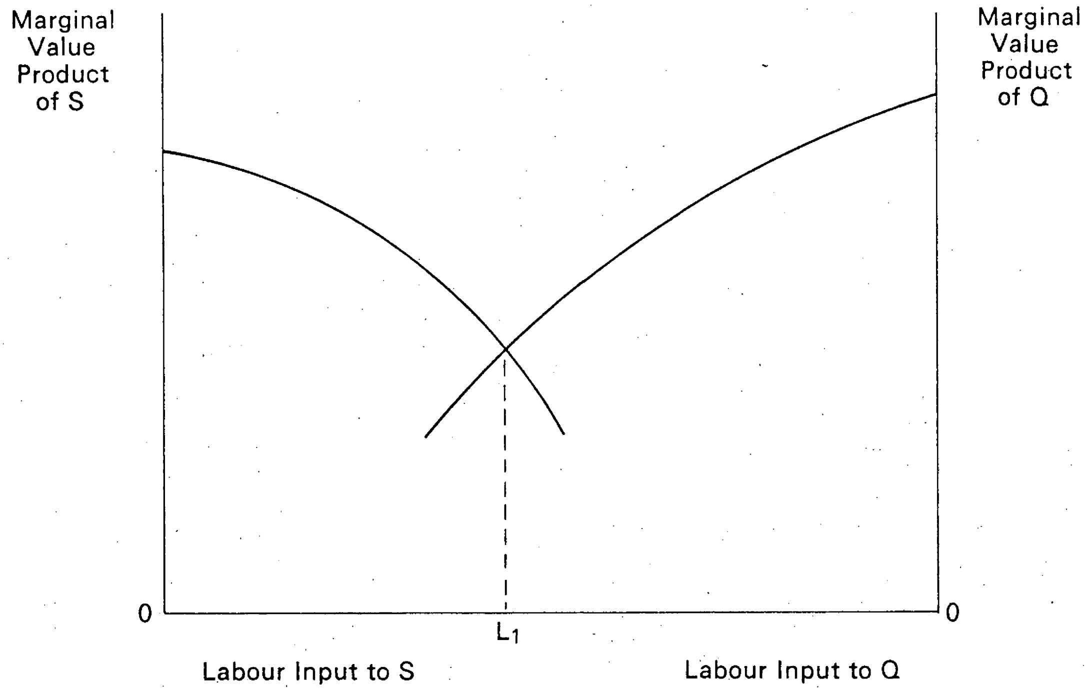

Fig. 6.1

Labour Allocation when the Output of Both Sectors is Marketed

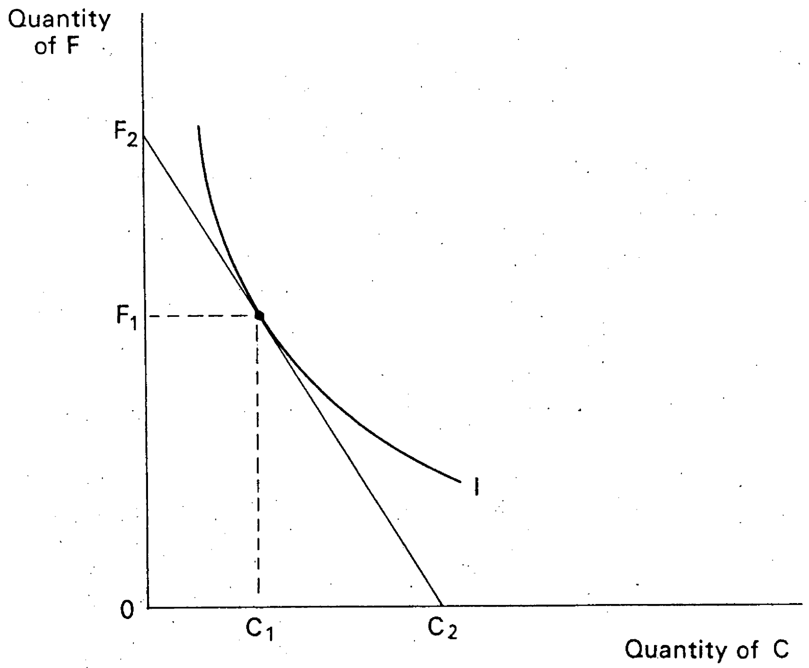

Fig. 6.2

The Consumption Choice when the Output of Both Sectors is Marketed

Comparative static analysis could be used to explore the impact of changes in various parameters. For example, if the family decided on a higher total labour allocation, the distance OL_1O in Fig. 6.1 would increase, and the budget line in Fig. 6.2 would shift in a north easterly direction. However this type of analysis in the case where the entire farm product is marketed was explored in detail by Nakajima. For the remainder of this chapter attention will be focussed on the case where one commodity is not marketed. In this situation, the first order conditions for utility maximisation are:[3]

$$\frac{U_{Le}}{U_F} = f' \ , \tag{6.10}$$

$$\frac{U_{Le}}{U_C} = \frac{P_q}{P_c} g' \ , \tag{6.11}$$

$$\frac{U_F}{U_C} = \frac{P_q}{P_c} \frac{g'}{f'} \ . \tag{6.12}$$

Consumption of F can be increased only by raising the production of S. Equation (6.10) implies that leisure will be reduced in order that the consumption of F can be increased to the point where the loss in utility from the increase in labour equals the gain in utility from the additional consumption of F. Equation (6.11) can be explained in a similar manner with the exception that Q must be exchanged in the market for C at the rate p_q/p_c. The two equations are represented diagrammatically in Figs. 6.3 and 6.4.

The curve AB is the consumption possibility curve (measured in physical units) for the subsistence good F. Since all subsistence output is consumed by the family it also represents the production function for S. In Fig. 6.4, EG is the quantity of C that could be purchased for any

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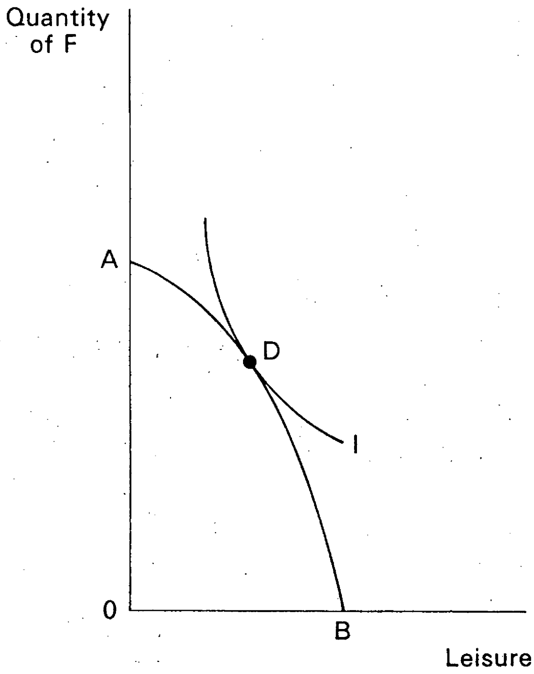
[3] See Appendix 2.



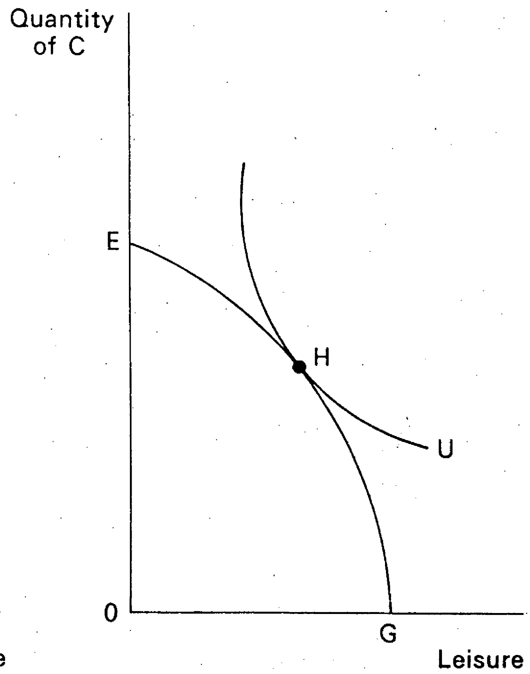


Fig. 6.3

The Choice Between Leisure and Consumption of the Subsistence Good (no Market for Subsistence Produce)

Fig. 6.4

The Choice Between Leisure and The Consumption of Market Goods given labour input to Q i.e. $\frac{P_q}{P_C} \cdot g(L_q)$. The slopes of the indifference curves in each case are $\frac{U_{Le}}{U_F}$ and $\frac{U_{Le}}{U_C}$ respectively. The household's optimum is reached when the conditions implied by points D and H are met simultaneously - when equations (6.10) and (6.11) are satisfied.

No longer however is the choice between the consumption of F and C determined by the price ratio of two marketed products. Equation (6.12) indicates that the household will reach its optimal position when the MRS_C equals the ratio of the amount of C that could be purchased by increasing labour input to Q by one unit $(\frac{P_q}{P_C} \cdot g')$, to the amount of F which could be obtained by increasing the labour input to S by one unit (f'). In Fig. 6.5 AB, DE and GH are consumption possibility curves for F and C for different total labour inputs. Labour input on GH is higher than on DE which in turn is higher than on AB. The assumption of declining Marginal Physical Products of labour is reflected in the sections on the curve with the highest labour input GH which are almost vertical and horizontal. Where both goods were marketed, budget lines represented consumption possibilities. In this case consumption possibilities are determined directly by total labour inputs and the relative marginal physical products of labour in each activity. The slope of the curves $(\frac{P_q}{P_C} \cdot \frac{g'}{f'})$, the right hand side of equation 6.12, is the rate at which C can be exchanged for F by allocating incremental units of a given total labour input away from one sector to the other.

Had the family decided on a total labour input which would have put it on DE, it would have reached its optimum when the highest possible indifference curve I_2 was tangential to DE at point J. The slope of the indifference curve is $\frac{U_F}{U_C}$ and equation 6.12 is satisfied.

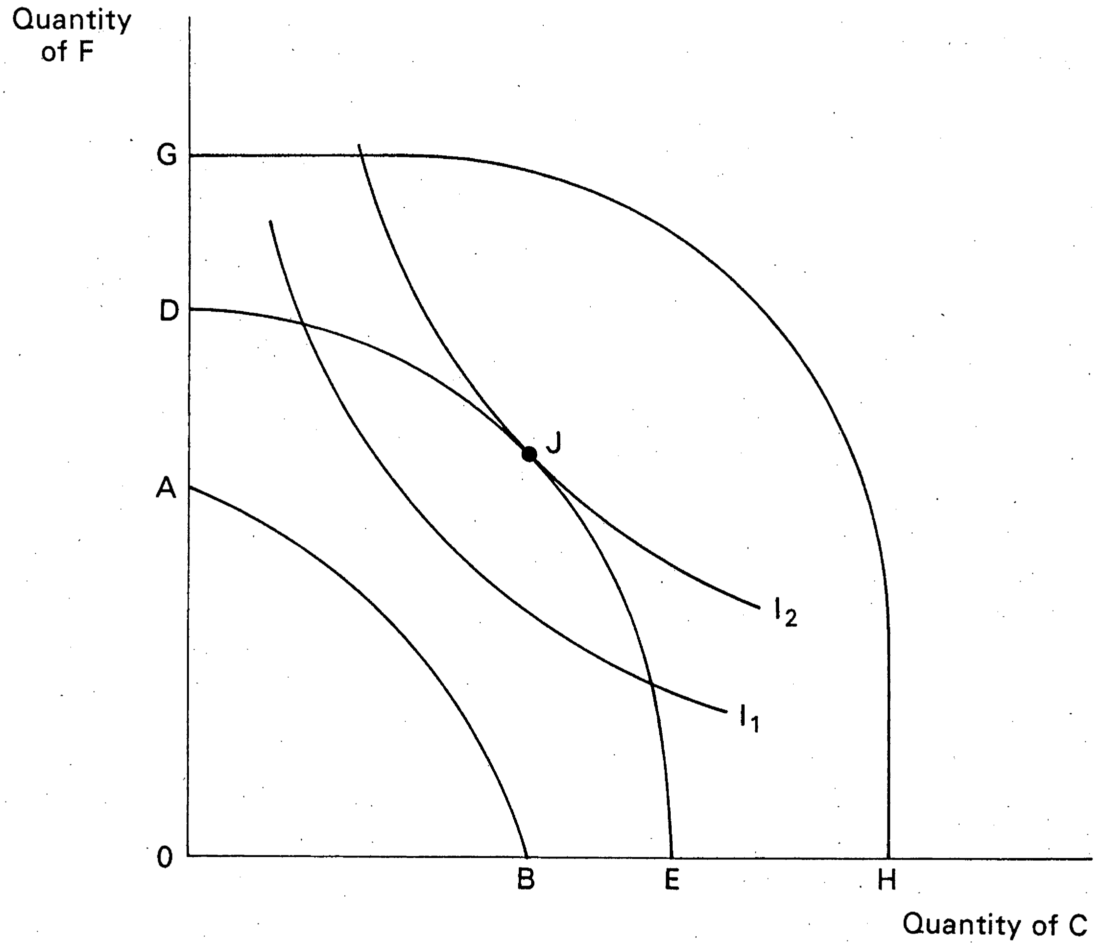


Fig. 6.5

The Choice Between Market and Subsistence Goods when the Output of the Subsistence Sector is not Marketed

In this way the family decides on both its consumption ratio, and the allocation of its labour between S and Q simultaneously. This can be contrasted to the case where both goods were marketed, and the total labour input was allocated between Q and S so as to equalise the Marginal Value Product of labour in each activity. In that case consumption patterns for a given income were determined by the market price ratio of F to C.

In this section a very basic neo-classical model has been adapted for the case in which the output of one sector is not marketed. It is clear that the lack of the market, by itself, does not invalidate neo-classical theory. In the next section minimum requirements and satiation levels are incorporated into this framework.

6.4 A Graphical Model of the Early Stages of Commercialisation

There are a number of ways of incorporating the other features of stage 2 economies, but the analysis in this chapter will be based on the scheme suggested by Fisk.[4] He concentrated on Figs. 6.3 and 6.4 but measured labour rather than leisure along the horizontal axis. For consistency, similar representations to his will be used in the remainder of the chapter. It must however be remembered that these two diagrams also imply Fig. 6.5.

Minimum requirements and maximum aspiration levels were introduced into both sectors of the Fisk model in the

[4] The model developed in this chapter, though based on the work of Fisk, is not identical to his model. To some extent the present model is more general. Fisk claims that the total labour available to the cash sector is that part of the physiologically possible maximum labour input remaining after subsistence needs have been met. At a later point this possibility is shown to be a special case of the model developed in this chapter.

manner suggested by Nakajima.[5] In Figs. 6.6 and 6.7, F_oF_o' and C_oC_o' represent minimum requirements for the subsistence and market good respectively. Similarly $\bar{F}\bar{F}'$ and $\bar{C}\bar{C}'$ are the relevant maximum aspiration levels. Where subsistence produce cannot be sold, there is little value producing goods greatly in excess of minimum requirements, and it is likely that $\bar{F}\bar{F}'$ would be fairly close to F_oF_o'. In the cash sector, $\bar{C}\bar{C}'$ is likely to be close to C_oC_o' in the very early stages of commercialisation where few market goods and services are available. However as the availability of market goods increases, aspirations are likely to rise.

In Chapter 3 it was shown that indifference curves were asymptotic to F_oF_o' (and C_oC_o') and vertical above $\bar{F}\bar{F}'$ (and $\bar{C}\bar{C}'$). This means that the marginal valuation of family labour curve L_2, which equals the slope of the indifference curve at any point, is zero at the intersection of the minimum subsistence line and the consumption possibility curve, and approaches infinity at the intersection of the consumption possibility curve and the maximum aspiration line. In each case, the curve L_3 measures the increase in consumption that would be made available by an incremental increase in labour input, similar to the concept of the Marginal Physical Product of Labour. Optimisation occurs where the marginal valuation of family labour equals labour's marginal productivity in each activity. A labour input of OA_{F2} units is applied to the subsistence sector, and $A_{F1}A_{C2}$ units are allowed to production of the cash crop.

This representation is slightly different to that used by Fisk. In the present model F_oF_o' is not defined solely in terms of the quantities necessary to ensure the family's physical survival. The Wharton concept of minimum

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[5] See Chapter 3.

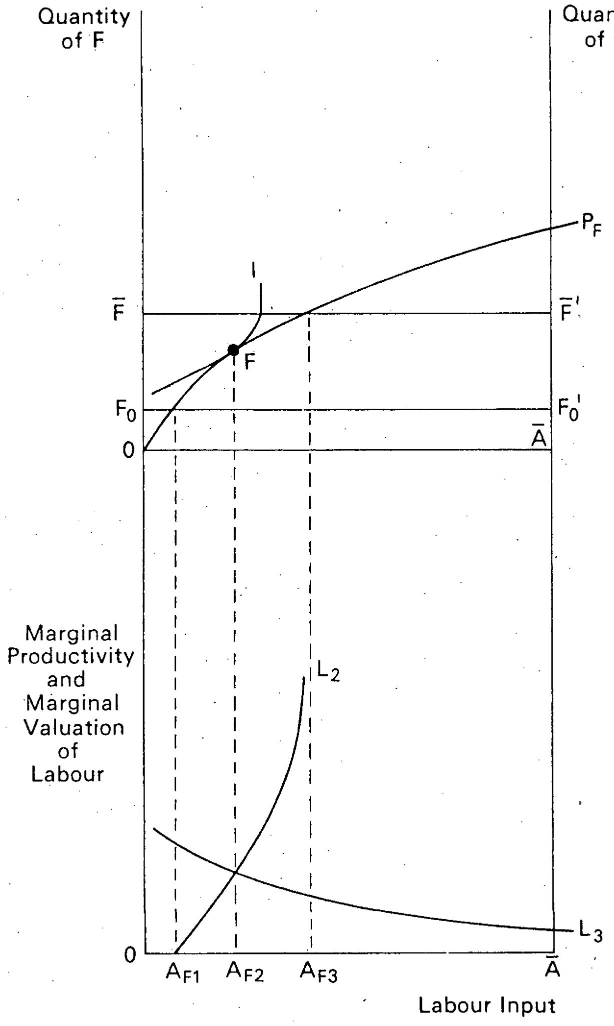

Fig. 6.6

The Impact of Minimum Requirements and Maximum Aspirations on the Choice Between Leisure and Consumption of the Subsistence Good

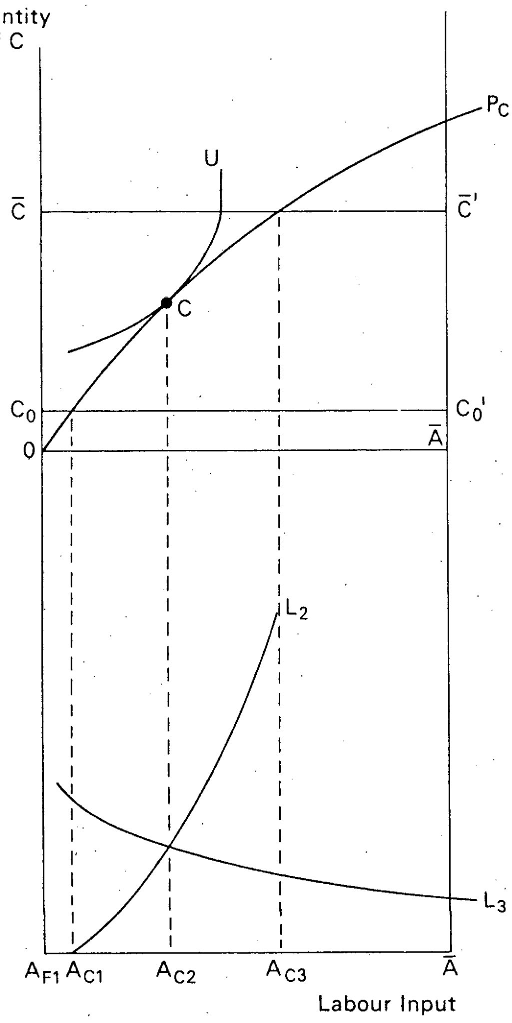

Fig. 6.7

The Impact of Minimum Requirements and Maximum Aspirations on the Choice Between Leisure and Consumption of the Market Good requirements that was outlined in Chapter 3 is used. Included is a survival component, an economic wellbeing variable and a cultural component. Although the utility function is not defined for consumption below F_o the family would probably survive physically at these levels.

Fisk argued that in early stages of commercialisation households distrusted markets and would not jeopardize their survival by failing to produce a desired quantity of subsistence goods. They therefore contemplated production in the commercial sector only when a particular level of subsistence output had been achieved. In his model, priority to the point OA_{F2} was given to the non-monetary sector. In the present model, once the family has attained its minimum requirements for subsistence production there is no reason why it should give further priority to this sector. Hence priority is given only to OA_{F1} and the length of the horizontal axis in Fig. 6.7 is therefore $A_{F1}\bar{A}$.

Indeed it is likely that once these minimum requirements have been met a family next would concentrate on achieving its minimum demands for such items as taxes and school fees, which can be attained only by production in the cash sector. Once minimum requirements in both sectors had been met no further priority would be given to either sector.

By stage 3 the subsistence sector no longer receives priority. All produce can be marketed and the family is confident that its minimum requirements can be met through market activity. They will be met by the home production of subsistence crops only if it is believed to be a more efficient method than producing cash crops for sale in the market.

This type of framework can be used to analyse problems of agricultural development. For example Fisk recognised that an aim of planners has been to increase family labour input to the commercial sector, and used similar diagrams as a basis for examining how the aim might be achieved. However before this form of analysis can be applied to Seaqaqa, it is necessary to determine if conditions in Seaqaqa were consistent with the assumptions of the model.

6.5 The Model Applied to Seaqaqa

a. Non-Marketing of Subsistence Produce. An important assumption of the model is that markets for subsistence produce either do not exist or are not used to a great extent. In Chapter 2 it was shown that very limited opportunities for marketing fruit and vegetables in the project area existed, but that most produce had to be taken to Labasa for sale. During the year of fieldwork sales of subsistence produce averaged only $17.65 per family, and less than 20% of this consisted of voluntary sales of starchy staples.[6] Intermittent sales of vegetables were made only if families had excess to their requirements and were going to Labasa for other reasons. No farmer in the sample appeared to plant subsistence crops with the intention of selling the output. Excess production of cassava never was sold but was left in the ground.

Even though all the Indian families in the sample planted as much land to rice as possible, none had enough to be self-sufficient.[7] They had to purchase additional rice, much of which was supplied by the FSC. For all settlers food purchases on average accounted for almost

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6 Dalo was sold on occasions. The Seaqaqa region was generally too dry to successfully cultivate dalo unless a farmer had well shaded land close to a permanent water course. No farmers had enough of this type of land to be self sufficient in dalo, and sold it only when under pressure from friends or relatives.

7 Some households planted rice in conjunction with relatives rather than on an individual basis.

41% of total recurrent purchases throughout the year, but this consisted of rice, and goods which could not be produced by the family - tinned fish for example. Few examples of a household purchasing food which it could have produced itself were noted. Thus although a market for subsistence produce existed in Labasa, households rarely participated.

Two possible exceptions to this conclusion exist. Firstly some Fijians appeared to have substituted rice for traditional staples, although in limited quantitites. Secondly, Indian families grew Fijian staple crops in addition to rice, yet at times chose to purchase rice rather than to consume their own output. To the extent that households were accepting that their minimum subsistence requirements could be met through the market, they were operating in stage 3 rather than in stage 2. However, limited substitution between cash goods and subsistence produce is consistent with the stage 2 model that has been developed. Once families satisfy minimum requirements in both sectors, labour is allocated to the most efficient activity. A shift from above minimum requirement consumption of the subsistence good to a market good (substitution of purchased rice for home produced cassava) could occur if:

a. it became relatively less costly in terms of labour time to produce the cash income to buy rice. In Seaqaqa the FDB provided settlers with cash loans at low interest rates which were used to purchase market goods including rice. If the family did not claim all the loan which had been approved, it was still charged interest on the full amount (see Chapter 2). It therefore cost the family no more to utilize the subsistence allowance to full capacity than it did to use only a portion of the approved loan. The additional cost, in terms of the current labour input required to repay the loan, was therefore zero. The introduction of cash loans thus reduced the labour cost of obtaining rice, while the cost of producing Fijian staples remained unchanged.

b. tastes were such that rice was more attractive than cassava. Indian families preferred to eat rice whenever possible and would consume cassava only when rice was not available. Thus if they had enough income to purchase rice they would not consume the Fijian crops growing on their farms. As far as Fijians were concerned, a diet based on cassava was monotonous, and most readily admitted that they welcomed a change in cuisine. The project made available both rice and the income to purchase it. The relative preference for rice, meant that some substitution of rice for cassava would occur.

c. the time involved in preparing rice was shorter than that required to cook cassava. Borrowing from the New Household Economics literature, consumption not only involves time in production, but also time in preparation, and an increase in the relative time in either could result in a switch in consumption patterns. Cassava required cleaning, peeling and cooking for a relatively long period. With the increase in purchasing power provided by the project, settlers could afford to substitute rice for at least some of the more time intensive cassava consumption.

Thus the apparent substitution of a market good for subsistence produce can be explained in a manner consistent with the stage 2 model. However, whether Seaqaqa can be described by this model hinges crucially on whether a clearly defined minimum requirement for subsistence production existed. If it did, the substitution observed was between consumption bundles in excess of minimum requirements. If not, families simply were choosing to meet minimum food requirements in the most efficient manner, and a stage 3 model should be developed. The existence of minimum requirements in the subsistence sector will be examined in the next section.

b. Minimum Requirements for Subsistence Production. All Fijian households produced enough root crops to be self sufficient. Indian families planted as much rice as possible but generally could not produce enough for a year's consumption. Rather than rely on the market for additional requirements, most planted root crops as well. Households of both racial backgrounds planted whatever vegetables they wished to consume, to the extent that few purchases of vegetables were noted. All families in the sample ensured that they had sufficient food to survive in the event of cash being unavailable. This implies stage 2 behaviour.

Although it is difficult to prove that a minimum requirement for subsistence production existed, the evidence suggests that families produced enough food to survive, and that when survival had been ensured, substitution in consumption could be considered. This behaviour is consistent with the concept of a minimum requirement. Casual support for the conclusion that this crucial element of stage 2 was observed in Seaqaqa is found in the answer to a question frequently asked of households. To the question of why they had planted subsistence crops on land suitable for cane, the answer commonly was "We must eat first".

c. Maximum Aspirations for Subsistence Production. Some excess production of subsistence crops was undertaken, probably for reasons of risk aversion. This excess rarely was sold but was left in the ground. It is likely that once a family was well fed and the needs of social exchange were satisfied, little benefit accrued from additional subsistence production - i.e. the maximum aspiration level was fairly close to the minimum requirement.

d. Minimum Requirements in the Cash Sector. Households in Seaqaqa appeared to have minimum requirements for specific market goods. All wore clothes purchased in the market, and sent their children to school for at least a few years. These requirements can be represented by the line C_oC_o' in Fig. 6.7. However it was argued earlier that families did not appear to contemplate production in the monetary sector until they had met minimum requirements in the subsistence sector, in which case minimum demands in the cash enterprise would have been subservient to those in the non-monetary enterprise. Observed behaviour in Seaqaqa therefore was consistent with Fisk's contention that some priority is given to the subsistence sector in early stages of commercialisation.

There was also a provision in each tenancy agreement that settlers could be evicted from their farms in the event of unsatisfactory performance. In Chapter 5 it was argued that the Project Administration judged performance in terms of cane output, and at the end of each harvest warning notices were sent to farmers which it considered had not produced enough cane. To this extent there was a minimum requirement for cane output. This is discussed further in Section 6.5.g.

e. Maximum Aspirations for Market Goods. In Chapter 5 it was shown that migrants achieved a higher output of cane than people who had been living in the Seaqaqa region before the scheme began. Members of the Project Administration believed that some of the latter group had applied for blocks either to prevent outsiders obtaining land, or simply because land had become available. Because of local political pressures they also were less in danger of losing their blocks through poor performance than migrants. Some of these households appeared to be less highly motivated than other settlers. Indeed settlers from a village a few hours walk from the scheme visited their farms only rarely. They appeared to plant less cane and to spend less time in cane production. However, they did not appear to utilise any alternative methods of obtaining a cash income, and it is possible that some of these families had low aspirations for market goods.[8] An alternative explanation is that they discounted the future more heavily than other families. The importance of rates of time discount on decision-making is considered in Section 6.5.g.

For the majority of families however, no evidence of limited aspirations affecting their behaviour was found. The FDB constantly was being requested for loans, either to enable wooden houses to be constructed or for the purchase of vehicles. Many families valued education highly and wished to send their children to school for as long as possible. Fig. 6.7 would apply to those settlers with low aspirations, with the marginal valuation of family labour curve approaching infinity where the consumption possibility curve cuts the maximum aspiration line. Where aspiration levels are above possible consumption levels, as in Fig. 6.8, the marginal valuation of family labour curve approaches infinity at the physiologically possible maximum labour input. This difference has important policy implications which will be discussed in a subsequent section.

f. The Absence of a Competitive Labour Market. This was discussed fully in Chapter 2. At a later stage it will be shown that wages could be introduced without changing the essence of the model.

g. One Period Production. An assumption of the model as it has been expounded is that all production and consumption are undertaken within one time period. For subsistence

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8 The mataqalis to which these people belonged owned coconut plantations near the village. However, only one case of a farmer cutting copra during the year was observed, and the income earned was less than $5.

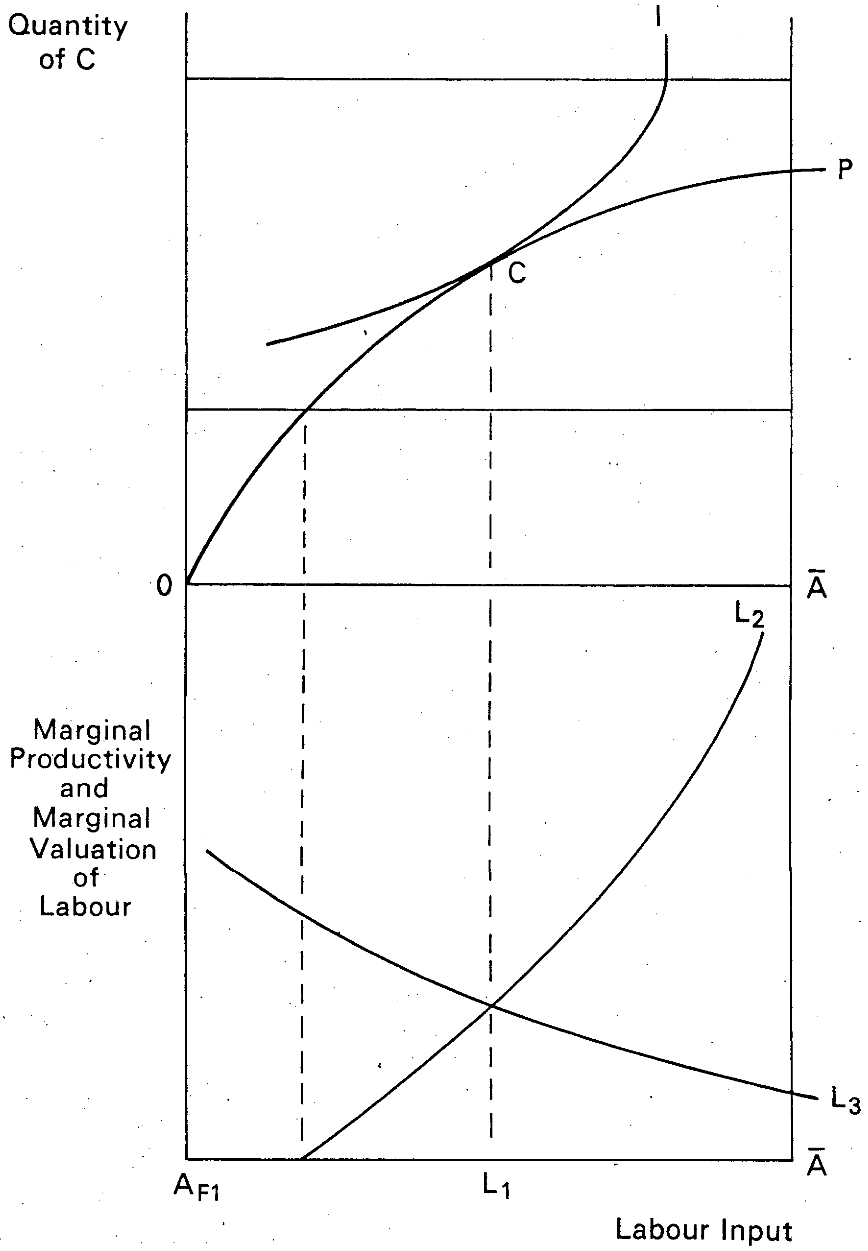

Fig. 6.8

The Choice Between Leisure and Consumption of the Market Good when there are no Limited Aspirations for Market Goods crops the assumption is valid.[9] Sugar cane, however, is a semi-perennial crop, and current labour inputs will produce an income flow spanning a number of periods into the future. In fact, the method of debt repayment ensured that families would receive no income from cane in the current period. Modifications must therefore be made to the consumption-possibility curve in the monetary enterprise. In Fig. 6.9, OX represents the value of the cane produced in the current period. To simplify the discussion, the origin will be denoted by O although it should be remembered that it represents the OA_{F1} units of labour input that already have been allocated to the subsistence sector.

Because of the debt repayment system in force at the time of fieldwork, none of this income was received in the current period. Depending on the initial level of indebtedness it would accrue over a number of subsequent periods. The curve OP is derived from OX and represents the present value of all future consumption of the cash good made possible by current labour inputs to cane. For positive rates of time discount, the curve will be lower and flatter than OX - probably considerably lower because the debt repayment prevented cash incomes from cane being generated until well into the future. Similarly, the shorter the family's time horizon in relation to the income flow, the lower and flatter will be the curve. Despite the fact that the present value curve is dependent on time horizons and the subjective rate of time discount, the curve from which it is derived, OX, does not change if production relationships and prices remain constant.

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9 One exception existed. Yagona takes four to six years to mature. No yagona was grown by households in the sample on blocks in Seaqaqa because of the lack of suitable moist, shady land, and only a few settlers had yagona growing in their villages for the same reason. Thus, in essence the assumption is valid for subsistence crops.

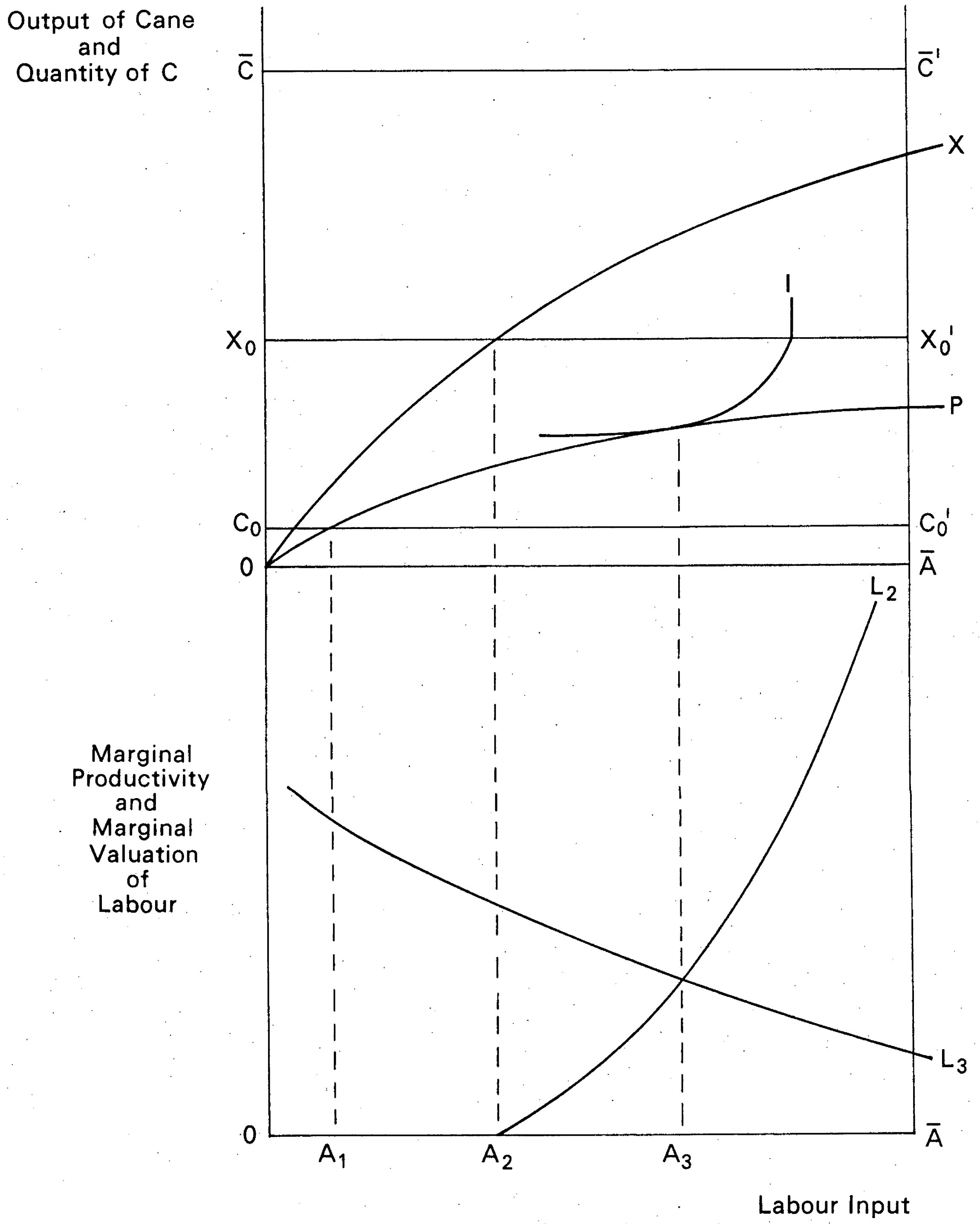

Fig. 6.9

Derivation of the Present Value Consumption Curve

In this situation, families would choose between leisure in the current period, consumption of the subsistence good in the current period, and the consumption of market goods made available by current labour inputs to the cash sector.[10] Indifference curves therefore are defined in the present value/labour input space. In the absence of cane farming performance criteria imposed by the Project Administration, indifference curves would not be defined for present values below C_oC_o', which represents Wharton's concept of minimum requirements for market goods. Households would not be willing to provide less than OA_1 units of labour to the monetary sector. An assumption of the model is that these minimum requirements can be met at any stage during the period over which income accrues from present labour inputs to cane. They do not necessarily have to be met in the current period.

It was argued in Chapter 5 that the Project Administration judged performance largely in terms of total cane production. The minimum output the family thinks is necessary to ensure that it retains control of the land is represented by X_oX_o'. Utility functions of households which did not want to be evicted would not therefore have been defined for outputs less than this amount. These families would not have been willing to apply less than OA_2 units of labour to cane in any circumstances.

The marginal valuation of family labour curve would begin at whichever of the minimum acceptable labour inputs A_1 and A_2 is the higher. Whether the constraint imposed by the Administration was stronger than the household's own requirements for market goods makes little difference

[10] The implied utility function is $U = U(F,PVC,Le)$ where PVC is the present value of consumption possibilities of the market good resulting from the current labour input to the cash crop.

to much of the analysis in the remainder of the chapter. Graphical exposition is however simplified by assuming that A_2 is greater than A_1 as depicted in Fig. 6.9 - the imposed constraint is the stronger. In the subsequent analysis attention will be drawn to the instances where the assumption makes a significant difference to policy recommendations.

Even allowing for the minimum requirements in the cash sector imposed by the Administration, families still appeared to give some priority to the subsistence enterprise. Households generally planted root crops on their blocks before they started to plant cane, for example. Further, Indian families ceased all work on cane to plant rice when the rains signalling the end of the dry season arrived, even when preparations for the next cane harvest were incomplete. Although the desire to avoid eviction was strong, minimum requirements in the subsistence sector took precedence.

In Fig. 6.9, $\bar{C}\bar{C}'$ is drawn so as not to constrain behaviour because, with the possible exception of some migrants, there was no evidence that limited aspirations existed for most households. The impact of any limited aspirations on these curves would be similar to that illustrated in Fig. 6.7 earlier. The curve L_3 is the slope of OP. It is the present value of the return from allocating additional increments of labour input to the cash sector - a present value marginal product curve. The family maximises its utility by allocating OA_3 units of labour to cane.

h. Conclusions. The three important stage 2 characteristics that were identified earlier were observed in Seaqaqa. Subsistence produce was not marketed, and there appeared to be clearly defined concepts of both minimum requirements and maximum aspirations for the output of the non-monetary enterprise. Minimum requirements for market goods may also have existed, but first priority was given to meeting a minimum level of output in the subsistence sector. For most families there was no evidence that aspirations for market goods were limited. However a minority of households appeared to be less highly motivated than others. Although this behaviour might have been determined by a number of factors, one possible explanation is that these families had lower aspirations for market goods than the remaining settlers.

In earlier sections of this chapter, a simple neo-classical model was adapted to describe economic behaviour under such circumstances. However because current labour inputs to cane could yield returns over a number of periods, and because the system of debt repayment ensured that farmers would receive no cash income from this labour in the current period, the impact of time on decision making had to be incorporated. A curve representing the present value of the consumption made possible by current labour inputs in the monetary sector was derived. Despite the changes made to the model many of the essential features of the Fisk model have been retained.

Like all models, the one developed in this chapter is an abstraction from reality. For example an assumption that families chose between allocating inputs to either cane or subsistence crops was made. Cutting and wage labour, and the time spent hiring out tractor services have been ignored. However it was shown in Chapter 5 that only four of the sample households had the opportunity of semi-regular wage employment, and that both cutting labour and the time spent hiring tractor services were, to a large extent, determined by factors beyond the family's control. They could therefore be regarded as external constraints on the decision making process described in this chapter.

In the model explicit consideration was not given to the allocation of non-labour inputs. Few inputs other than labour were applied to root crops and vegetables, but tractors, bulls, fertiliser and weedicide intermittently were utilized in both cane and rice production. In a cross-sectional framework however, varying levels of such inputs can be accommodated. The consumption-possibility curve in the subsistence sector, and both curves in the monetary sector, would be higher for greater applications of non-labour inputs.

The model is not ideal in terms of some of the criteria outlined in Chapter 3. Firstly in the absence of a competitive labour market it cannot be estimated. There is no way of identifying the marginal valuation of family labour for each household. Secondly, although attitudes toward risk are implicit in the shape of the present value curve, they have not been considered explicitly.

On the other hand, some of these criteria were incorporated. Household utility was defined in terms of the consumption of three aggregate commodities rather than total income - subsistence goods, market goods, and leisure. The impact of socio-economic variables on such factors as minimum requirements and aspirations could be incorporated. Some are considered in the next section. The ways in which attitudes to the future affect decision making were included by specifying the present value curve as a function of the subjective rate of time discount. It was however assumed that time horizons were limited to consideration of the impact of labour inputs applied in the current period. In Chapter 8 it is argued that this assumption was applicable to the settlers observed at the time of fieldwork.

The model therefore is not ideal and is not a perfect description of reality. It does however depict decision making in Seaqaqa reasonably well, and importantly, incorporates the essential stage 2 features that were present. Moreover, it proves a particularly useful means of clarifying some of the trends observed in Seaqaqa during the early years of the scheme. These are discussed in the next section.

6.6 Policy Implications.[11]

Incorporated into the scheme were a set of incentives and disincentives designed to encourage families to allocate a high proportion of their labour input to cane. These were described in Chapter 2. Briefly, they were:

a. The FSC extension system used elsewhere in Fiji was introduced to Seaqaqa. The supply and delivery of most purchased inputs, and the marketing of the output of the cash sector were organised for settlers, who also were provided with information on cane farming techniques.

b. Until early in 1978, the MAFF provided some extension services for subsistence crops.

c. A large quantity of finance was made available at concessional interest rates for cane farm development.

d. Settlers were allowed a cash loan for "subsistence purposes".

e. Leases were longer than was usual in Fiji and there was provision in each lease that families which failed to farm cane to a satisfactory standard could be evicted.

In this section, the likely impact of these policies on the quantity of labour allocated to cane will be considered in the light of the model which has been developed. Where it is shown that policies could have had adverse effects on labour input, alternatives are suggested. Wherever possible, the data presented in Chapter 5 are used to clarify the discussion.

a. The Marginal Physical Product of Labour in Cane Production. As families gained experience cultivating

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[11] The policy implications illustrated graphically in this section could be derived algebraically by inverting a large matrix comprising of the first order conditions given in Appendix 2. However, this would provide no information in addition to that presented in this chapter.

cane they might be expected to move to higher production functions. Assuming that prices did not change, both the curves in Fig. 6.9 would move upwards over time. The FSC extension services were introduced partly to speed this process, and the evidence presented in Chapter 5 that the yield (output per hectare) attained by second year farmers was significantly higher than that of first year farmers, suggests that they may have had some success.

The impact of the increase in productivity on the marginal valuation of family labour curve is illustrated in Fig. 6.10 on the assumption that the imposed cane farming performance criterion was more powerful than the household's own minimum requirements for market goods (see Section 6.5.f). The value of cane production curve shifts from OX to OX_1 and the marginal valuation curve begins at A_1 rather than A_2. In Figs. 6.11 and 6.12, A_1 and A_2 are determined by the process described in Fig. 6.10.[12] The curves in the upper half of these diagrams are the present value curves associated with OX and OX_1 in Fig. 6.10. The present value of the marginal productivity of labour curve shifts from L_3 to L_3' in each case.

In Fig. 6.11 utility is constrained by low aspirations. Not only does the origin of the labour valuation curve move from A_2 to A_1 but it becomes nearly vertical at a labour input of A_5 rather than A_6. Family labour input falls from A_4 to A_3. Where no limits to desires for market goods exist, both L_2 and L_2' are assymptotic to $\overline{AC}'$ and labour input increases from A_3 to A_4, as shown in Fig. 6.12.

It is possible to conceive instances where different effects to those described in Figs. 6.11 and 6.12 apply. However, the graphical representation illustrates that an increase in the productivity of labour used in cane production is likely to increase the

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12 In order to simplify the diagrams, indifference curves have been omitted from the upper portion.

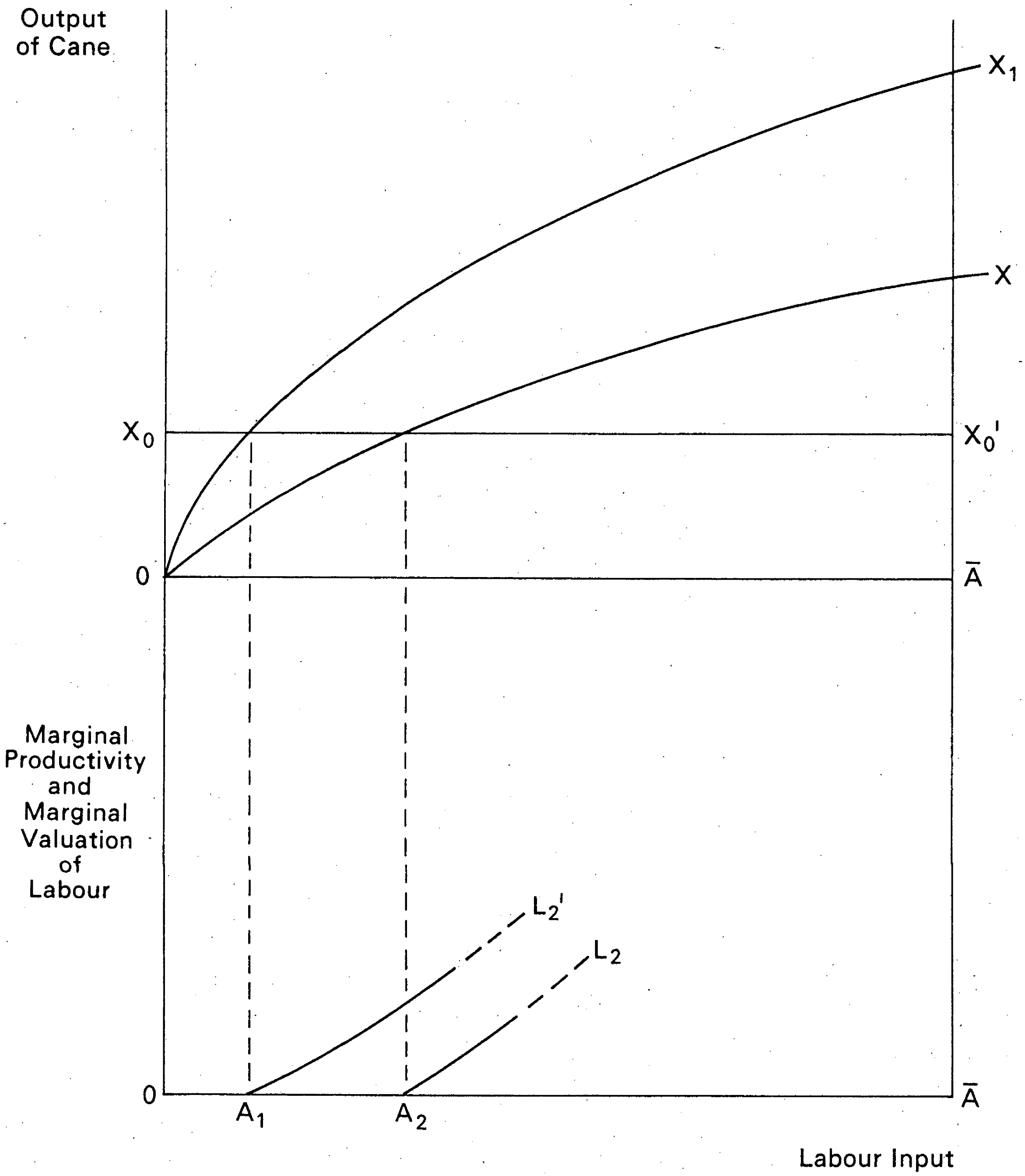

Fig. 6.10

The Impact of an Increase in the Productivity of Labour Used in Cane Production on the Marginal Valuation of Family Labour Curve

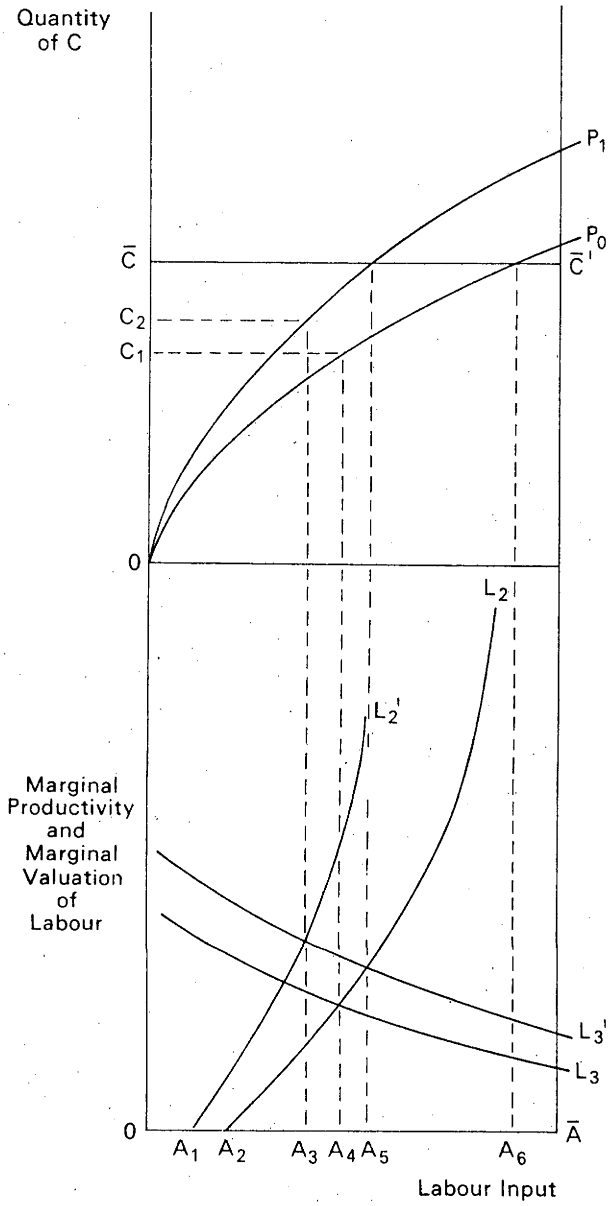

Fig. 6.11

The Impact of an Increase in the Productivity of Labour Used in Cane Production on Labour Inputs to the Cash Sector - Low Aspirations for Market Goods

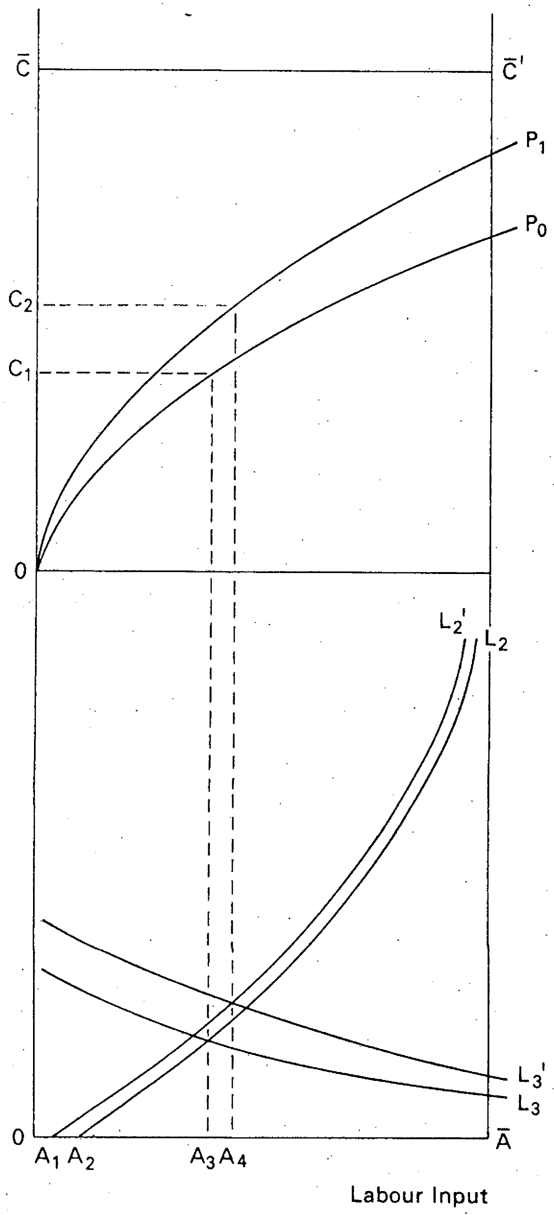

Fig. 6.12

The Impact of an Increase in the Productivity of Labour Used in Cane Production on Labour Inputs to the Cash Sector - High Aspirations for Market Goods labour input to cane when aspiration levels for market goods are high. On the other hand an upward movement in the present value curve could cause a reduction in labour inputs to the monetary sector of any families whose aspirations are low. Thus the Administration's attempt to raise the productivity of labour employed in the cash sector was likely to have the desired effect on families with high aspirations for market goods.

b. The Marginal Physical Product of Labour in Subsistence Production. The MAFF provided extension services in Seaqaqa for non-cane crops until early in 1978. This could have increased the marginal productivity of the labour allocated to these crops. Because aspiration levels for subsistence goods were likely to be close to minimum requirements, an increase in the productivity of labour in subsistence activities would probably reduce the labour input to subsistence crops (similar to Fig. 6.11). The effect on the labour allocation to cane is unclear. To the extent that high quality land used in the production of subsistence crops is released to cane, the marginal product of labour used in cane production would increase, and total labour input to cane would rise or fall depending on aspiration levels for the market goods (either Fig. 6.11 or 6.12). However on most farms cane was not competing with other crops for land. Rice was grown largely on boggy land unsuitable for cane, and Fijian staples grew adequately wherever they were planted. In most cases the section of the farm to be planted to cane was cleared before the family moved to the block, and root crops then were planted in other areas, often on hilly land unsuitable for cane. It is unlikely therefore that any release of land from the subsistence sector would have effected the labour input to cane significantly.

If aspirations for subsistence goods were very close to minimum requirements (in the extreme, if they coincided), the quantity of family labour available to the cash sector could be considered as the residual of the physiologically maximum possible labour input after subsistence requirements had been met. In this case the model developed in this chapter would be identical with the Fisk model. A release of labour from the subsistence sector would increase the labour available to cane from $O\bar{A}_1$ to $O\bar{A}_2$ in Fig. 6.13. The marginal valuation of family labour curve would move from L_2 to L_2' when aspirations were high, and family labour input to cane would increase from A_o to A_1. However, when aspirations are low, Fig. 6.14 shows that the increase in the available labour would have no effect on the household's allocation of labour to cane.

The closer aspiration levels are to minimum requirements in the subsistence sector, then the more likely is a rise in the productivity of labour in subsistence activities to result in an increase in family labour input to cane. It is this situation that Fisk appears to be considering when he argues that governments should pursue a policy of increasing the productivity of labour in the traditional sector. It is possible therefore, that the MAFF extension services could have been providing for a transfer of labour from the subsistence to the cash sector, either by raising the productivity of labour in the traditional sector, or to a very limited extent, by releasing high quality land to cane. The withdrawal of extension services would have prevented further labour flows of this nature.

c. Debts. One hundred percent of net cane proceeds were retained by the Bank for debt repayment during the first three years of the scheme, after which time the family would receive 25% of proceeds until its debt was retired. For a given rate of time discount, the longer the time until a household expected to receive an income from its labour input to cane, the lower and flatter would be its present value consumption possibility curve. At the extreme, if time horizons were short and if cane proceeds were not received for a relatively long period, the present

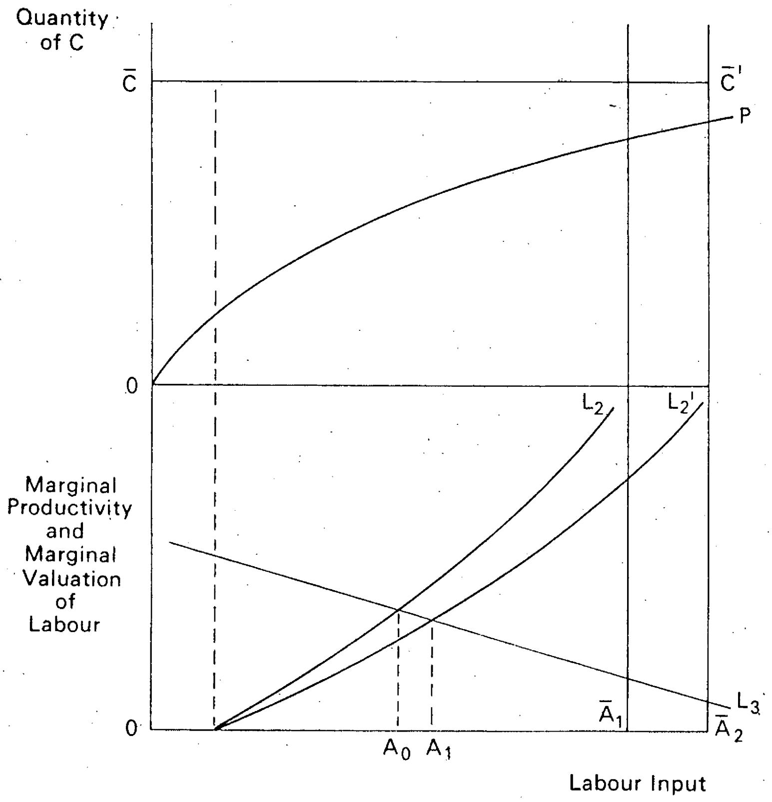

Fig. 6.13

The Impact of a Release of Labour from Subsistence Production on Labour Inputs to the Cash Crop - High Aspirations for Market Goods

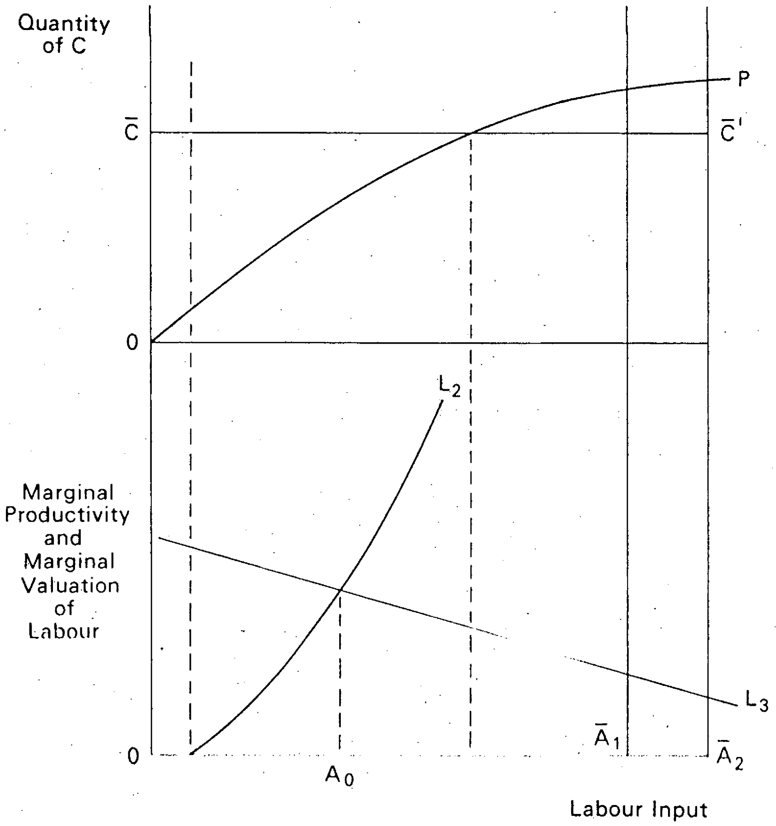

Fig. 6.14

The Impact of a Release of Labour from Subsistence Production on Labour Inputs to the Cash Crop - Limited Aspirations for Market Goods value curve would approach a horizontal line very close to the labour axis, OP in Fig. 6.15. This is also the case for families with high rates of time discount.

The Administration's minimum performance criteria could be crucial in this situation. In their absence, families would probably choose very low inputs of labour to cane - OA_1 units in Fig. 6.15. In the extreme, where time horizons are very short and discount rates very high, the present value curve would be horizontal, and families would choose to apply no labour to cane. They might leave the farm voluntarily. Indeed in the early years of the scheme a number of farms were abandoned.

On the other hand, once families realized that they had to attain an output of OX_o units to avoid eviction, they would allocate OA_2 units to cane as long as they retained the desire to keep the farm. Some families appeared to be operating at this point. They claimed that they provided as little labour to cane as possible because they felt that they had no prospects of receiving an adequate income from the cash crop, but they wished to retain the farm.

Provided aspirations were not very low, a way of increasing the voluntary input of labour to cane would have been to increase the proportion of cane proceeds repayable to the family in the early years, thereby raising the present value curve. It would have been necessary for the lending agency to provide finance for a longer period, and from a national point of view these costs would have to be weighed against the benefits of increased farmer commitment to cane. Evidence to show that this policy might successfully raise the amount of labour families chose to allocate to cane was presented in Chapter 5. Households which were preparing for their fourth harvest were due to receive 25% of the proceeds from the next harvest whereas other households would have received nothing. The present value curve of the average fourth year farmer was thus likely to be higher than that

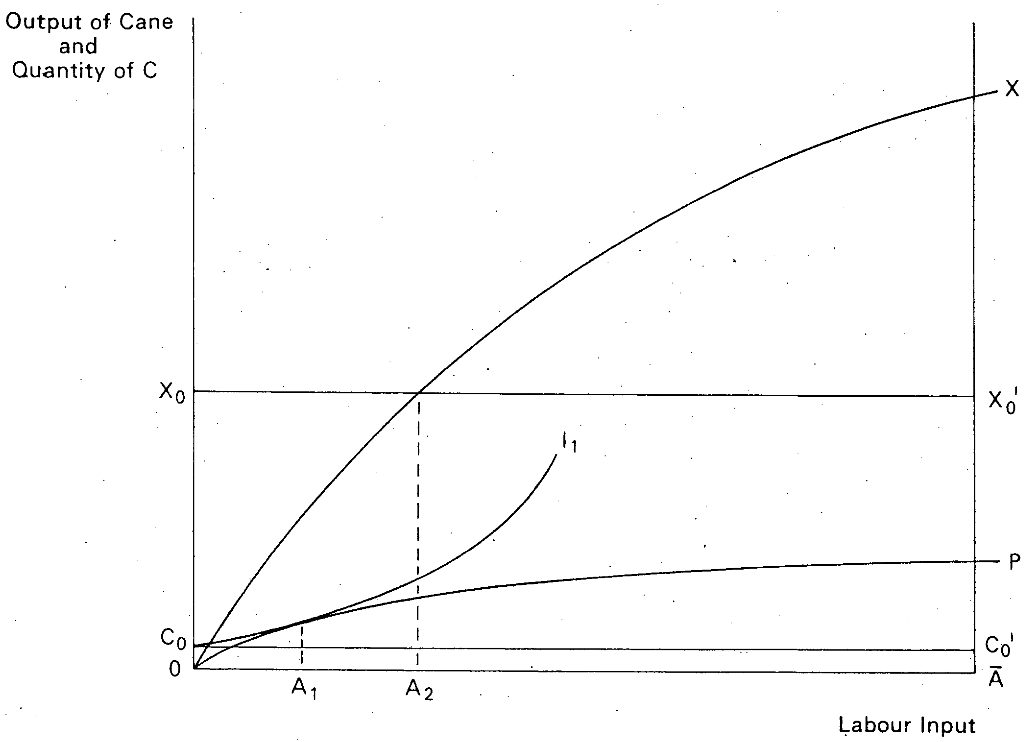

Fig. 6.15

The Present Value Curve with High Loan Repayments and Short Time Horizons of other farmers, and the model suggests that the former group was likely to apply more labour to cane on average than the latter. This hypothesis was confirmed in Chapter 5.

Since the period of fieldwork, the FDB has increased the term of the loans and allowed families to keep a greater proportion of their cane proceeds. Casual observation suggests that the impact on labour inputs was as predicted by the model.[13]

d. The Subsistence Allowance.[14] The subsistence allowance, a cash loan advanced by the FDB, was debited against a household's cane farm development account. The allowance appeared to be used by farmers for needs associated with the cash rather than the subsistence sector. These allowances were requested particularly when school fees were due, but the money also was used to purchase school uniforms, clothing, driving licences and tinned foods. Subsistence type produce rarely was purchased.

The impact of the subsistence allowance on the present value curve is depicted in Fig. 6.16, on the assumption that the term of the loan is not extended with the introduction of the allowance. The loan allowed the family to obtain OB units of C in the current period with no labour input to cane, but it had to be repaid from the proceeds of the current labour input. The slope of the new present value curve BP_2 is less than that of OP_1 because the return from any incremental unit of labour input to cane is lower-some part of the income generated

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13 These observations were made during a subsequent field trip in August 1979.

14 The algebraic specification of the amended model obviously depends crucially on the type of debt repayment system in force. See Chapter 8 for one possible specification.

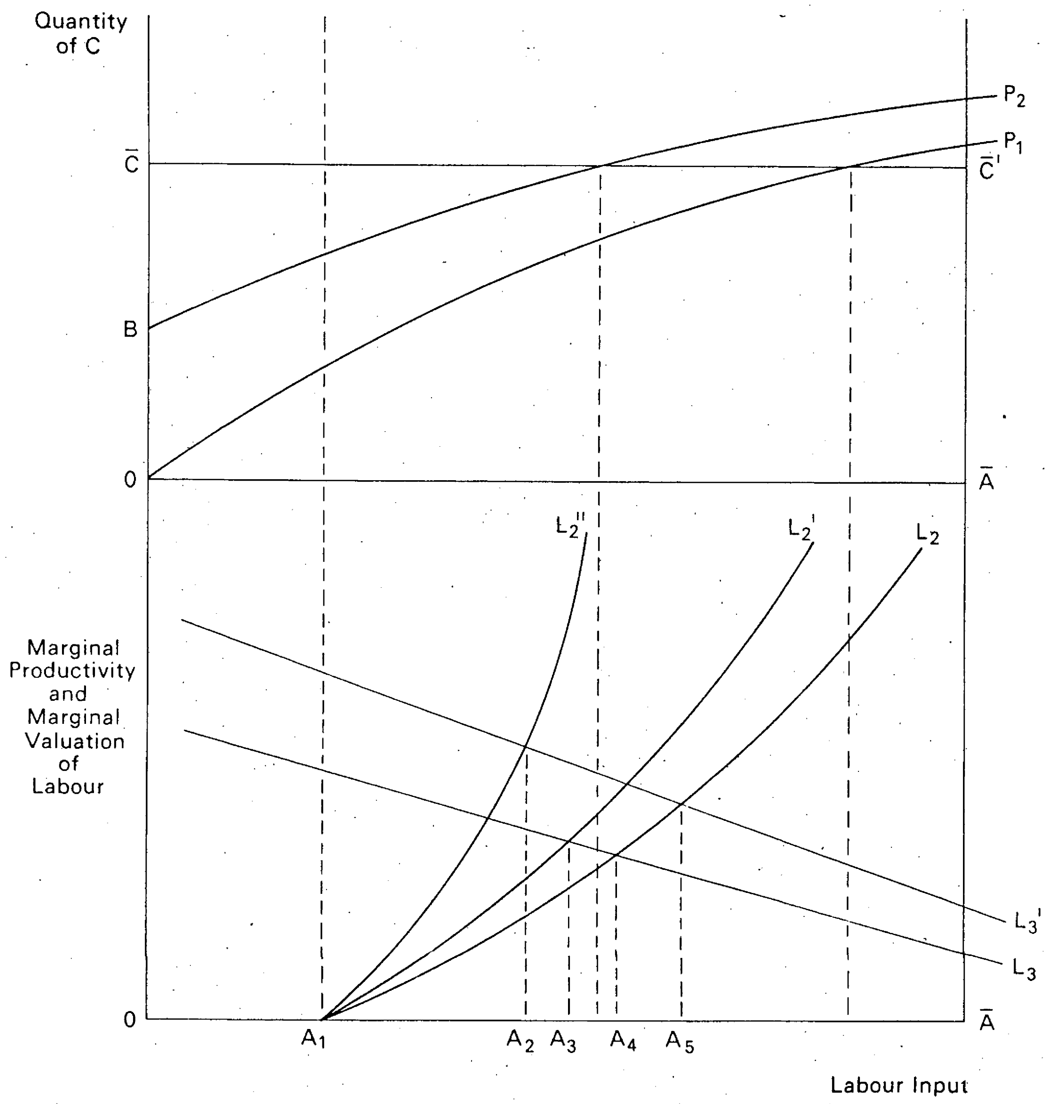

Fig. 6.16

The Impact of the Subsistence Loan in the Present Value Curve must be used to repay the loan. The marginal product curve shifts from L_3 to L_3'.

This diagram is constructed on the assumption that imposed cane performance constraints were more powerful than the household's minimum requirements for market goods. The marginal valuation of family labour curve therefore begins at A_1 in all cases. Assuming that aspirations are not low (i.e. if $\bar{C}C'$ is omitted), the marginal valuation curve is L_2 and the introduction of the subsistence allowance would have caused the optimal labour allocation to increase from A_4 to A_5.

Had aspirations however been low, the marginal valuation curve before the subsistence allowance was introduced would have been L_2' implying an optimal labour input of A_3 units. In this case, the upward movement of OP_1 resulting from the introduction of the allowance shifts the curve to L_2'' and labour inputs could fall - to A_2.[15] This may have been the situation perceived by those local residents who did not fear eviction from their farms.

Fig. 6.17 illustrates another way in which the introduction of the subsistence allowance might have caused families to reduce labour inputs to cane. In this case the Project Administration's cane performance criterion, implying a labour input of at least A_1 units, is weaker than the household's minimum desires for market goods which imply a minimum labour input of A_3 in the absence of the allowance. The marginal valuation of labour curve is L_2. With the introduction of the subsistence allowance, the marginal valuation curve moves to L_2' and labour input falls from A_5 to A_4.

15 In the case of low aspirations, if BP_2 intersected OP_1, labour input could conceivably increase. A series of rough projections were made, and for realistic levels of both the subsistence allowance and the discount rate, this was not likely to occur.

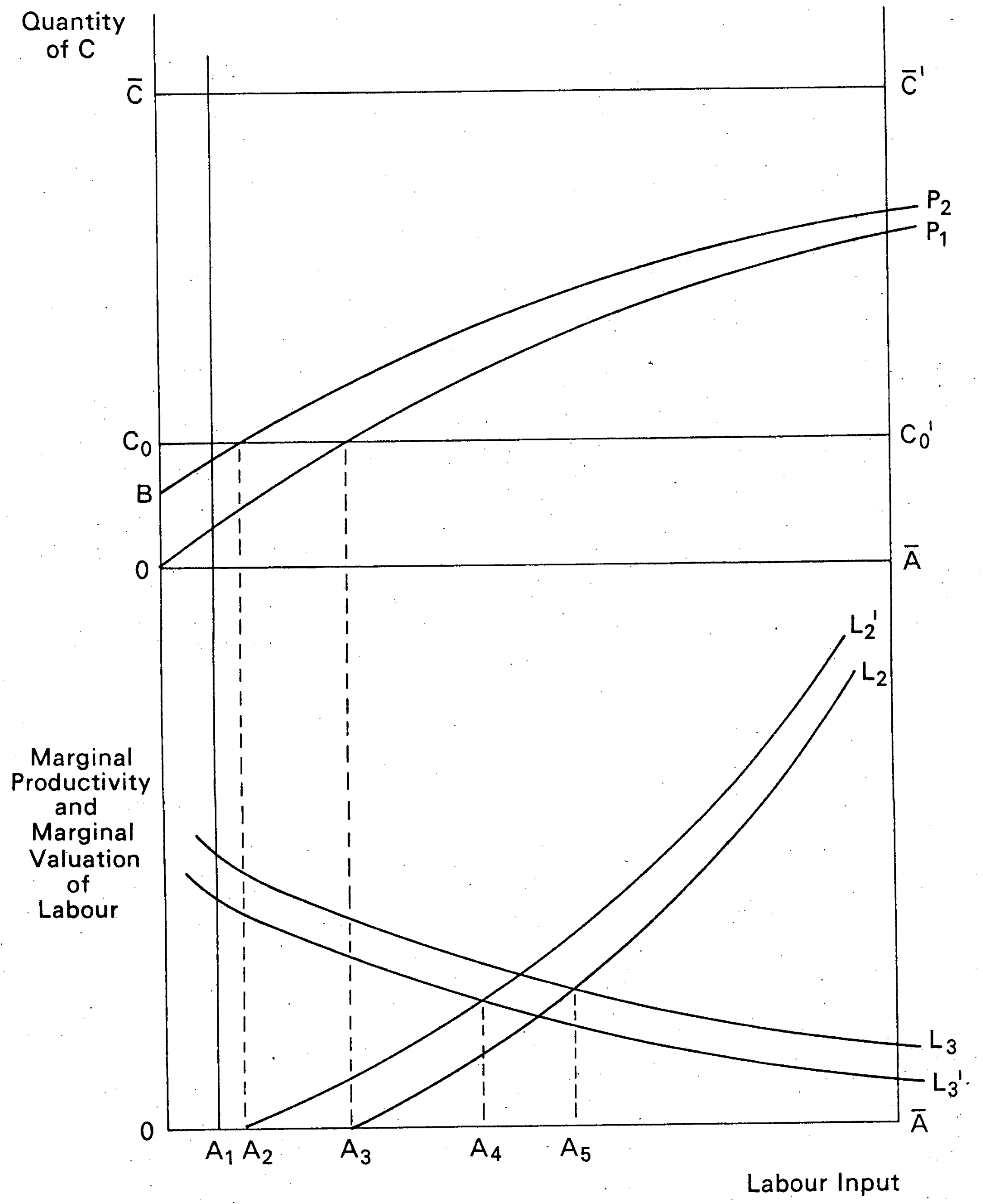

Fig. 6.17

The Impact of the Subsistence Loan when Imposed Minimum Cane Farming Performance Criteria are Weak

The subsistence allowance was designed to provide for some of the family's cash needs during the time that it was receiving no income from cane. In two situations however it has been shown that labour inputs to cane were likely to be higher in the absence of the allowance. A better way of providing a cash income would have been to extend the term of the loan and allow the family a proportion of its gross cane proceeds in the manner suggested in Section 6.6.b of this chapter, a policy which would have reduced labour inputs only in the case of low aspirations for market goods. Another method of providing a cash income without reducing the labour input of families which do not have low aspirations will be suggested.

Fig. 6.18 shows the impact on the present value curve of paying the household a wage for a proportion of its own labour input to cane. It is paid only for its own labour and cannot hire outside help. The cost of the wages are deducted from future cane proceeds. OP_o is the present value curve in the absence of wage payments. If the rate of interest charged on wage advances was less than the household's rate of time discount, the curve would move to OP_1, and conversely if the subjective rate of time discount was less than the interest rate, it would shift to OP_2.

In Seaqaqa interest was levied on farm development loans at the concessional rate of 4.25% p.a. It is unlikely that households would have discounted the future by less than this rate at a time when inflation was greater than 5%, and thus the present value curve would have risen. It was shown earlier that in the absence of low aspirations, this would have resulted in an increase in family labour input. It therefore would have been preferable to introduce a system of wage payment rather than the subsistence allowance in Seaqaqa.

e. Minimum Requirements in the Cash Sector. Labour inputs to cane could be increased by raising perceptions

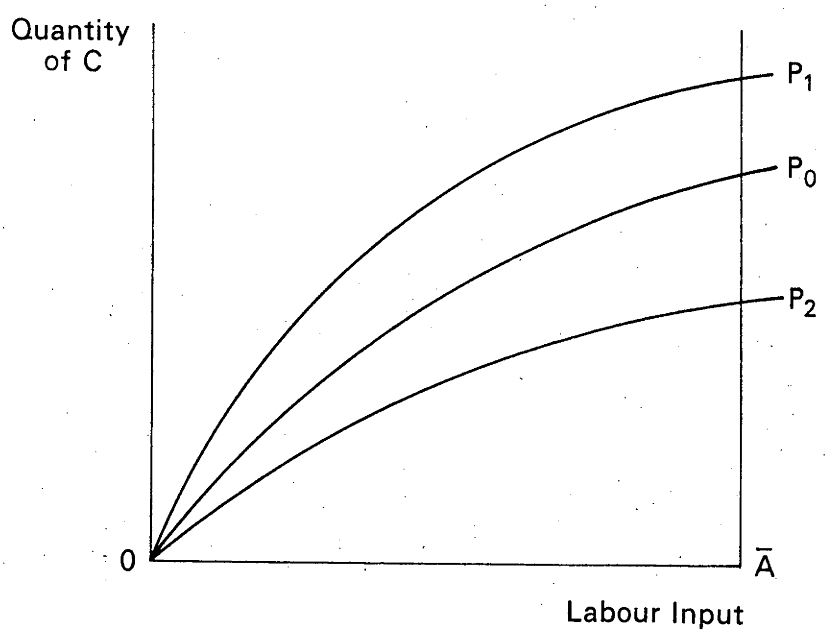

Fig. 6.18

An Alternative to the Subsistence Loan - Wage Payments of the minimum output necessary to avoid eviction if a family's minimum requirement for cash goods was subservient to the imposed performance criterion. In Fig. 6.19 minimum performance levels are perceived to increase from X_oX_o' to X_1X_1', and the marginal valuation of family labour curve accordingly shifts from L_2 to L_2'. For a given present value curve OP, labour inputs increase from A_1 to A_2. The Project Administration had been relatively lenient with poor performers in the first two years of the scheme, but by the period of fieldwork was applying increasing pressure to these households. This pressure would have raised the perceived minimum labour input to cane necessary to ensure that the family retained control of the farm. The Administration believed that the labour input of these families had increased as a result of their pressure, a result consistent with the model.

On the other hand, another possible situation is posed in Fig. 6.20; A_1 is the labour input required to satisfy the Project Administration, but in this case to meet its own minimum requirements the family must apply at least A_2 units of labour. Unless the Administration could shift A_1 to the right of A_2, pressure of the type described in the last paragraph would have no impact on labour inputs. In this case labour inputs would increase only if a method of increasing C_oC_o' to C_1C_1' could be found.

In 1978 the FDB agreed to support attempts by settlers to establish a secondary school within the project area. More families would have been able to send their children to school for longer periods, and it is likely that the minimum requirements of these households for the market good, school fees, would have increased (C_oC_o' shifted to C_1C_1'). According to the model, this increase would lead families to apply additional units of labour to cane production. Some support for this conclusion is found in the data presented in Table 6.1.

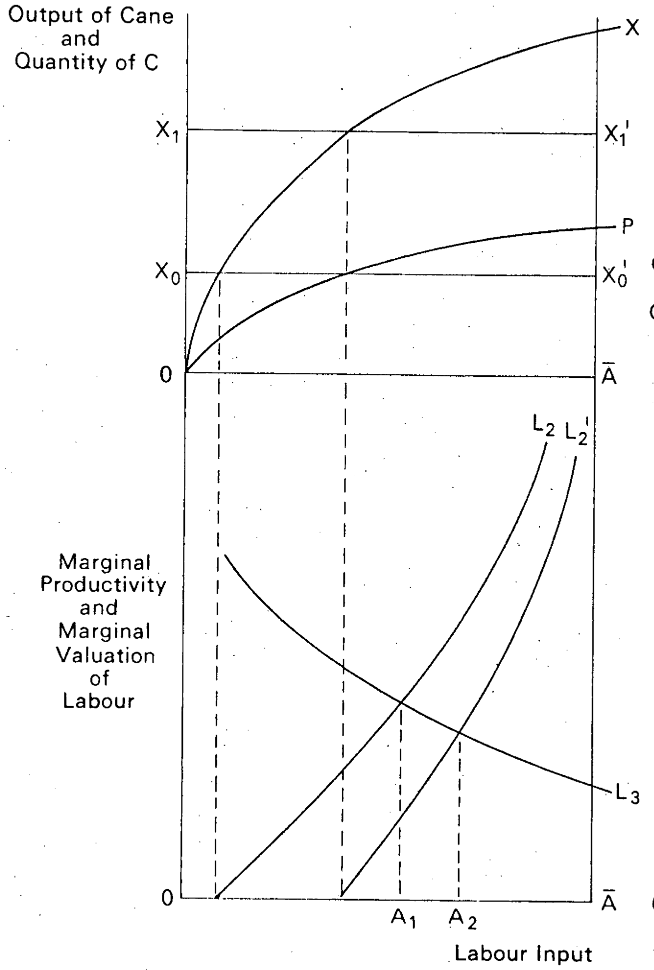

Fig. 6.19

The Impact of an Increase in Perceived Minimum Performance Criteria with Low Minimum Requirements for Market Goods

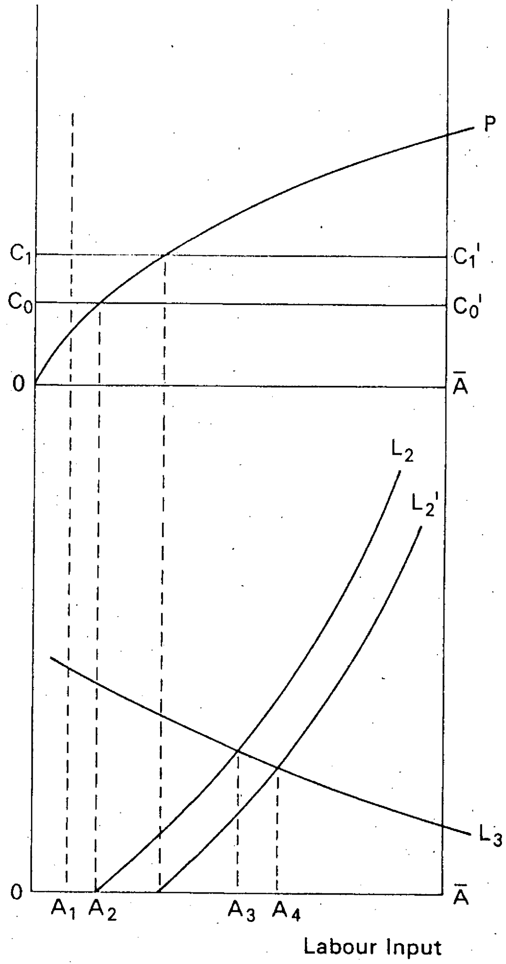

Fig. 6.20

The Impact of an Increase in Perceived Minimum Performance Criteria with High Minimum Requirements for Market Goods

The hypothesis is that families:

a. with children boarding at secondary schools,
b. with a large number of consumption units to support, or
c. who owned tractors,

might be expected to have higher minimum requirements for market purchased goods than other households. They therefore would be expected to apply more labour to the cash sector than other households. The table shows that the mean labour input was significantly higher for large than small families, although no significant difference in labour inputs per family production unit were observed. The mean labour input of tractor owners was significantly higher than that of non owners only at the 20% level, and although families with children boarding at secondary schools appeared to apply more labour than other families, the difference was not statistically significant.[16] In both cases, the low number of observations in one of the groups being compared would have reduced the t-statistic and it is possible that if the sample size were larger the difference would become significant.[17] There are other possible explanations for these differences in labour inputs - the socio-economic variables could influence both aspirations and discount rates. However, the data are not inconsistent with the offered interpretation.

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16 The t-statistic for tractor ownership was close to being significant at 10%. The critical t-value is 1.71.

17 The formula used to estimate the t-statistic on the assumption that the two samples means need not come from populations with the same variance is

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

where the $\bar{X}_i$ are the sample means, the S_i^2 are the variances of the sample means, and the n_i are the sample sizes. The larger the n_i, the lower will be the denominator, and the higher the t-value.

TABLE 6.1

LABOUR INPUTS TO THE CASH SECTOR, BY CHILDREN'S SCHOOLING, CONSUMPTION UNITS AND TRACTOR OWNERSHIP, 53 FAMILIES

	Number of families	Mean total labour input to cash sector	Standard deviation	t-statistic (degrees of freedom)	Mean labour input per family production unit	Standard deviation	t-statistic (degrees of freedom)
Schooling							
- Families with children boarding at secondary schools	10	758.41 †	452.41	1.25	147.26	91.91	1.05
- Others	43	534.06	704.46		113.20	94.10	
Consumption Units							
- More than 6.00	22	759.47	663.09	2.07** (26.98)	114.86	110.65	0.29
- ⩽ 6.00	31	446.46	296.04		123.01	81.59	
Tractor Ownership							
- Owned	13	789.02	543.79	1.67 (18.34)	164.44	130.02	1.56 (15)
- Did not own	40	507.29	474.92		105.06	75.14	

** Significant at 5%.

† Figures differ slightly to those presented in Chapter 5. The four households with semi-regular wage employment have been omitted.

f. Tenure of Lease. The period of tenure of leases in Seaqaqa was longer than elsewhere in Fiji to encourage families to invest in long term land improvements. The present value curve is drawn on the assumption of a fixed level of investment in the cash sector. Increased investment shifts the curve upward, which in the absence of low aspirations should increase labour inputs to this sector.

Families which had been originally resident in Seaqaqa, often for generations, probably felt more secure in their tenure than migrants. One of the contributing factors was that it politically would have been difficult for the Project Administration to evict these settlers even in the event of their poor performance. It therefore is likely that the longer lease would have had more effect on the behaviour of migrants than people living in Seaqaqa before the scheme began. In this case, migrants would be expected to have invested more in the cash sector, and therefore to have reached a higher present value curve than local residents. According to the model, their labour inputs to cane were likely to be higher.

Data presented in Chapter 5 support this argument. Migrants harvested an average of 6.13 hectares of cane in 1978 while local residents harvested only 4.24 ha. This difference cannot be explained simply by the fact that migrants had on average been producing cane longer than original residents (Table 6.2). Fourth year migrants harvested 6.08 ha compared to the 4.13 ha harvested by local residents who had been producing cane for the same period of time. Despite the low number of observations, the difference was significant at the 10% level. Migrants therefore had invested more in land than local residents, and in accordance with expectations, applied more labour to cane. Tables 5.17 and 5.18 showed that although total labour inputs did not differ between the groups, migrants applied a significantly higher proportion to debt reducing activities.

TABLE 6.2

NUMBER OF SETTLERS BY MIGRANT STATUS AND PREVIOUS HARVESTS

	Migrant Status		
Previous Harvests	Local	Migrant	Total
1	10	3	13
2	10	7	17
3	15	12	27
TOTAL	35	22	57

The period of lease tenure could also have affected time horizons. Assume that current labour inputs to fertilising cane, for example, will effect yields for 15 years, but that leases are guaranteed for only 10 years. Family time horizons are unlikely to be longer than 10 years, in which case returns from this activity that would accrue from the eleventh to the fifteenth year would be discounted by 100%. Assume now that leases are guaranteed for 30 years. Time horizons probably would lengthen, and the returns to fertilizer accruing from years 11 to 15 would no longer be discounted fully. The present value curve for any given labour input would rise, and labour inputs to the cash sector in general would increase.

It has been argued that time horizons of Fijians are shorter than those of Indians. According to the argument developed in the last paragraph, if this were true, Fijians would face a lower present value curve and put less labour into cane. Tables 5.17 and 5.18 illustrated that Fijians did in fact allocate less time to debt reducing activity than Indians. The paradox of how Fijians managed to produce a similar output of cane (Table 5.27) is discussed in Chapter 7.

There is evidence therefore that the additional length of lease tenures in Seaqaqa was likely to have had the desired impact on labour inputs to the cash sector. Additional investment would have been encouraged and time horizons increased.

6.7 Conclusions

In this chapter, beginning from a simple neo-classical framework, a model of household behaviour in Seaqaqa was developed. The model was constructed specifically to account for features peculiar to stage 2 of the process of commercialisation. Two of the most important were that households made no use of the market for subsistence produce and gave priority to meeting minimum requirements in the subsistence sector. Using some of the data presented in Chapter 5, it was shown that many of the assumptions on which the model was based were applicable to Seaqaqa. The model was shown to be very similar to one developed by Fisk and much of the analysis in the later parts of this chapter has its foundations in his work.

Although it has been argued that behaviour in Seaqaqa during the period of fieldwork could be explained by a stage 2 model, the data of Chapter 5 also implied that families had become more commercialised since the scheme had begun. In the previous chapter it was suggested that confidence in the commercial sector might have been positively related to the number of completed harvests. It may therefore be expected that in the near future at least some families would move firmly into stage 3, where the model developed in this chapter would contract to the more simple Nakajima model outlined in Chapter 3. This might occur when households begin to receive a substantial income from the cash sector. Thus the model is applicable to the early years of the Seaqaqa Sugar Development Project.

The model proved a valuable means of assessing the impact of the official incentive scheme on household labour inputs to the cash sector. It was shown that the FSC, and perhaps the MAFF extension services, by increasing the consumption possibility curves in the cash and subsistence sectors respectively, could have increased the labour input to cane of many households. The strict policing of minimum performance criteria for cane farming, and the introduction of policies which would have increased minimum requirements for market goods, were likely to have had the desired effect on labour input as also was the unusually long tenure of the leases. However, the initial method of debt repayment, could have had a disincentive effect. High repayments in the early years of cane production, coupled with a relatively short repayment period, reduced markedly the present value of purchases which could be made from the returns to current labour input in the cash sector.

Two problems were identified. Firstly, the withdrawal of MAFF services would have prevented further increases in the consumption possibility curve in the subsistence sector. While this would not have reduced the labour input to cane, it could have prevented additional transfers of labour from the subsistence to the cash sector. Secondly, the subsistence allowance was shown to be less effective as a method of providing families with a cash income in the early years than the suggested system of wage payments. This scheme would have provided families with a similar cash income but would at the same time have encouraged households to increase their efforts in the cash sector. In designing other projects, planners should consider carefully the merit of wage payments in preference to a subsistence allowance.

Many of the incentives which would have encouraged additional inputs of labour for most households were shown to have the opposite effect on families with low aspirations for market goods. However, it was seen that data consistent with an interpretation of low aspirations could also be explained by other factors, including high rates of time discount. It therefore is important to determine if observed low levels of motivation were related more to low aspirations for market goods, although it is not easy to recommend how these families should be treated. Strict policing of the unsatisfactory farmers, thereby raising perceived minimum levels of performance in cane production, would be effective as long as households retained the desire to keep possession of the land. The Project Administration has, in recent years, increased its efforts with these settlers. However, if households were pushed to the stage that they were no longer willing to provide labour simply for the sake of retaining the land, their labour allocation to cane would fall. The Administration then would face the costs of eviction, and in the short run, there would be a reduction in the amount of cane produced on these farms.

It was argued that an alternative method might be to attempt to raise minimum requirements for market goods. Official support of community projects such as the building of the secondary school, could be useful. Similarly, the Bank's policy of providing finance to enable some settlers to build wooden houses might increase both minimum requirements and the aspirations for market goods for other families. During the time of fieldwork there was a great demand for non-farm vehicles, but the FDB refused to provide finance. It is possible that the occasional loan for this type of market good could raise aspirations and minimum requirements in the same manner as loans for housing, thereby increasing labour inputs to cane.

In designing other schemes, the problems posed by households with low aspirations should be considered before blocks are allocated. It was suggested that people who migrated specifically to become involved in the cash economy were likely to be more highly motivated than local residents who applied for blocks to prevent others from gaining control of the land. In Fiji it is difficult to prevent local land owning units from exerting some control over the selection of settlers, as was illustrated in the discussion of the selection system in Seaqaqa in Chapter 2. However, the evidence of this chapter suggests that efforts by landowners to allocate all farms to mataqali nominees, as was done in Naravuka, the last area to be subdivided in Seaqaqa, should be resisted wherever possible.

Although it was not ideal, the model developed in this chapter therefore has proved to be a useful tool in analysing policy as it effects both Seaqaqa and other schemes. However much of the discussion relies on the assumption that the discounted marginal value product of labour applied to the cash sector was in fact positive. The shape of the present value curve depends crucially on (a) the production function for cane, and (b) each household's subjective rate of time discount and time horizon. If, for example, additional labour applied to cane had no effect on cane output, the curve would be horizontal. Similarly, the higher the rate of time discount the lower and flatter will be the present value curve. It therefore is essential to have information about both the production function for cane, and subjective rates of time discount. The production function is considered in Chapter 7 while in Chapter 8 a method is derived which enables an indicator of time preference for each household to be estimated from observed data.

CHAPTER 7

THE MARGINAL PHYSICAL PRODUCT OF LABOUR USED IN CANE PRODUCTION

7.1 Introduction

In Chapter 6 it was shown that the shape of the present value curve depended crucially on the marginal product of labour allocated to cane. If the Marginal Physical Product (MPP) was perceived to be zero, or if it was less than the marginal valuation of family labour, the household would not voluntarily choose to apply labour to the cash crop. The results of an attempt to estimate the MPP of labour used in cane production are presented in this chapter.

In fact, it is shown that a production function for cane could not be estimated for Seaqaqa, and functions based on other sugar-producing countries could not be used because of the atypical organisation of cane production in Fiji. A multi-period production function using detailed time series and cross-sectional data is required. These data were not available from official sources and could not be collected during a single year of fieldwork. Some of the problems of estimating a production function for a semi-perennial crop such as cane are discussed, and suggestions are made for the type of data which must be collected before a multi-period study of cane cultivation in Fiji can be undertaken. These topics provide the focus of Sections 7.2 to 7.4.

The data covering the 1977-78 season that were originally intended for the production function analysis, are also used in an attempt to resolve some of the dilemmas posed in Chapter 5. There it was shown that Indian families, and households headed by persons aged between 30 and 44 years, did not produce more cane than other families, even though they applied more labour. Moreover, the families harvesting cane for the third time in 1978 achieved a significantly higher yield than those harvesting for the second time. Whether these differences could have been due to variations in input usage is examined in Section 7.5.

During the survey it was noted that a number of farmers did not employ some of the inputs recommended by the FSC. Commonly used multiplicative forms of the production function cannot be estimated in the presence of zero inputs. Accordingly, a modification which would enable this type of specification to be estimated even when some inputs are zero is suggested in Section 7.6.

7.2 Method of Estimating the MPP of Labour

The MPP of labour in cane production, could be calculated by estimating a production function for cane in terms of aggregate inputs e.g. labour and capital. Ignoring the well known problems of input aggregation (Solow 1956; Upton 1979), an assumption of this approach is that a family is unrestricted in its choice of inputs. Any given input then is allocated to farm activities so as to equate its MPP in each activity. For example, the MPP of labour in inter-row ploughing would equal the MPP of labour in weeding.

In Seaqaqa, the FSC had developed a list of recommended farming practices based largely on its experience supervising cane production in other areas of Fiji. Farm Advisors applied pressure on families to follow these practices. Using a similar argument to Schultz (1964),it is possible that the FSC had developed a set of efficient recommended practices based on their decades of experience. However, farming conditions in Seaqaqa were different to those in the areas of Fiji where the recommendations were developed. Cane was cultivated on land with a greater slope, and soils were of a different type, than was usual in other areas. Therefore, until cane has been grown in Seaqaqa for sufficient time to allow the development of a set of efficient, Seaqaqa-specific, recommended practices, and while there is some compulsion for farmers to follow the FSC advice, it cannot be assumed that the MPP of any factor of production will be identical across all farm activities.

The MPP of separate farm activities, each of which has an implied labour component, will be considered in preference to the MPP of aggregate labour. In this way the MPP of labour to each activity can be calculated and the efficiency of the FSC recommendations can be tested. A further advantage of this specification is that it avoids having to aggregate diverse forms of the different physical inputs.

The activities recommended by the FSC are compared with the average observed practice in Table 7.1. To prevent excessive evaporation from soils that did not retain moisture well, and to help control weed growth, the trash remaining after a harvest had been completed was supposed to be left on the ground rather than burned.[1] Two applications of fertiliser were to be made to ratoon cane, the first immediately after harvesting and the second, six to eight weeks later. Fertiliser was to be placed in the furrows as plant cane was being planted. Once the cane had been covered with soil, two above ground applications were to be made, the first about six weeks after planting, and the second after a further six weeks.

After each above ground application (to ratoons or to plant cane,), the entire area planted to cane was supposed to be "cultivated", a process designed to cover the fertiliser with soil and to stimulate plant regeneration by cutting old roots of cane.[2] Either bulls or tractors could be used in these inter-row ploughings.

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1 "Trash" is defined in Chapter 4, footnote 8.

2 "Cultivation" was the term used to describe inter-row ploughing.

TABLE 7.1

COMPLIANCE WITH FSC RECOMMENDATIONS

Activity	FSC recommendation	Observed average	No. of observations	No. following FSC advice fully	No. not following FSC advice at all
Number of completed inter-row ploughings	2.00	1.298 (0.773) *	57	13	6
Proportion of trash to be burned	0	0.728 (0.384)	55 †	4	32
Fertiliser Applications					
Plant Cane	42.5 bags/hectare	36.363 (6.720)	36	12 **	0
1st Ratoons	22.5 bags/hectare	19.264 (4.975)	45	14 **	0
Older Ratoons	27.5 bags/hectare	22.729 (5.430	38	9 **	0
Weed Control					
Spraying	as needed	4.968 gals/hectare	57	n.a.	20 ††
Hand Weeding	"	25.302 hours/hectare	57	n.a.	24 ††

* Figures in parentheses are standard deviations.

† This recommendation was not applicable to 2 households which harvested no ratoon cane in 1978.

** Within 10% of recommended fertiliser applications.

†† Number of farms on which no weed control measures undertaken.

n.a. = not applicable.

Yield was expected to be negatively related to the proportion of cane that was burned after the previous harvest, but positively related to the number of completed inter-row ploughings, and to the two weed control variables of Table 7.1. Excessive fertiliser use, however, could burn cane, resulting in lower yields. Thus although yield was expected to be positively related to the quantity of fertiliser over most of the observed range of inputs, the MPP of fertiliser could become negative at excessively high levels of use.

Details of the farming activities employed, and the corresponding yields for cane of the three different ages, are presented in Tables 7.2 to 7.4. Two variables have been added to those of Table 7.1. X_7 represents the total amount of fertiliser applied per hectare of ratoons harvested before the 1978 crush. The soil on farms where a large quantity of fertiliser had previously been applied was expected to be more fertile than that on other farms, and thus yield was expected to be positively related to X_7.[3] The area of land harvested in 1978 (X_4) was included to capture any economies or diseconomies of scale. Tables 7.2 to 7.4 reveal no linear relationships between yield and the observed activities.

In Section 7.4 it is shown that a production function for cane in which yield is related mainly to inputs in the current period is not specified correctly. Accordingly detailed consideration of either production function

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3 This is the only way in which soil quality entered the estimated production functions. No scientific measurements of soil quality were available. During the field research, a Resource Scientist, Dr R. Hills, visited the area and found no apparent major differences in soil texture. In any case, Young and Goldsmith (1977) illustrated that where variations in management ability and in the use of physical inputs were large, the impact of small variations in soil quality on yield were not statistically significant.

theory, or of production function estimates for Seaqaqa is not warranted. However, to highlight the problems encountered in estimating production functions for semi-perennial crops, some of the estimates of the Transcendental Production Function will be discussed briefly. The same conclusions emerge from the estimates of the Quadratic function.

7.3 Production Function Estimates

To avoid any problems of multicollinarity, yield was chosen as the dependent variable in preference to total output. The Quadratic and the modified Transcendental forms were chosen because they could be estimated even when some inputs were zero. Moreover, it was shown in Section 7.2 that the MPP of fertiliser could be negative for large applications. The commonly used Cobb-Douglas specification does not allow for this stage of production, whereas estimated marginal products using a Quadratic or Transcendental specification can be both positive and negative.

The general form of the Transcendental Production Function specified by Halter et al (1957) was

$$Y = C\prod_{i=1}^{n} X_i^{a_i} e^{b_i X_i} , \qquad (7.1)$$

where Y was output, the X_i were inputs, c, a_i, and b_i were parameters, and e was the base of natural logarithims. Sepien (1978) modified this specification by dividing inputs into two groups, A and B. When the b_i for all inputs in one group are zero, the function can be rewritten as:-

$$Y = C\prod_{i\varepsilon A}^{n} X_i^{a_i} e^{\alpha_i X_i} . \prod_{i\varepsilon B}^{n} e^{\beta_i X_i} . \qquad (7.2)$$

Set A thus incorporates essential inputs ($i\varepsilon A$: any $X_i = o$, $Y = o$) and Set B, non-essential inputs ($i\varepsilon B$: all $X_i = o$, $Y = C\prod_{i\varepsilon A}^{n} X_i^{a_i} e^{\alpha_i X_i} > o$).

Marginal products of essential inputs can be increasing, decreasing or negative, but the marginal products of non-essential inputs thus defined are linear. To allow for non-linear marginal products of the non-essential factors of production, Sepien made a further modification

$$Y = C\prod_{i\varepsilon A}^{n} X^{a_i} e^{\alpha_i X_i} \cdot \prod_{i\varepsilon B}^{n} e^{(\beta_i X_i + \gamma_i X_i^2)} . \qquad (7.3)$$

Rewriting equation 7.3 for application to cross-sectional data, and specifying it in logarithmic form, produces

$$y_i = c_j + \sum_{i\varepsilon A}^{n} (a_i x_{ij} + \alpha_i X_{ij}) + \sum_{i\varepsilon B}^{n} (\beta_i X_{ij} + \gamma_i X_{ij}^2) + u_j , \qquad (7.4)$$

where X_{ij} is the quantity of input i employed by household j,

u_j is an error term,[4]

and lower cases denote logarithms.

The only variable in Tables 7.2 to 7.4 that is essential to production is land (X_4). However it will only be significant in a production function in which yield is the dependent variable if economies of scale exist. An output would still be produced in the absence of the other factors of production which therefore are elements of Set B, the non-essential inputs.

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4 The usual assumptions about the errors are made.
(i) $E(u_i) = o$
(ii) $\underset{i \neq j}{E} (u_i u_j) = o$ but $\underset{i=j}{E} (u_i u_j) = \sigma^2$
(iii) $E(x_i u_i) = o$
(iv) u is distributed normally i.e. $u \sim N(o, \sigma^2)$.
These assumptions allow production parameters to be estimated by least squares techniques (Kalirajan 1979, pp88-90).

TABLE 7.2

OBSERVED YIELD AND FARMING PRACTICES - PLANT CANE

Y	X_1	X_2	X_3	X_4	X_5
94.4	36.7	1.00	0	0.3	130.00
92.5	35.0	0.40	0	2.0	0
81.7	36.0	3.33	0.33	3.0	32.50
80.0	46.0	2.00	0.18	0.5	0
78.3	37.0	2.27	0.25	2.3	65.21
77.5	39.4	1.32	0.15	0.8	0
77.5	33.3	0	0	1.2	0
76.0	28.0	0.24	0.50	2.0	0
75.4	27.3	2.00	0.60	6.0	68.35
75.0	42.5	2.00	0.45	0.4	0
75.0	34.8	1.26	0.08	2.0	0
75.0	29.2	0.33	0.15	0.6	40.00
73.8	25.0	1.00	0	0.8	0
71.7	35.0	2.00	0.50	1.2	28.00
70.0	33.1	1.08	0.83	0.8	8.13
69.0	38.7	2.38	0.03	6.3	0
68.8	31.3	2.00	2.30	0.8	5.65
68.5	32.7	0.50	0.18	2.6	11.21
65.3	30.0	2.00	0	0.4	0
65.0	50.0	2.00	0	0.2	80.00
64.3	30.0	1.27	1.68	1.4	16.70
62.5	45.0	1.82	0	0.4	30.69
62.5	42.5	0.41	0.13	0.4	26.55
62.5	25.0	2.00	0.18	1.2	10.83
62.1	42.9	0	0	1.4	21.40
62.0	32.0	1.00	0.88	1.0	0
58.1	38.8	0.20	0	1.6	0
55.2	46.3	2.00	0.05	4.8	24.82
55.0	30.0	1.00	0.50	0.8	1.63
53.8	45.0	1.85	0.80	0.8	0
52.5	35.0	2.00	0.20	0.8	46.25
51.3	28.8	1.36	0.78	1.6	51.20
50.0	32.5	0.50	0	0.4	13.93
40.0	38.8	2.13	1.13	0.4	22.16
37.3	30.4	0	0.03	2.4	16.25
32.5	43.8	1.09	0.33	0.8	0

TABLE 7.3

OBSERVED YIELD AND FARMING PRACTICES - FIRST RATOONS

Y	X_1	X_2	X_3	X_4	X_5	X_6	X_7
114.5	21.3	0.96	0.60	2.0	60.00	1.00	49.81
94.7	21.2	0.80	1.00	6.1	4.26	0.67	40.15
82.5	20.9	0.50	0.18	0.4	11.21	1.00	60.31
78.9	20.9	1.32	0.15	1.8	0	1.00	70.73
77.2	17.4	1.88	0.83	6.8	0	1.00	66.39
75.0	17.0	1.08	0.83	0.2	8.13	0.05	117.71
70.0	16.8	2.00	0.18	0.8	10.83	1.00	65.56
69.3	24.1	0.40	0	4.4	0	0	36.82
68.8	18.7	1.00	0.88	0.8	0	1.00	64.78
68.8	17.8	1.27	1.68	1.6	16.70	1.00	86.19
67.7	24.0	2.00	0.18	1.5	0	0.46	186.00
67.3	19.0	2.00	0.50	2.6	28.00	1.00	53.25
67.1	19.5	2.00	0.05	2.4	24.82	0.44	181.00
66.7	21.3	1.40	0.03	1.2	0	1.00	123.84
66.7	20.0	2.00	2.30	0.6	5.65	1.00	179.33
65.0	28.4	0.33	0	3.0	0	1.00	63.03
64.1	25.6	0.42	0	4.4	2.95	0.96	36.93
63.3	19.1	0.86	1.10	2.4	62.62	1.00	37.78
62.5	22.3	2.00	0.45	2.0	0	0.25	41.82
62.5	19.0	0.33	0.15	0.8	40.00	0.33	99.75
61.3	20.8	2.13	1.13	0.8	22.16	1.00	74.13
60.7	19.0	1.00	0	3.0	130.00	0.83	168.33
60.0	11.7	1.69	1.45	2.0	15.87	1.00	37.91
59.7	19.4	1.26	0.08	2.9	0	0.95	60.41
58.6	25.9	2.00	0.60	3.7	68.35	0.03	27.16
58.0	7.5	0	0	1.2	0	0	72.50
56.3	24.0	1.82	0	0.8	30.69	1.00	41.36
55.4	19.1	3.33	0.33	2.2	32.50	0.50	50.45
55.2	12.4	0.41	0.13	4.4	26.55	0.09	52.11
54.2	11.7	2.00	0.20	1.2	46.25	1.00	75.68
53.0	11.8	0.24	0.50	4.4	0	1.00	90.16
52.7	20.4	0	0	6.8	21.40	0.21	50.59
52.5	16.2	2.00	0	1.2	52.60	1.00	50.71
52.0	25.0	0	0	0.8	0	0	220.00
51.3	25.2	1.85	0.80	0.8	0	0.44	119.11
51.3	20.3	0	0.03	2.4	116.46	0	67.71
49.8	20.7	0.20	0	4.5	0	0	26.89
45.5	20.8	1.63	0	3.8	0	0.44	36.05
45.0	12.6	1.36	0.78	0.4	51.20	1.00	80.71
44.9	13.3	1.00	0	4.8	0	0.70	48.13
43.3	14.0	1.09	0.33	1.2	0	1.00	56.07
39.4	28.4	2.00	0	4.8	0	1.00	32.19
39.4	17.5	0.50	0	2.4	13.93	0.50	32.08
32.5	26.6	1.41	0.03	2.0	0	1.00	77.50
29.6	8.3	1.00	0	6.0	0	1.00	35.00

TABLE 7.4

OBSERVED YIELD AND FARMING PRACTICES - OLDER RATOONS

Y	X_1	X_2	X_3	X_4	X_5	X_6	X_7
75.2	19.8	2.00	0	1.6	52.60	1.00	50.71
75.1	21.2	1.88	0.83	4.0	0	1.00	66.39
72.9	25.6	0.50	0.18	2.8	11.21	1.00	60.31
65.2	23.2	0.33	0.15	1.2	40.00	0.33	99.75
64.2	23.5	2.36	0.45	2.6	40.00	0.45	181.15
63.5	20.7	1.08	0.83	2.2	8.13	0.05	117.71
62.8	23.5	2.38	0.03	3.4	0	1.00	31.18
61.8	24.2	2.00	0	2.4	80.00	1.00	76.25
60.9	26.0	1.40	0.03	6.1	0	1.00	123.84
59.8	26.1	0.96	0.60	3.2	60.00	1.00	49.81
59.8	15.1	0.41	0.13	3.2	26.55	0.09	52.11
57.8	14.3	1.69	1.45	6.6	15.87	1.00	37.91
57.6	21.8	1.27	1.68	1.9	16.70	1.00	86.19
57.3	25.4	2.13	1.13	3.2	22.16	1.00	74.13
55.9	14.3	2.00	0.20	3.2	46.25	1.00	75.68
55.7	34.7	0.33	0	3.6	0	1.00	63.03
55.0	32.8	2.27	0.25	4.0	65.21	1.00	91.75
55.0	25.5	1.32	0.15	3.0	0	1.00	70.73
54.3	22.9	1.00	0.88	3.8	0	1.00	64.78
53.2	24.4	2.00	2.30	0.9	5.65	1.00	179.33
52.7	29.4	1.82	0	3.6	30.69	1.00	41.36
52.5	14.5	0.24	0.50	2.0	0	1.00	90.16
50.8	20.5	2.00	0.18	1.0	10.83	1.00	65.56
50.8	16.4	1.00	0.00	1.4	0	1.00	178.57
50.4	30.8	1.85	0.80	4.8	0	0.44	119.11
50.0	23.4	0.86	1.10	1.2	62.62	1.00	37.78
49.4	23.3	1.17	0	6.0	0	1.00	67.83
48.5	27.3	2.00	0.45	2.4	0	0.25	41.82
48.5	23.7	1.26	0.08	3.2	0	0.95	60.41
47.9	24.8	0	0.03	2.4	116.46	0	67.71
47.2	27.3	1.75	0.15	3.0	30.33	0.75	112.33
46.6	15.0	2.00	0.48	2.4	287.08	1.00	241.67
37.9	15.4	1.36	0.78	2.4	51.20	1.00	80.71
36.4	17.1	1.09	0.33	4.4	0	1.00	56.07
36.2	17.5	1.00	0.50	3.2	1.63	1.00	87.19
34.5	16.1	1.60	0	2.8	18.57	1.00	76.79
25.0	32.5	1.41	0.03	2.4	0	1.00	77.50
21.3	23.9	2.00	0.05	1.6	24.82	0.44	181.00

A description of the variables in Tables 7.2 to 7.4

Y = yield in tonnes per hectare

X_1 = bags (50 kgs) of fertiliser applied in preparation for the 1978 harvest

X_2 = number of completed inter-row ploughings

X_3 = quantity of weedicide applied per hectare

X_4 = hectares harvested

X_5 = adult equivalent hours of hand weeding per hectare

X_6 = proportion of area cut in 1977 burned in preparation for the 1978 harvest

X_7 = bags of fertiliser applied to ratoons cut in 1978, in preparation for previous harvests (not the 1978 harvest which is included in X_1).

TABLE 7.5

DUMMY VARIABLES USED IN PRODUCTION FUNCTION ESTIMATES

Variable	Classification	Number in Group		
		Plant Cane	First Ratoons	Older Ratoons
D1 = Race	Indian = 0 Fijian = 1	22 14	21 24	21 17
D2 = Education	Primary school or less = 0 Post primary = 1	21 15	27 18	23 15
D3 = Experience	Full time cash earning = o No cash earning = 1	13 23	18 27	15 23
D4 = Age of the leaseholder	Younger than 30 = 0 Older than 29 = 1	15 21	18 27	13 25
D5 = Migrant Status	Local residents = 0 Migrants = 1	22 14	27 18	21 17
D6 = Tractor Ownership	Own Tractors = 0 No Tractor = 1	9 27	10 35	11 27
D7 = Timing	Poor timing = 0 Good timing = 1	21 15	26 19	20 18
D8 = Dominant Variety - Plant Cane	Mostly ragnar = 0 Mostly mali = 1	5 31	- -	- -
D9 = Dominant Variety - First Ratoons	Ragnar = 0 Mali = 1	- -	9 36	- -
D10 = Dominant Variety - Older Ratoons	Ragnar = 0 Mali = 0	- -	- -	20 18

Shift dummy variables (neutral shifts in the production function) can be introduced by redefining c_j in equation 7.4 as

$$c_j = \theta_o + \sum_{k=1}^{m} \theta_k D_{kj} \quad . \tag{7.5}$$

Non-neutral shifts (slope dummies) require the following modifications.

$$a_i^* = a_i^o + \sum_{k=1}^{m} a_k' D_{kj} \tag{7.6}$$

$$\alpha_i^* = \alpha_i^o + \sum_{k=1}^{m} \alpha_k' D_{kj} \tag{7.7}$$

$$\beta_i^* = \beta_i^o + \sum_{k=1}^{m} \beta_k' D_{kj} \tag{7.8}$$

$$\gamma_i^* = \gamma_i^o + \sum_{k=1}^{m} \gamma_k' D_{kj} \quad . \tag{7.9}$$

Substituting a_i^*, α_i^*, β_i^*, γ_i^*, for a_i, α_i, β_i and γ_i, equation 7.4 becomes, (assuming no neutral shifts),

$$y_i = c_j + \sum_{i\varepsilon A}^{n} [(a_i^o + \sum_{k=1}^{m} a_k' D_{kj}) x_{ij} + (\alpha_i^o + \sum_{k=1}^{m} \alpha_k' D_{kj}) X_{ij}] + \sum_{i\varepsilon B}^{n} [(\beta_i^o + \sum_{k=1}^{m} \beta_k' D_{kj}) X_{ij} + (\gamma_i^o + \sum_{k=1}^{m} \gamma_k' D_{jk}) X_{ij}^2] + u_j \quad . \tag{7.10}$$

The dummy variables considered for Seaqaqa are summarised in Table 7.5. All except the Timing Dummy (D7) and the dummies representing the dominant variety of cane (D8 to D10) were introduced in Chapter 5 and details of the continuous values of those variables for each farm were included in Data Set A. The dummy variable score (0,1) for each family is presented in Table 7.6.

Because fertiliser applications and inter-row ploughings were supposed to be completed within a set time after harvesting (or planting), a dummy variable to describe the timing of these activities was introduced. At each of the four intensive visits, families which had applied

TABLE 7.6 - Dummy Variable Scores

Var. Farm No.	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
1	0	0	0	1	0	1	0	-*	-	0
2	1	1	0	0	0	0	0	1	1	-
3	1	1	1	1	1	1	0	-	1	1
4	1	1	0	1	0	0	1	1	1	1
5	1	1	1	0	1	1	1	-	1	-
6	0	0	0	1	0	1	1	1	0	0
7	0	0	0	0	1	1	0	1	1	1
8	1	1	1	1	1	1	0	1	1	1
9	1	0	0	1	0	1	0	-	1	1
10	1	0	0	1	0	1	0	-	-	1
11	1	0	1	1	0	1	1	-	1	1
12	1	1	1	0	0	0	0	0	-	1
13	1	0	1	1	1	1	0	-	1	1
14	1	0	1	1	1	0	0	-	1	0
15	0	1	1	0	1	0	1	-	0	0
16	0	1	0	1	1	0	1	-	1	0
17	0	1	0	1	1	0	1	1	-	1
18	0	0	0	0	1	1	1	0	0	-
19	0	0	0	0	0	1	1	1	1	-
20	0	1	0	0	0	1	1	1	0	1
21	0	0	0	1	0	1	0	1	1	-
22	0	0	0	1	0	1	0	1	1	-
23	0	0	0	0	1	1	0	1	1	0
24	0	0	0	1	0	1	0	1	1	0
25	0	1	0	0	0	1	0	-	-	0
26	0	1	0	0	0	0	1	1	1	0
27	0	0	1	1	1	0	1	1	1	0
28	1	1	1	0	0	1	0	-	-	1
29	1	1	1	0	0	1	0	1	-	-
30	1	0	1	1	0	1	1	-	1	-
31	1	1	1	0	0	1	0	1	1	-
32	1	0	0	1	0	1	0	-	1	-
33	1	1	1	0	0	0	1	-	1	-
34	1	1	0	0	1	1	0	-	1	-
35	0	0	0	1	0	1	0	1	0	0
36	0	0	0	0	1	1	1	1	1	1
37	1	1	0	0	0	1	1	-	1	1
38	1	0	1	1	0	1	0	1	1	0
39	1	0	0	1	1	1	0	-	1	0
40	1	0	1	1	0	0	1	1	1	1
41	0	0	0	0	0	1	0	1	1	0
42	0	1	1	1	1	0	0	1	1	1
43	0	0	0	1	1	1	1	0	-	0
44	0	0	0	0	1	1	1	1	1	0
45	0	0	0	0	0	1	1	0	0	0
46	0	0	0	1	0	1	1	-	-	0
47	1	1	1	1	0	1	0	1	1	-
48	1	1	1	1	1	1	0	1	0	-
49	1	1	1	1	1	0	1	1	-	1
50	0	0	0	1	0	1	1	1	0	-
51	1	0	0	1	0	1	0	1	1	-
52	1	0	1	1	1	1	0	1	1	0
53	1	1	0	0	0	1	0	-	1	-
54	1	0	1	1	0	1	0	1	0	-
55	1	0	1	1	0	1	1	-	-	0
56	0	1	0	1	0	1	0	1	1	1
57	0	1	0	0	1	1	0	0	-	-

*Dashes indicate that no cane of this age was harvested in 1978.

within 20% of the recommended fertiliser applications were given a score of 1, the remaining households scoring 0. Similarly those which had completed within 20% of the recommended inter-row ploughings at each visit were given a score of 1. Families scoring four or less out of the maximum possible total of eight, were deemed to have timed these input applications badly, while those scoring five or more had timed their activities well.

The cane-variety dummies were included because the Project Administration generally had advised farmers to plant _mali_ cane, which was thought to be particularly suitable to the sloping, infertile land of Seaqaqa. It also required less care than _ragnar_, the other major variety grown in Seaqaqa, which was more suited to flat, fertile regions. Families which had predominantly planted mali were given a score of 1 and were expected to produce higher yields than households which had planted a large proportion of ragnar. This expectation, however, might be valid only for the early years of the project because ragnar could be ratooned for longer periods with no decline in yield. The FSC recommended that mali cane be replanted every three to four years, whereas the same stand of ragnar often had been harvested for well over ten years in other areas of Fiji.

Timing could not be included simply as a shift dummy. If the FSC recommendations were correct, it could have affected the MPP of both fertiliser applications and inter-row ploughings. Similarly, tractor ownership could have affected the MPP of inter-row ploughing and possibly fertiliser applications. Although the likely impact of the other dummy variables on the production function are not as clear, they were included as both shift and slope dummies at various stages. Dummies also were included singly and in conjunction with other dummy variables to allow for possible interactive effects.

It was important that results of the dummy variable analysis be consistent across equations. For example, if Indians obtained a better yield of plant cane than Fijians using similar inputs, they should also have obtained a better yield with ratoons, provided that the pattern of cane varieties did not differ significantly between races. Similarly, if the MPP of inter-row ploughing on farms operated by tractor owners was greater than on other farms for ratoons, the same tendency should have been revealed with plant cane.

No consistent pattern emerged from this analysis, either when dummies were included singly or in groups. Race showed significance both as a shift and slope dummy with first ratoons, but only as a shift dummy with plant cane. It did not have a significant impact on the yield of older ratoons. Tractor ownership was insignificant in all equations and each of the remaining dummies was significant in only one equation. Accordingly, dummy variables have been omitted from the results presented in Tables 7.7 to 7.9. The equations which maximised $\bar{R}^2$ are presented.[5]

The results do not justify detailed explanation. The F-statistic and $\bar{R}^2$ show that the equations fit poorly, and the significance tests for individual coefficients reveal that the impact of most variables on yield were statistically insignificant. Moreover there is little consistency between equations. For example, an inter-row ploughing variable is contained in each equation, but its impact on yield is negative in one, positive in another, and in the remaining equation is initially negative then

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[5] $\bar{R}^2$ is R^2 adjusted for degrees of freedom. The formula used was

$$\bar{R}^2 = R^2 - \left(\frac{k-1}{n-k}\right)(1-R^2).$$

where n = the number of observations
k = the number of independent variables in the equation.

TABLE 7.7

TRANSCENDENTAL PRODUCTION FUNCTION ESTIMATE FOR PLANT CANE

Variable	Parameter Estimate
C (Constant)	4.142
X_5 (Hand Weeding)	-0.005^{*} (0.003)†
$(X_5)^2$	0.00006^{**} (0.00003)
$(X_2)^2$ (Inter-row Ploughing)	0.019 (0.017)
$\bar{R}^2 = 0.072$	
$R^2 = 0.152$	
F-statistic = 1.90 with 3,32 degrees of freedom	

† = Figures in parenthesis are standard deviations

* = Significant at 10% level of significance

** = Significant at 5% level

TABLE 7.8

TRANSCENDENTAL PRODUCTION FUNCTION ESTIMATE FOR FIRST RATOONS

Variable	Parameter Estimate
C (Constant)	2.923
X_1 (Fertiliser)	0.116*** (0.040)
$(X_1)^2$	-0.003*** (0.001)
X_2 (Inter-row Ploughing)	-0.058 (0.045)
X_3 (Weedicide)	0.409** (0.164)
$(X_3)^2$	-0.153* (0.088)
$\bar{R}^2$ = 0.270	
R^2 = 0.353	
F-statistic = 4.25** with 5,29 degrees of freedom	

* = Significant at 10% level

** = Significant at 5% level

*** = Significant at 1% level

TABLE 7.9

TRANSCENDENTAL PRODUCTION FUNCTION ESTIMATE FOR OLDER RATOONS

Variable	Parameter Estimate
C (Constant)	3.406
X_1 (Fertiliser)	0.083 (0.057)
$(X_1)^2$	-0.002^{**} (0.001)
X_2 (Inter-row Ploughing)	-0.486^{*} (0.268)
$(X_2)^2$	0.193^{*} (0.103)
X_7 (Previous Fertiliser)	-0.001 (0.001)

$\bar{R}^2$ = 0.055

R^2 = 0.183

F = 1.43 with 5,32 degrees of freedom

* = significant at 10% level

** = significant at 5% level

increasingly positive. Although some variation in the magnitudes of the MPP's of particular activities might be expected, variations in signs cannot be justified.

Other estimated coefficients have signs which are difficult to explain. Labour input to hand weeding to a maximum of 83.3 hours per hectare appears to reduce the yield of plant cane, though inputs in excess of 83.3 hours improve yield at an increasing rate. Inter-row ploughing had a negative impact on the yield of first ratoons, and the quantity of fertiliser per hectare applied before the 1978 season was negatively related to the yield of older ratoons. These effects are difficult to explain.

In sum, these equations reveal no consistent relationship between yield and the activities undertaken during the 1978 growing season.[6] They suggest that farmers following the FSC recommendations produced no greater yields than those who ignored the advice.

7.4 The Efficacy of the Farming Practices Recommended by the FSC

The results of the production function estimates are clearly inadequate. Although both officials and farmers at times expressed doubts about the efficacy of the burning and inter-row ploughing recommendations, it never was suggested that fertiliser and weed control measures were not warranted. The zero burning recommendation, although tailored specifically to Seaqaqa soils, caused most controversy. Only four families followed it fully, and three of the four FSC Farm Advisors who also operated farms burnt the trash remaining on their farms after the 1977 harvest. Some officials argued that ploughing was important only when soil was being prepared for initial cane planting, and that subsequent inter-row ploughing had no effect on yields.

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6 Quadratic production function analysis produces the same conclusion.

Farmers generally however, expressed the belief that yields would fall in the absence of fertiliser, and in the presence of excessive weeds. Soils in Seaqaqa were of a poorer quality to those in other cane growing areas, and the quantity of fertiliser recommended was correspondingly higher. The difference between cane to which adequate fertiliser had been applied and that suffering from fertiliser deficiency, was obvious even to an untrained observer. Similarly, cane grew poorly in areas where there were a large number of weeds, and few doubts about the efficacy of the weed control measures were expressed.

Therefore, although doubts existed about two of the FSC recommendations, it was widely believed that the fertiliser and weed control recommendations had proved reliable. The lack of a consistently significant impact of current fertiliser inputs in the production function analysis is particularly surprising. Wide variations in fertiliser applications were observed, and even in a cross-sectional study involving only one time period, some effect on yield would be expected. A possible explanation is that the fertiliser recommendations were too general for Seaqaqa conditions. In other areas of Fiji, leaf samples from individual cane farms have been analysed, and farm specific fertiliser recommendations made. This had not been done in Seaqaqa.

Thus it is possible that farmers in Seaqaqa were modifying the official recommendations to suit the requirements of their own farms. If families on better soils used less fertiliser than those farming poor soils, a cross-sectional study would reveal no correlation between fertiliser applications and yields. A possible implication is that the FSC should arrange for leaves from each farm, or at least from different areas of the project, to be analysed, thereby making their recommendations specific to the different soil varieties.

However, before it can be concluded that the FSC's advice was incorrect, sources of error in the production function analysis should be considered. Two such possibilities can be identified. The data may have been unreliable, and the equations may have been incorrectly specified.

7.4.1 The Data. There is little reason to doubt the accuracy of data collected from official sources or from household responses that could be checked by the interviewer. However:-

1. According to rumour, some families obtained fertiliser on credit from the FSC and then used it to pay for goods purchased from local stores. During the survey it was possible to measure the area of land a family had fertilised, and to check fertiliser stocks on the farm, but the fertiliser that had actually been applied to cane could not be measured. A family whose stocks had been reduced by eight bags might have sold four and applied four to their cane, while claiming to have applied all eight bags. However, although some families in the scheme as a whole were notorious for this practice, only one in the sample came under suspicion.
2. Some plant cane harvested in 1978 had been planted before the survey began. Responses to questions about the activities undertaken when this cane was planted may not have been accurate, either because the farmer's memory was poor, or because the family wished to present a particular facade. It may, for example, have wished to show that it was following the FSC recommendations correctly, or conversely that the FSC was giving valueless advice. To minimise such inaccuracies, checks were made with neighbours and with the FSC Farm Advisor responsible for the area whenever possible. Few errors were noted.

3. Details of inter-row ploughing, burning, spraying and hand weeding were collected for the farm as a whole. Because it was not possible to identify at all times the age of cane to which an input had been applied, it was assumed that each activity was applied to cane of different ages at the same rate. In general there was no reason to assume that a family would plough plant cane twice for example, and ratoons once, or burn the trash remaining from second ratoons but not from first ratoons. However, if this assumption was incorrect, the data are inaccurate.

Although some inaccuracies might exist, in general the data are considered to be of a high quality. Problems with the interpretation of the estimated production functions therefore are unlikely to be due entirely to data difficulties.

7.4.2 Specification Errors. The two weed control variables may not have been consistently significant in the production functions because of the nature of cross-sectional surveys. In a cross-sectional study, only if weeds grew roughly to the same extent on all farms would the level of weed control activities be expected to be positively related to yields. In Seaqaqa, many farms did not have major problems with weeds. The use of a large quantity of weedicide therefore might have represented simply the presence of a large number of weeds, and conversely spraying could not have improved yields if no weeds existed. In this case, weed control variables are unlikely to be statistically significant unless an indicator of the presence of weeds at the beginning of the period is included.

In any case, this indicator would have been a proxy for other variables, such as the presence of weeds before the land had been cleared and past levels of weed control on the farm. The only information on past cane farming practices that was included in the production functions was the total quantity of fertiliser applied per hectare in preparation for previous harvests. More historical information is required if the production function is to be specified correctly.

Detailed discussions with scientists and field officers in the FSC, the MAFF and NLDC, suggested the following pattern. The quality of the cane stool from which the ratoons generated, was determined by:-

a. the quality and age of the cane that was planted initially;
b. the depth at which this cane was planted;
c. the space left between stalks of cane as it was laid in the ground;
d. the quantity of fertiliser used at this initial planting;
e. the timing of planting - if rain did not fall for even a few weeks after the cane was planted, growth could have been impaired;
f. the quality of soil preparation before the initial planting.

Officers from both the NLDC and the MAFF claimed that this was of particular important in Seaqaqa where soils were highly compact. In this case ground should have been "ripped" to the maximum possible depth before planting.[7]

These practices determined the basic quality of the cane stand and hence potential yields in subsequent harvests. The scientists considered that subsequent yields could be influenced to an extent by maintenance procedures

[7] A "ripper" is an attachment for a bulldozer or tractor, consisting of a series of vertical prongs. The prongs are pushed into the soil and the ripper is dragged across the ground. The process is called "ripping".

such as those recommended by the FSC, but the dominant determinants were the initial planting practices. Thus to describe accurately the output from a hectare of third ratoon for example, information on the initial planting practices as well as the maintenance undertaken in every preceding year must be known. If the information provided by these officials was correct, the production functions tested earlier included variables which could have had but a marginal effect on 1978 cane yields.

No written details of planting practices for any of the cane harvested in 1978 were available.[8] The only official documentation of previous maintenance practices concerned the total fertiliser delivered to each farm since the project began. Families were unable to remember details such as the time between planting and the first rainfall, and the depth at which cane had been planted. They never knew the depth the rippers on the bulldozer had been set during the initial land preparation.

Despite the differences between Seaqaqa and other cane producing areas in Fiji, attempts were made to estimate a production function for these other areas. The estimated MPP of labour to cane, while not applicable to Seaqaqa, could have been used at least to illustrate how the model of Chapter 6 might have been tested. However, while the FSC recorded details of all imputs supplied to each cane farm in Fiji, no detailed information on planting or maintenance practices could be obtained. Neither was it possible to estimate a production function in terms of aggregate inputs because no records of historical labour inputs were available.

The production functions reported in this thesis were not specified properly. Correct specifications would

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8 Accurate details for much of the plant cane harvested in 1978 were not available for reasons mentioned in Section 7.4.1. This cane often had been planted before the survey commenced.

would require the estimation of a multi-period production function in which yield was made dependent on both the initial planting practices and the maintenance procedures undertaken in all previous years. The necessary information had not been recorded previously, and could not be obtained during one year of fieldwork. The nature of cane cultivation in Fiji therefore, put the estimation of such a production function out of reach for this thesis. However the data that were collected should provide useful historical information for future studies of this nature.

Earlier it was shown that many farmers doubted the validity of some of the farming practices recommended by the FSC, and followed them to varying degrees. Table 7.1 revealed that the trash on 32 of the 57 farms was burned after the 1977 harvest, and 6 families did no inter-row ploughing. The average fertiliser application to "older ratoons" was 17% lower than the recommended level.

Because the production functions presented in Section 7.3 could not be properly specified, the estimated coefficients would have been biased, and the efficacy of these recommendations could not be evaluated. These judgements could be made only by estimating a multi-period function for Seaqaqa cane. The FSC had not estimated this function, and had no means of accurately testing the impact of their recommendations on the cane production of settlers in Seaqaqa.[9] Increasing doubts about the efficacy of these farming practices could have important effects on behaviour - the model of Chapter 6 illustrated that if the returns from current labour inputs to cane were perceived to be zero, families would have allocated all their time to other pursuits. It therefore is in the interests of the Project Administration to conduct a study of the type suggested in this chapter.

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[9] The FSC has an Experiment Station in Seaqaqa which, in time, should be able to test the validity of some of the recommendations in a limited way.

7.5 Variations in Input Usage

Without the multi-period production function, it is not possible to resolve the dilemmas encountered in Chapter 5 where it was shown that Indians on average applied more labour per unit of land than Fijians, yet attained no greater output. Similarly, households headed by people aged between 30 and 44 years applied more labour for no apparent advantage in yields. Further, families which had completed two harvests before 1978 achieved a higher yield than those with only one previous harvest, without applying extra labour to cane. It was suggested that these differences could have been due to variations in the use of inputs other than land and labour. Indians, and families with heads aged between 30 and 44, might have used fewer of these inputs than remaining households, while two harvest families may have used more than one harvest families.

In fact, Table 7.10 shows that Indians used more weed killer and followed the inter-row plouging recommendation to a greater extent than Fijian households. If the FSC recommendations were correct, these measures combined with the extra labour input, should have enabled Indian farmers to produce a greater output than Fijians. The variable X_6 may provide the key to understanding this dilemma. It may also explain the data of Table 7.11. The FSC expected output to be negatively related to the proportion of cane land burned in preparation for a harvest (X_6). The greater tendency of Indians and families with heads aged between 30 and 44 to burn trash could have prevented the land from retaining moisture, to the extent that it counteracted the positive impact of the additional inter-row ploughing, weed control and labour inputs. This may have been exacerbated by the fact that the 1977 dry season in Seaqaqa was drier, and lasted longer, than was usual (see Chapter 2).

The negative effect of burning could have outweighed the positive impact of weed control, cultivation and labour inputs in the case described by Table 7.10. Yet in Table

TABLE 7.10

VARIATIONS IN INPUT USAGE BY RACE
57 FAMILIES

Input	Indian		Fijian		t-statistic
	Mean	Standard deviation	Mean	Standard deviation	
X_2=Inter-row Ploughings†	1.681	0.625	0.954	0.737	4.03***
X_3=Weedicide per Hectare	0.488	0.581	0.203	0.332	2.24**
X_6=Proportion Burned	0.797	0.350	0.618	0.414	1.77*

† See the explanation of variables given in Table 7.2-7.4.

* Significant at 10%.

** Significant at 5%.

*** Significant at 1%.

TABLE 7.11

VARIATIONS IN INPUT USAGE BY AGE OF HOUSEHOLD HEAD
57 FAMILIES

Input	Heads Aged Between 30 and 44 years		Other Households		t-statistic
	Mean	Standard deviation	Mean	Standard deviation	
X_6=Proportion Burned	0.817	0.282	0.636	0.433	1.90*

* Significant at 10%.

7.12, burning did not outweigh the impact of weed control and higher applications of fertiliser in previous years (X_7). Two harvest families still obtained a larger yield than one harvest families. Again assuming the validity of the recommended farming practices, this suggests that the impact of previous fertiliser applications must have been particularly important, a finding consistent with the earlier conclusion that current production could be crucially dependent on inputs applied in previous season.

Variations in performance could therefore be explained by the extent to which families followed the FSC advice. However, without the production function estimates, other explanations cannot be rejected. Firstly, two harvest families may have attained a greater yield than one harvest households because their extra cane farming experience allowed them to use inputs more efficiently.

TABLE 7.12

VARIATIONS IN INPUT USAGE BETWEEN TWO AND ONE HARVEST FAMILIES

Input	Two Harvests		One Harvest		t-statistic
	Mean	Standard deviation	Mean	Standard deviation	Degrees of freedom
X_3=Weedicide per Hectare†	0.269	0.352	0.035	0.094	2.63** (18.90)
X_6=Proportion Burned	0.779	0.323	0.415	0.399	2.68** (22.74)
X_7=Previous Fertiliser Applications	65.300	37.512	40.567	19.768	2.33** (25.28)

** Significant at 5%.

Secondly, it is possible that the additional labour applied by Indians was allocated to tasks that did not immediately effect cane production. Increased inter-row ploughing and weed control, for example, may have increased output only if they were undertaken consistently over a relatively long period of time, in which case higher current labour inputs to these activities would not be revealed in production figures for a number of years. The fact that Indians applied more labour to cane than Fijians could therefore have been a reflection of the lower rate of time discount of the former group. This hypothesis could be tested if a method of estimating rates of time discount could be developed. This is considered in Chapter 8.

7.6 The Treatment of Zero Inputs

One of the reasons why the Quadratic and the modified Transcendental forms were chosen in preference to the more commonly used production functions was that they could be estimated when some inputs were zero. Logarithmic functions such as the Cobb-Douglas, imply that all inputs are essential to the production process. If one input was zero output would be zero.

A method of adapting common logarithmic specifications is to assign arbitrarily small numbers to all zero observations (Layard et al 1971, p154). A less arbitrary method is suggested in this section using the Cobb-Douglas function for illustrative purposes. Consider the relationship

$$Y = \alpha X_1^{\beta_1} X_2^{\beta_2} X_3^{\beta_3} \tag{7.11}$$

where γ is output and the X_i are inputs. If any X is zero, the equation implies that output will be zero.

Assume however that X_1 is essential to production but that Y will be positive in the absence of X_1 and X_2. It is hypothesised that nature provides a natural component of many inputs which allows production in the absence of artifical additions of these inputs. The soil for example, contains a natural component of fertiliser, as most crops will grow if no fertiliser is applied. Further, nature provides predators to control insects which destroy crops, and soil and climatic conditions naturally control weed growth - i.e. there is a natural component to both weed and pest control activities. Although X_1 and X_2 are not essential inputs, their marginal products are expected to be positive, at least for relatively low input levels. Equation 7.11 can be modified to include constant natural components (θ_1 and θ_2) of the non-essential inputs X_1 and X_2 respectively:

$$Y = \alpha(X_1+\theta_1)^{\beta_1}(X_2+\theta_2)^{\beta_2}(X_3)^{\beta_3} . \qquad (7.12)$$

The concept of a natural component is similar to that of the subsistence or precommitted component in linear expenditure systems of consumer demand, discussed in Chapter 3. In these systems utility is a function of the quantity of goods consumed minus the subsistence component, and only above minimum subsistence consumption contributes to utility. The precommitted component sometimes is specified as a constant, but often is allowed to vary with such factors as the socio-economic characteristics of the family (e.g. Philp 1976). On the other hand, in the modification of the production function suggested in this section, output is a function of the quantity of an input that is applied plus the natural component. Production occurs in the absence of the input, but additions of the input contribute toward increasing production. The natural component thus defined, is positive and a constant.

In some conditions the natural component could be negative. A crop may not grow in very poor soil despite limited applications of fertiliser, for example. Only once fertiliser applications had reached a critical level would the MPP of fertiliser be positive. In such cases, only applications in excess of the natural component add to production, and the concept is similar to that of precommitted consumption. Thus the natural component of any input, although a constant, could vary according to the conditions under which a crop is produced.

An advantage of this specification is that it allows production functions with a simple interpretation to be estimated, even when some inputs are zero. Although the Cobb-Douglas function was used as an example, the modification could be applied to any logarithmic specification. However, non-linear estimating techniques must be employed. The modified Cobb-Douglas specification for the data of Tables 7.2 and 7.3 for example, is

$$Y_j = \alpha(X_{1j}+\theta_1)^{\beta_1}(X_{2j}+\theta_2)^{\beta_2}(X_{3j}+\theta_3)^{\beta_3}(X_{4j})^{\beta_4}(X_{5j}+\theta_5)^{\beta_5}.$$

$$(X_{6j}+\theta_6)^{\beta_6}(X_{7j}+\theta_7)^{\beta_7}, \qquad 7.13$$

where the X_i are as defined for Table 7.2. The area of land (X_4), being an essential input, does not have a natural component. In order to make the notation of equation 7.13 consistent, θ_4 is taken to be zero.[10]

Given the arguments of Section 7.4, this equation is not correctly specified, and the coefficient estimates thus would be biased. However, to illustrate the technique, an attempt was made to estimate the equation for the data of Table 7.2.

A non-linear regression computer programme which sought to minimise the error sum of squares ($S=u'u$ where $u = \begin{bmatrix} u(1) \\ \vdots \\ u(N) \end{bmatrix}$) using an iterative procedure was employed.[11] The programme required starting values of each parameter to be supplied. Two methods of obtaining realistic starting

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10 This implies that only the quantity of land is captured by X_4. Qualitative aspects of the soil are included elsewhere.

11 The programme was written by Dr A.R. Pagan of the Australian National University.

values for α and the β_i were used. Firstly the θ_i were set at the observed average value of the X_i (except $\theta_4 = o$), and secondly at the lowest positive observed value of the X_i. In both cases a linear regression using Ordinary Least Squares (OLS) was run, and the resulting estimates of α and β_i were used with the initial specified values of the θ_i as starting values for the two non-linear regressions.

Like the estimates of the modified transcendental production function, the results using the modified Cobb-Douglas function were poor. At no stage did the error sum of squares fall below the total sum of squares, showing that the predicted yields were not close to the observed yields. At no stage were any of the coefficients apart from the constant term statistically significant. Other starting values of the θ_i were used (and the corresponding α and β_i estimated by OLS) without improvement.

The failure of the modified Cobb-Douglas estimates, like the earlier production functions, is likely to be a result of the difficulties, outlined in Section 7.4, of specifying a full production function for cane as it is grown in Fiji. However, data from Seaqaqa were used in this section to illustrate how the suggested modification could be estimated, rather than to enable conclusions about cane farming in Fiji to be drawn. The technique warrants further empirical investigation.

7.7 Conclusions

In this chapter an attempt was made to estimate the MPP of labour used in cane production, a crucial determinant of the present value curve of Chapter 6. A lack of knowledge of certain long term variables in Fiji prevented this from being done, but a number of important conclusions emerged.

Some of the problems inherent in estimating a production function for a semi-perennial crop such as cane were highlighted. Cane production cannot be considered in a single period framework, and accordingly the efficacy of the farming practices recommended by the FSC could not be tested. Such tests require the estimation of a multi-period production function, utilizing detailed cross-sectional and time series data. The type of information needed for this function was discussed in Section 7.4. The data collected for this thesis should prove a useful starting point for such a study.

It was shown that the causes of inter-family variations in cane farming performance could not be identified accurately without the estimation of the multi-period function. They might have been due to observed differences in input usage, or to variations in factors such as the rate of time discount. In Chapter 8 a method of calculating an indicator of time preference from the observed behaviour of each family is derived.

Finally, a way of adapting common logarithmic forms of the production function to incorporate zero inputs was suggested. The data collected in Seaqaqa did not prove adequate to illustrate the technique fully, but further tests with data from other sources are warranted.

DATA SET B

Var. / Farm No.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	2.8	.0	2.8	.0	1.00	1.60	1.86	.0
2	6.4	4.4	.0	2.0	.0	0.40	.00	.0
3	4.4	2.0	2.4	.0	1.00	1.41	.0	0.03
4	6.4	1.2	4.4	0.8	1.00	1.09	.0	0.33
5	6.1	6.1	.0	.0	0.67	0.80	0.43	1.00
6	2.3	0.6	0.9	0.8	1.00	2.00	0.57	2.30
7	3.2	0.2	2.2	0.8	0.05	1.08	0.81	0.83
8	8.0	4.4	3.2	0.4	0.09	0.41	2.66	0.13
9	6.6	3.0	3.6	.0	1.00	0.33	.00	.00
10	6.0	.0	6.0	.0	1.00	1.17	.00	.00
11	5.2	2.0	3.2	.0	1.00	0.96	6.00	0.60
12	4.0	.0	3.2	0.8	1.00	1.00	0.16	0.50
13	3.6	2.4	1.2	.0	1.00	0.86	6.26	1.10
14	7.3	1.2	6.1	.0	1.00	1.40	.00	0.03
15	8.6	2.0	6.6	.0	1.00	1.69	1.59	1.45
16	10.8	6.8	4.0	.0	1.00	1.88	.00	0.83
17	6.3	.0	4.0	2.3	1.00	2.27	6.52	0.25
18	9.7	3.7	.0	6.0	0.03	2.00	6.84	0.60
19	2.0	1.5	.0	0.5	0.46	2.00	.00	0.18
20	4.8	2.0	2.4	0.4	0.25	2.00	.00	0.45
21	3.3	3.0	.0	0.3	0.83	1.00	13.00	.00
22	5.2	2.2	.0	3.0	0.50	3.33	3.25	0.33
23	8.1	2.9	3.2	2.0	0.95	1.26	.00	0.08
24	5.8	0.4	2.8	2.6	1.00	0.50	1.12	0.18
25	1.4	.0	1.4	.0	1.00	1.00	.00	.00
26	4.4	0.8	3.2	0.4	1.00	2.13	2.22	1.13
27	5.6	1.8	3.0	0.8	1.00	1.32	.00	0.15
28	2.6	.0	2.6	.0	0.45	2.36	4.00	0.45
29	2.4	.0	.0	2.4	-*	.00	1.63	0.03
30	4.4	4.4	.0	.0	0.96	0.42	0.30	.00
31	5.6	4.8	.0	0.8	0.70	1.00	.00	.00
32	3.8	3.8	.0	.0	0.44	1.63	.00	.00
33	4.8	4.8	.0	.0	1.00	2.00	.00	.00
34	6.0	6.0	.0	.0	1.00	1.00	.00	.00
35	8.4	4.4	2.0	2.0	1.00	0.24	.00	0.50
36	4.8	0.8	3.6	0.4	1.00	1.82	3.07	.00
37	2.8	1.2	1.6	.0	1.00	2.00	5.26	.00
38	4.4	0.4	2.4	1.6	1.00	1.36	5.12	0.78
39	4.8	2.4	2.4	.0	.00	.00	11.65	0.03
40	6.4	0.8	4.8	0.8	0.44	1.85	.00	0.80
41	5.6	0.8	3.8	1.0	1.00	1.00	.00	0.88
42	8.8	2.4	1.6	4.8	0.44	2.00	2.48	0.05
43	2.6	.0	2.4	0.2	1.00	2.00	8.00	.00
44	5.2	1.2	3.2	0.8	1.00	2.00	4.63	0.20
45	3.0	0.8	1.0	1.2	1.00	2.00	1.08	0.18
46	2.4	.0	2.4	.0	1.00	2.00	28.71	0.48
47	6.1	4.5	.0	1.6	.00	0.20	.00	.00
48	8.2	6.8	.0	1.4	0.21	.00	2.14	.00
49	9.7	.0	3.4	6.3	1.00	2.38	.00	0.03
50	5.2	2.6	1.4	1.2	1.00	2.00	2.80	0.50
51	2.0	0.8	.0	1.2	.00	.00	.00	.00
52	2.6	0.8	1.2	0.6	0.33	0.33	4.00	0.15
53	1.2	1.2	.0	.0	.00	.00	.00	.00
54	2.8	2.4	.0	0.4	0.50	0.50	1.39	.00
55	3.0	.0	3.0	.0	0.75	1.75	3.03	0.15
56	4.9	1.6	1.9	1.4	1.00	1.27	1.67	1.68
57	0.4	.0	.0	0.4	-	2.00	.00	.00

DATA SET B (cont.)

Var. / Farm No.	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
1	-	-	45.0	96.71	.00	96.71	.00	215.0
2	70.0	106.0	-	489.96	304.96	.00	185.00	162.0
3	-	53.0	78.0	124.89	65.00	59.89	.00	341.0
4	35.0	17.0	75.0	238.29	52.00	160.29	26.00	314.0
5	-	129.0	-	577.5	577.50	.00	.00	245.0
6	25.0	12.0	22.0	142.88	40.00	47.88	55.00	269.0
7	26.5	3.5	45.5	210.72	15.00	139.72	56.00	282.5
8	17.0	54.5	48.5	459.42	243.00	191.42	25.00	396.0
9	-	85.0	125.0	395.44	195.00	200.44	.00	416.0
10	-	-	140.0	296.66	.00	296.66	.00	407.0
11	-	42.5	83.5	420.40	229.00	191.40	.00	259.0
12	24.0	-	56.0	159.98	.00	115.98	44.00	279.0
13	-	46.0	28.0	211.96	152.00	59.96	.00	136.0
14	-	25.5	158.5	451.21	80.00	371.21	.00	904.0
15	-	23.5	94.5	501.30	120.00	381.30	.00	326.0
16	-	118.0	85.0	825.23	525.00	300.23	.00	717.0
17	85.0	-	131.0	399.96	.00	219.96	180.00	367.0
18	163.5	96.0	-	669.15	217.00	.00	452.15	100.5
19	23.0	36.0	-	141.60	101.60	.00	40.00	279.0
20	17.0	44.5	65.5	271.42	125.00	116.42	30.00	184.0
21	11.0	57.0	-	40.32	182.00	.00	28.32	505.0
22	108.0	42.0	-	366.79	124.79	.00	245.00	111.0
23	69.5	56.0	76.0	478.11	173.00	155.11	150.00	368.3
24	85.0	84.0	716.0	415.00	33.00	204.00	178.00	193.0
25	-	-	23.0	71.19	.00	71.19	.00	250.0
26	15.5	16.5	81.5	248.38	49.00	183.38	16.00	296.5
27	31.5	37.5	76.5	368.87	142.00	164.87	62.00	339.5
28	-	-	61.0	166.84	.00	166.84	.00	471.0
29	73.0	-	-	89.44	.00	.00	89.44	749.0
30	-	112.5	-	282.25	282.25	.00	.00	162.5
31	20.0	64.0	-	274.58	215.58	.00	59.00	231.0
32	-	79.0	-	173.05	173.05	.00	.00	137.0
33	-	136.5	-	189.27	189.27	.00	.00	154.5
34	-	50.0	-	177.48	177.48	.00	.00	210.0
35	56.0	52.0	29.0	490.04	233.00	105.04	152.00	577.0
36	18.0	19.0	106.0	259.69	45.00	189.69	25.00	182.0
37	-	19.5	31.5	183.27	63.00	120.27	.00	142.0
38	46.0	5.0	37.0	191.02	18.00	91.02	82.00	226.0
39	-	48.5	59.5	237.99	123.00	114.99	.00	325.0
40	36.0	20.0	148.0	325.86	41.00	241.86	43.00	667.0
41	32.0	15.0	87.0	323.18	55.00	206.18	62.00	298.0
42	222.0	47.0	38.0	460.05	161.00	34.05	265.00	724.0
43	10.0	-	58.0	161.30	.00	148.30	13.00	183.0
44	28.0	14.0	46.0	285.79	65.00	178.79	42.00	333.0
45	30.0	13.5	20.5	181.80	56.00	50.80	75.00	118.0
46	-	-	36.0	111.76	.00	111.76	.00	580.0
47	62.0	93.0	-	317.03	224.00	.00	93.03	121.0
48	60.0	139.0	-	445.50	358.50	.00	87.00	344.0
49	244.0	-	80.0	648.64	.00	213.64	435.00	106.0
50	42.0	49.5	32.5	261.00	175.00	.00	86.00	213.0
51	40.0	20.0	-	134.60	41.60	41.60	.00	176.0
52	17.5	15.0	28.0	173.25	50.00	78.25	45.00	199.5
53	-	9.0	-	69.63	69.63	.00	.00	87.0
54	13.0	42.0	-	114.61	94.61	.00	.20	77.0
55	-	-	82.0	141.68	.00	141.68	.00	337.0
56	42.0	28.5	41.5	309.61	110.00	109.61	90.00	302.0
57	12	-	-	26.12	.00	.00	26.12	134.0

Data Set B

Var.No.		Explanation of Variables
(1)	=	total hectares of cane harvested in 1978
(2)	=	hectares of first ratoons harvested
(3)	=	hectares of older ratoons harvested
(4)	=	hectares of plant cane harvested
(5)	=	proportion of the area of cane harvested in 1977 that was burned in preparation for the 1978 harvest.
(6)	=	the number of full inter-row ploughings
(7)	=	yearly family labour inputs to hand weeding cane in adult equivalent units
(8)	=	yearly application of weedicide in gallons per hectare
(9)	=	bags (50 kgs) of fertiliser applied to plant cane harvested in 1978
(10)	=	bags of fertiliser applied to first ratoons
(11)	=	bags of fertiliser applied to older ratoons
(12)	=	total tonnage of cane sent to the mill in 1978
(13)	=	tonnage of first ratoon cane sent to the mill
(14)	=	tonnage of older ratoon cane sent to the mill
(15)	=	tonnage of plant cane sent to the mill
(16)	=	total number of bags of fertiliser applied to ratoon cane harvested in 1978 in preparation for previous harvests. Bags applied in preparation for the 1978 harvest are counted in (10) and (11).

* The dashes imply that the response is not applicable to the observation. e.g. the Burning Variable (5) is not applicable to the two farms which did not harvest any ratoon cane in 1978.

CHAPTER 8

THE SUBJECTIVE RATE OF TIME DISCOUNT

8.1 Introduction

In Chapter 6 it was shown that the way households allocated time between cane and food production was determined partly by the subjective rate of time discount. Attempts to measure this rate generally have been based on questionning farmers about what their actions would be under a set of hypothetical conditions (Jayasuriya 1977). In this chapter a means of estimating an indicator of time preference from observed behaviour is outlined.

The model from which the indicator is derived is based on the one developed in Chapter 6. It is described in Sections 8.2 to 8.5. The way this model operates is considered in some detail in Sections 8.6 to 8.8 in order to show that it is applicable to situations like Seaqaqa, and that it can be manipulated in a similar manner to the Chapter 6 model. In Section 8.9 the technique for estimating the "revealed rate of time discount" is described.

8.2 Assumptions

The assumptions common to both this and the Chapter 6 model are:

1. The decision making unit is the farm household;
2. Two types of crops are cultivated. Labour applied to the semi-perennial crop, cane, yields income (or a flow of incomes) sometime in the future, while labour allocated to the annual food crops produces a return in the current period;
3. All cane land in the project area was cleared by contractors and the cost was debited to the household's account with the lending agency. Proceeds from the semi-perennial crop were used

to repay this debt, while proceeds from the annual crop were retained by the family. For the first few years of the scheme the lending agency provided a cash loan which could be used for subsistence purposes. Debts so incurred were added to the land clearing debts.

4. No competitive labour market existed. The lending agency would not provide finance for farm labour which could be undertaken by the household, and no other employer was located in the region;
5. Only poor families were allocated blocks in the scheme. They had no cash savings beforehand and were not able to save during the early years. This assumption is consistent with the data on income and expenditure outlined in Chapter 5.

8.3 The Utility Function

It was shown in Chapter 6 that a model in which utility is specified in terms of the consumption of goods and services in the current period alone, would not explain the behaviour of families observed to apply labour to the semi-perennial crop. The effect of time on decision-making had to be incorporated. In Chapter 6, limited time horizons, beyond which households made few attempts to predict the future, were assumed. In that model, families did not consider possible labour inputs in future periods or the returns this labour might produce. This assumption is applicable to the early years of the Seaqaqa scheme where settlers had no previous experience growing cane. Moreover, because no cane had ever been grown in the Seaqaqa region before the scheme commenced, the advice provided by extension officers was based on experience in other areas of Fiji. Families therefore were not in a position to form detailed expectations about their future prospects growing cane in Seaqaqa.

It was, however, assumed that households could assess the present value of the consumption generated by current labour inputs. They would have had to estimate the income stream produced by this labour, their own future consumption patterns, and prices of consumer goods to the end of the income stream. In this chapter it is argued that the general specification of farmer objectives in Chapter 6 was correct, but that the calculations required to estimate present values were probably too complicated for the limited knowledge displayed by settlers during the period of fieldwork. They were likely to have used a simpler rule of thumb.

Hence the objective function is respecified as[1]

$$U_t = U(C_t, D_t, L_t; b), \quad (8.1)$$

where C_t = consumption in period t,

D_t = the level of terminal debt,

L_t = labour input to both crops in time t,

and b = a vector of household characteristics.

All families were in debt at the beginning of the period. Terminal debt is defined as the debt remaining after all cane proceeds accruing from current labour inputs to cane had been received. Given its knowledge limitations, this was the only measurement that the family could estimate reasonably accurately, which would reflect its prospects of future consumption. The greater the terminal debt, the longer the time until income would accrue from cane production, and the lower would be the present value of future consumption prospects. If, however, the family expected to complete its repayments from the proceeds of the next cane harvest ($D_t < 0$), future consumption prospects were bright. Thus the utility function assumes a slightly less complicated decision making process than that

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[1] The usual assumptions about the shape of the function are made -

$U'_C > 0,\ U''_C < 0,\ U'_L < 0,\ U''_L > 0,\ U'_D > 0,\ U''_D < 0.$

envisaged in Chapter 6. Family objectives however, remain the same, and the discussion in Chapter 6 is in no way invalidated.[2]

A side benefit of including debts directly in the utility function is that, as Clements (1976) argued, asset holdings can have non-pecuniary characteristics that yield utility. This appeared to be particularly relevant to Seaqaqa where the undesirability of debt was a common topic of conversation. All but one family claimed that they wished to be free of debt as soon as possible, regardless of the concessional interest rate.

The vector of household characteristics that was included in the utility function could influence the way households traded C_t for D_t, in which case the parameters of the utility function should be specified as a function of b. Alternatively, the concepts of precommitted consumption, precommitted terminal debt, and a maximum aspiration level, all dependent on household characteristics, could be introduced. These were discussed in Chapter 3 and are introduced into the present model in Section 8.6.

8.4 Constraints

To illustrate how the model operates, the simplest possible constraints will be specified.[3] During any agricultural cycle, total time (T) must be allocated between labour (L) and non-labour (Le) activities. Labour time then must be allocated between sugar (L_s) and food production (L_f)

$$T\text{-}Le = L_s + L_f = L. \tag{8.2}$$

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2 Terminal asset models are not new to consumer theory (e.g. Malinvaud 1977), but have not to my knowledge, been used to describe the behaviour of the traditional farmer.

3 See Appendix 3 for the assumptions that are involved.

It is assumed that no family held cash savings, and that in the early years of the scheme, income is sufficient only to cover current consumption expenses. All income earned during the current period therefore is consumed. Given the debt repayment system described earlier,[4]

$$C \equiv Y = p_f G(L_f, B_f, K_f) - p_K(K_f) - R_f + SA + E, \qquad (8.3)$$

where p_f, p_K = prices of food output and capital inputs to food production respectively,

$G(L_f, B_f, K_f)$ = the production function for food, dependent on the inputs of labour (L_f), land (B_f) and capital (K_f),

R_f = the rent of land available for food production, assumed to be fixed,

SA = the subsistence allowance,

E = exogenous income (positive or negative).

Terminal debt is given by

$$D = (1+i)(D_o - p_s F(L_s, K_s, B_s) + hF(L_s, K_s, B_s) + p_K K_s + R_s + SA), \qquad (8.4)$$

where i = the interest rate,

D_o = the level of debt at the beginning of the period,

p_s = the gross price received for cane,

$F(L_s, K_s, B_s)$ = the production function for cane, dependent on the inputs family labour (L_s), capital (K_s) and land (B_s),

$hF(L_s, K_s, B_s)$ = cost of cane harvesting and transportation, a proportion (h) of total cane output,

p_K = the price of capital inputs to cane,

R_s = the rent of land available for cane production, assumed to be fixed,

and SA = the subsistence allowance.

All cane proceeds are retained for debt retirement.

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[4] To ensure clarity of exposition, time subscripts have been omitted.

8.5 Equilibrium

The utility function of equation 8.1 is maximised subject to the constraints of equations 8.2 to 8.4. Because households could not hire labour, a family's demand for labour in cane production, and the supply of family labour, are both determined by the subjective marginal valuation of family labour. In Chapter 3 it was shown that previous empirical studies had failed to explain behaviour satisfactorily in this situation. To estimate the total supply curve of labour from the first order conditions would entail arbitrary assumptions about the marginal valuation of labour for each family. It therefore will be assumed that the allocation of time between labour and non-labour activities is made at the beginning of the period, and is not revised until the beginning of the next period. Like the studies of Benito (1976) and Barnum and Squire (1979), attention then can be focussed on the short term allocation of the fixed quantity of labour between cane and food production.

Within the limits determined by the choice of total labour input, a family can choose various combinations of current consumption and terminal debt. These choices can be expressed as a transformation curve, which, given the debt repayment system, is upward sloping.[5] The slope of the curve is equal to the ratio of the marginal value product of labour in cane production to that in food production.

In Fig. 8.1 the initial level of debt is D_O. Were total labour time to be allocated to food production, current consumption would be C_1 and terminal debt $D_1 = D_O(1+i)$. If one unit of labour then was allocated to cane production, terminal debt would be reduced by $(1+i)(p_s F'_{L_s} - hF'_{L_s})$ - the MVP of labour in cane production - and consumption reduced by $p_f G'_{L_f}$ - the MVP of labour in food production. At the other extreme, if no

[5] The transformation curve is derived in Appendix 4.

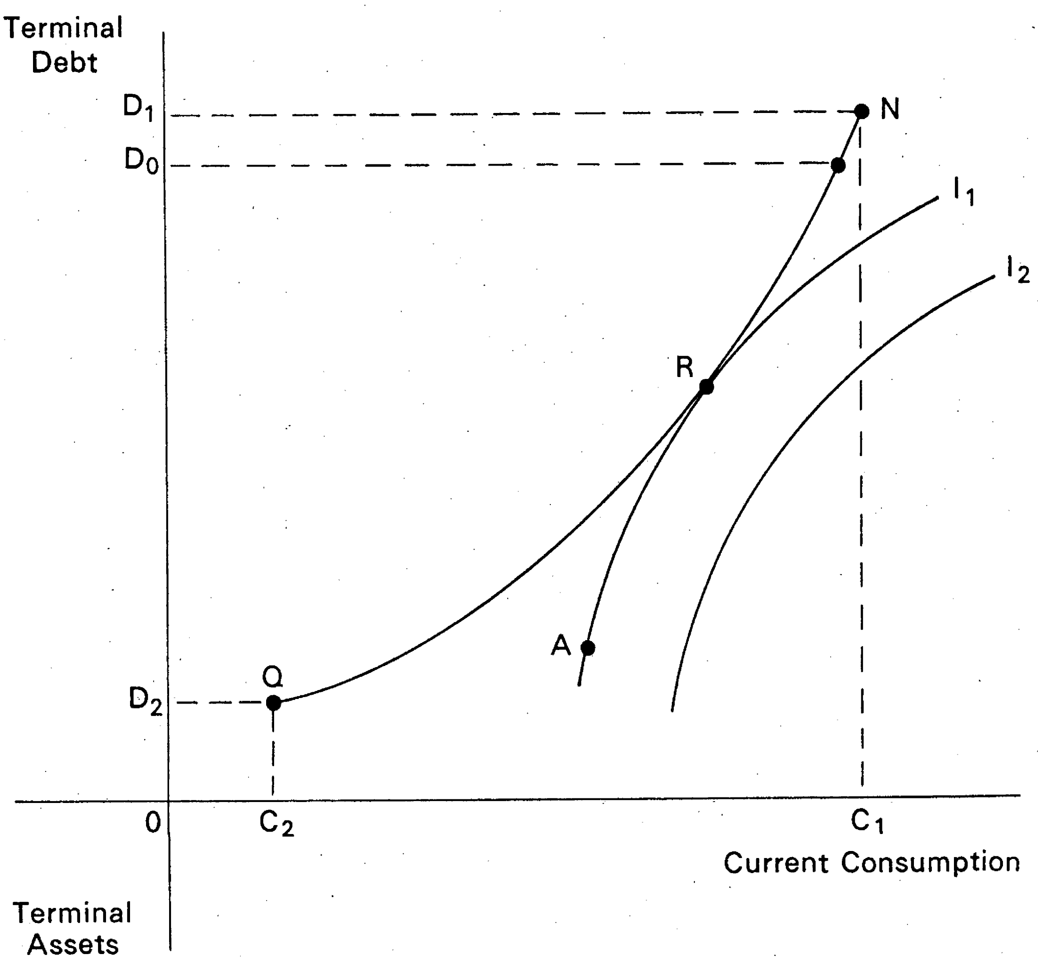


Fig. 8.1

The Short Term Equilibrium of the Farm Household - Terminal Debt Model labour were allocated to food production, terminal debt would be D_2. The level of current consumption would depend on exogenous income and the subsistence allowance, given by the distance OC_2.

A movement from N toward Q implies an increase in the labour input to cane at the expense of labour allocated to food production. Both terminal debt and current consumption decline. Conversely, a movement from Q toward N implies an increase in the labour input to food and a decline in the labour allocated to cane. At point R, the proportion QR/QN of total labour input would have been allocated to food production, and RN/QN allocated to cane cultivation.

Indifference curves, defined in the consumption-terminal debt space for a given total labour supply, are positively sloped $\left(\frac{-U'_C}{U'_D}\right)$. Because $U''_D > o$ and $U''_C < o$ they increase at a decreasing rate. To illustrate, at point A in Fig.8.1, where consumption is low (hence U'_C is high) and the terminal debt is low (U'_D is low), the family would be willing to increase debt by more than one unit to obtain an incremental unit of consumption. However, as the consumption level rises and terminal debt increases, the household will be willing to increase terminal debt by fewer units to obtain the incremental unit of consumption. Indifference curve I_2 represents a higher level of utility than I_1.

Subjective equilibrium is achieved at the point of tangency between the transformation curve and the highest indifference curve. Equilibrium conditions are derived algebraically in Appendix 4.

8.6 The Model Applied to Stage Two Economies

Two of the important characteristics of stage 2 economies identified in Chapter 6, minimum requirements and maximum aspirations for the output of the subsistence sector, can be introduced. In Fig. 8.2, indifference

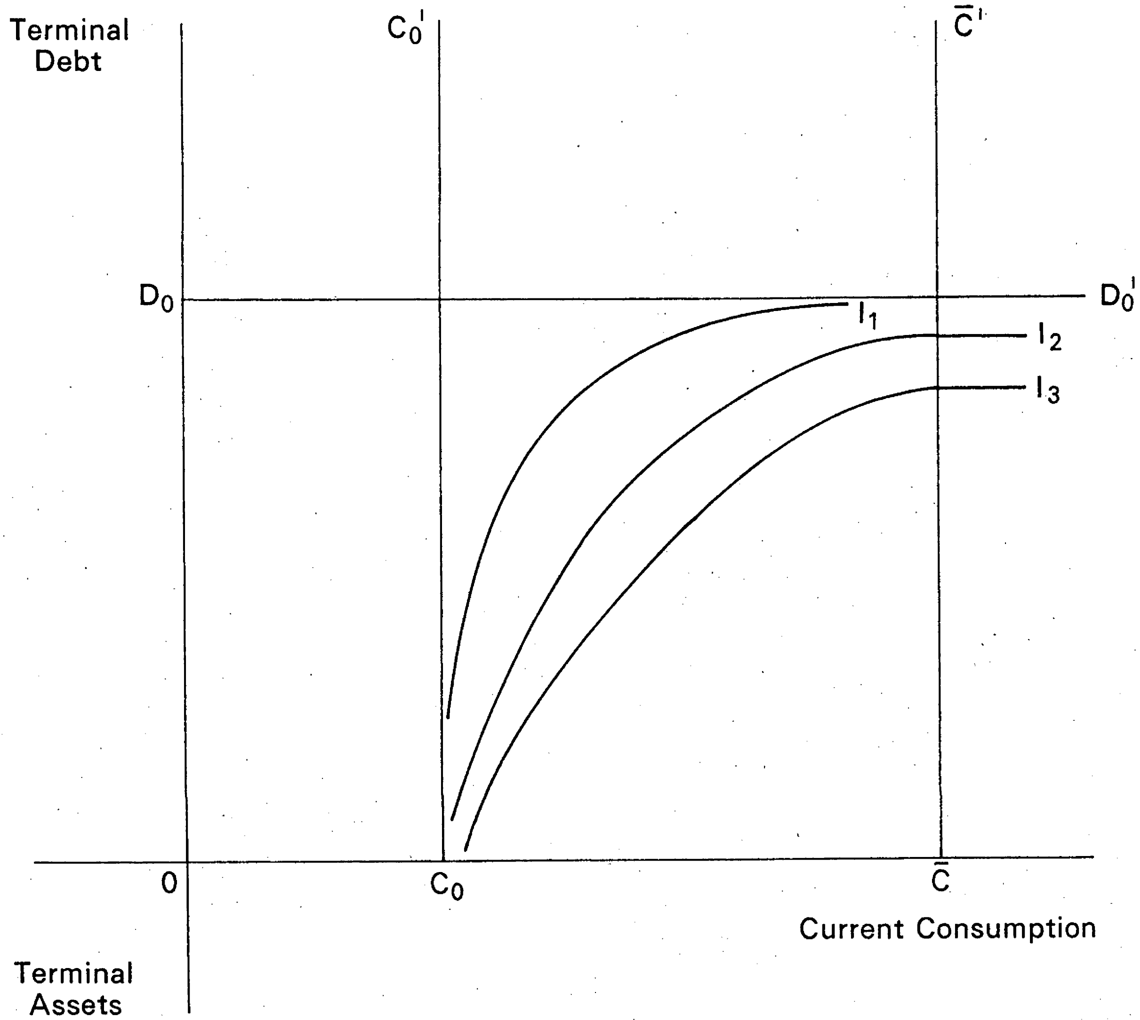


Fig. 8.2

The Impact of Constraints on the Utility Function curves are defined only for consumption levels above the precommitted demand C_oC_o'. They are horizontal beyond $\bar{C}\bar{C}'$ for families which do not aspire to consuming more than $\bar{C}$ in the current period.

The Project Administration's minimum cane farming criterion, expressed as the minimum output required to ensure the family would not be evicted, is represented as a maximum acceptable level of terminal debt. This maximum was a function of the amount of debt facing the family at the beginning of the period. Indifference curves are therefore not defined for terminal debt levels above D_oD_o' in Fig. 8.2.

The other important stage 2 characteristic, non-marketability of the output of the subsistence sector, has not yet been considered. Indeed, a price of "food" was included in the constraints of the current model. If this price was considered as a measure of the way the family valued the output of the subsistence enterprise rather than as a market price, the conceptual difficulties, raised by Fisk (1975), involved in applying the model to a stage 2 economy, are overcome. The practical problems of estimating this "price" however, remain. In fact, it is shown that for other reasons, the model could not be applied to Seaqaqa, and these practical difficulties did not have to be solved. The model however, is also applicable to stage 3 economies where there is a choice between allocating labour to either a semi-perennial or an annual crop. In this case the price of the annual crop is simply the market price.

Thus, the model developed in this chapter covers the same type of situation as the one outlined in Chapter 6. The decision-making described corresponds to the decision to allocate a given total labour input once the minimum requirements specified in Chapter 6 had been satisfied. The present model conceptually is applicable to economies in both stages 2 and 3, although it would be easier to estimate in the latter case.

Many of the influences on behaviour illustrated in Chapter 6 are also relevant to this chapter. To illustrate, some of the influences on the transformation curve are described in the next section, and in Section 8.8 an example of how the model can be used to analyse the official incentive scheme is provided.

8.7 The Transformation Curve

The transformation curve reflects the rate at which the households can trade current income for a reduction in debt, while the indifference map indicates the rate at which the household is just willing to trade at the margin. In the last section it was shown that the indifference map may be constrained by limited aspirations for the food crop, and by minimum requirements in both the monetary and non-monetary sector. In this section, influenceson the transformation curve are considered. They are:

a. A larger initial level of debt will shift the curve upward, but not alter its slope.
b. Households deciding to apply more labour at the beginning of the period would be able to consume more, and to reduce debt by a greater amount, than other families. The transformation curve of two families with identical initial debts and production possibilities are depicted in Fig. 8.3. The first decided on a total labour allocation of D_1N units while the second decided to allocate less - D_2N'. Had both families chosen to allocate no labour to cane cultivation during the period, they would have faced the same terminal debt $D_3 = D_0(1+i)$. However the first family would have consumed a greater amount because it would have invested more labour in food production. Similarly, if both allocated all their labour to cane cultivation, in the absence of exogenous income and a subsistence allowance, both would consume zero units during the present period. The

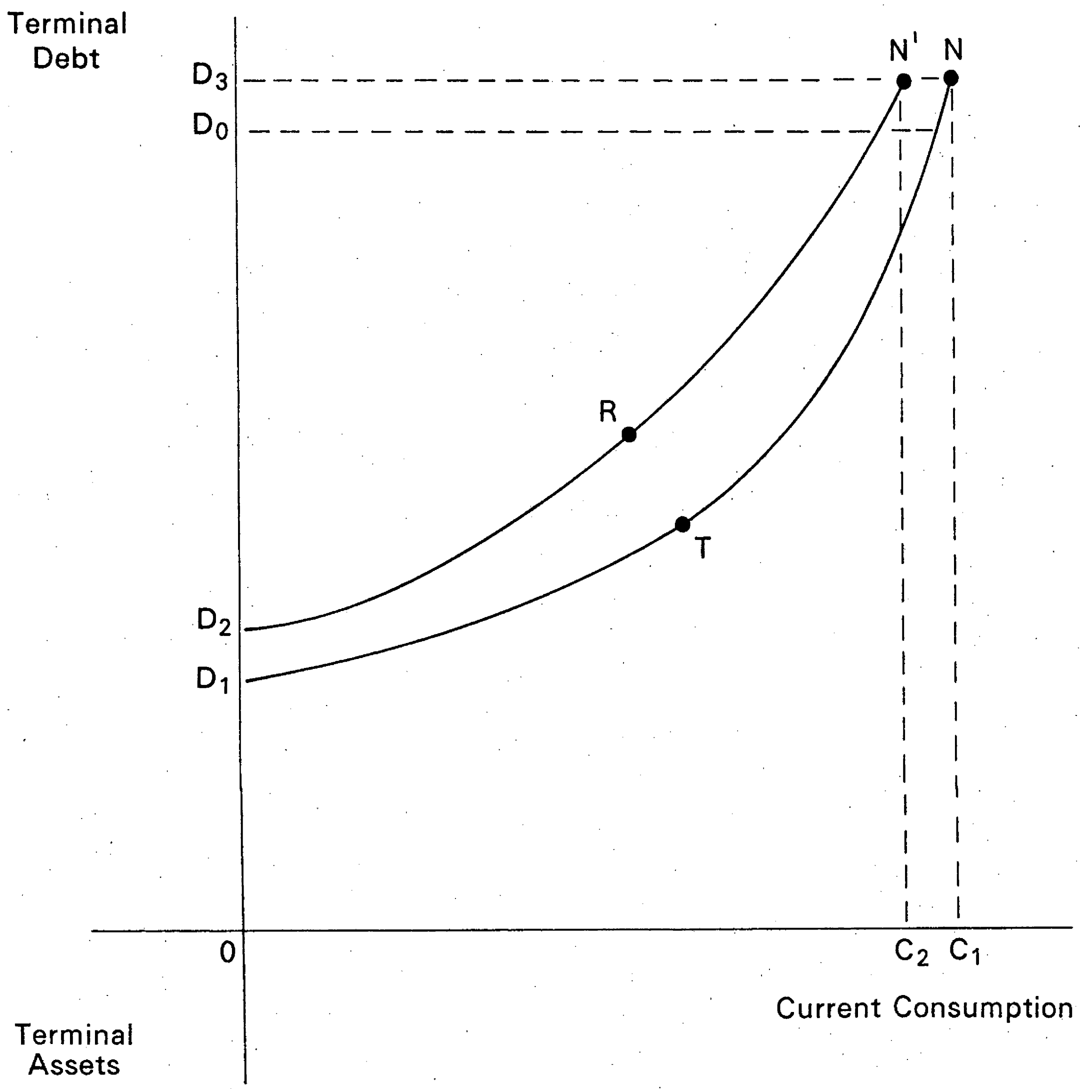


Fig. 8.3

The Effect of Variations in Total Labour Inputs on the Transformation Curve terminal debt of the first family however, would be lower because it would have allocated more labour to the semi-perennial crop.

The relative slopes of the curves are difficult to determine. The slope at D_1 must be lower than that at D_2 given the assumptions of declining MPP's of labour to both activities. To illustrate, the allocation of the first unit of labour to food should increase consumption by the same amount for both families i.e. the horizontal movement along each curve is the same. The increase in labour to food reduces the labour input to cane by one unit in each case. However family one was applying more labour to cane at D_1 than family two was applying at D_2. Accordingly a reduction in the labour input to cane by one unit would increase terminal debt by a greater amount at D_2 than at D_1 and the slope of the transformation curve at D_2 would be lower than that at D_1. Using similar arguments, the slope of the curve at N should be greater than that at N'. In between the two extremes the slopes cannot be determined without information about marginal products.

c. An increase in <u>exogenous income</u> from E_0 to E_1 in Fig. 8.4 shifts the transformation curve horizontally from QN to Q'N'. The slope of the curve does not change. Should exogenous income initially be negative because outlays exceed receipts, QN would originate on the left hand side of the debt axis, illustrated in Fig. 8.5. A small increase in exogenous income which still left total exogenous income negative, would shift the curve to Q'N', while a larger increase would shift it to Q"N".

d. The introduction of a <u>subsistence allowance</u> of SA units allows a family to consume an additional SA

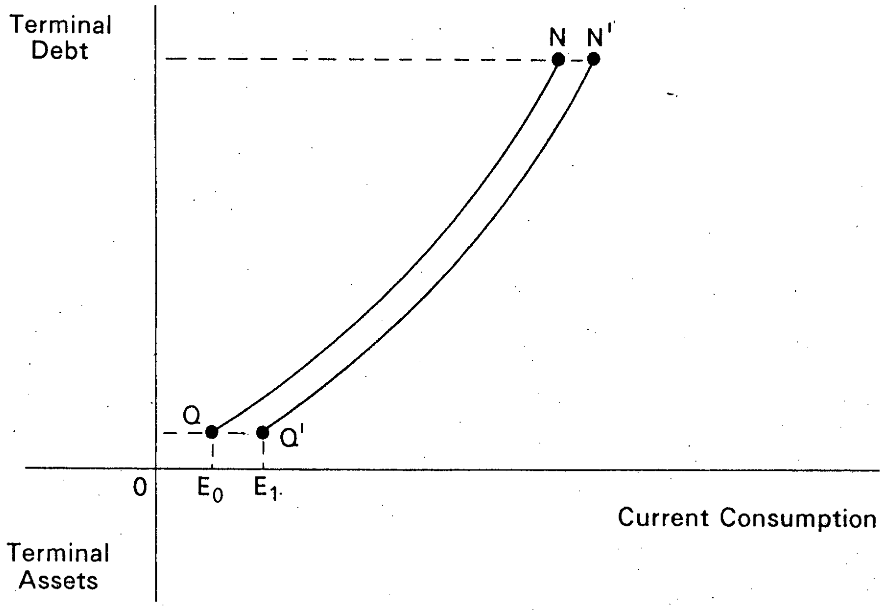


Fig. 8.4

The Effect of Variations in Exogenous Income on the Transformation Curve

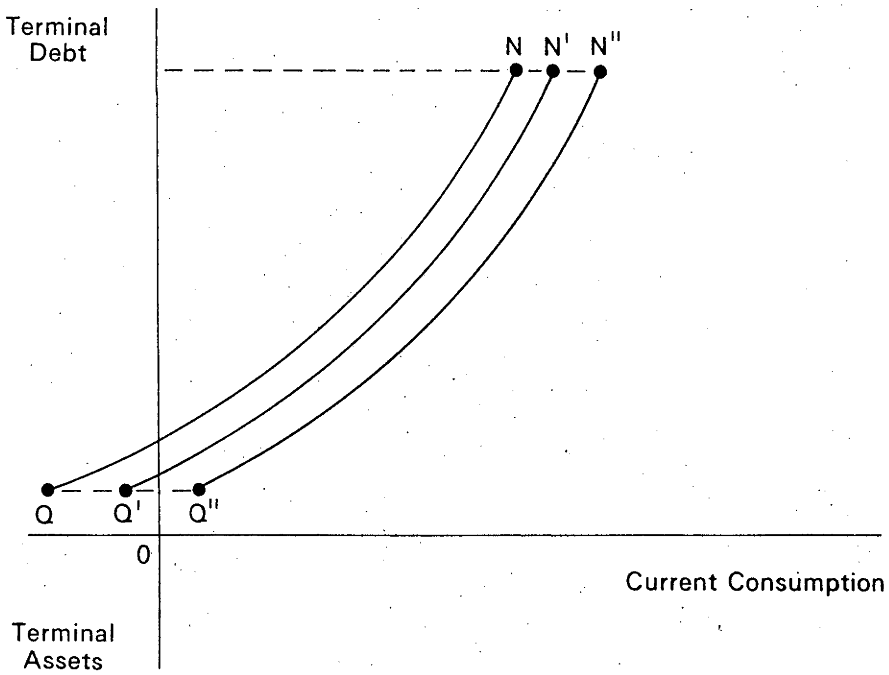


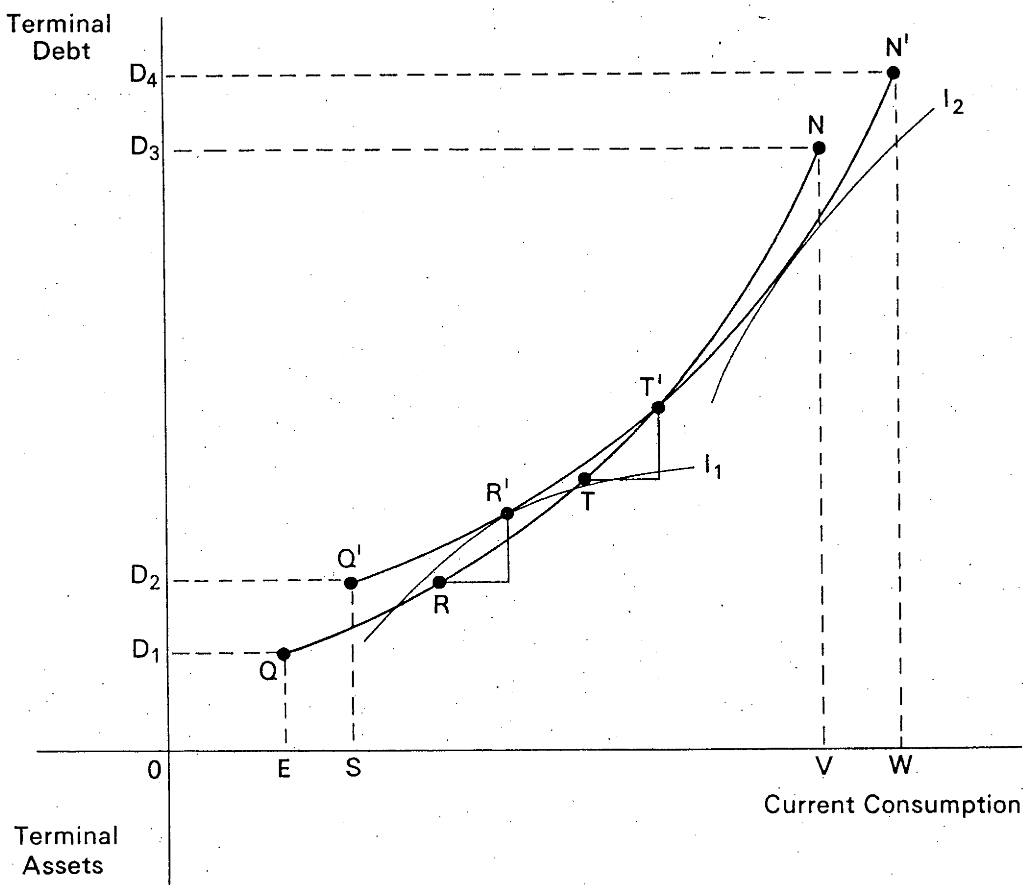
Fig. 8.5

The Transformation Curve with Negative Exogenous Income units for a given labour allocation. The curve therefore shifts horizontally by SA. However, the subsistence allowance is also added to the level of debt. If it is assumed that the entire allowance is payable at the beginning of the period, by the end of the period terminal debt would have increased by SA(1+i). Thus the curve also shifts vertically by this amount.

In Fig. 8.6, a family which initially received no subsistence allowance but received a positive level of exogenous income (OE), faced a transformation curve QN. If at the beginning of the period it then was allowed to borrow ES units for subsistence purposes, the curve would have shifted to Q'N'. The vertical distances between Q' and Q, and between N' and N - D_1D_2 and D_3D_4 respectively - represent the addition to terminal debt caused by the subsistence allowance - (ES)(1+i). The horizontal distances represent the addition to current consumption for a given allocation of labour - ES = VW. The relationships between R' and R, and between T' and T are the same as those described for Q and Q'. Q', R', T', and N' represent identical allocations of the same total labour input between food and cane cultivation i.e. Q'R'/Q'N' = QR/QN for example.

In Seaqaqa, a maximum allowance was set by the lending agency, and families would choose what proportion they wished to utilize. In this case, Q'N' in Fig. 8.6 would represent the maximum permissible subsistence loan, and families could operate anywhere on or between the two curves.

However, the slope of the indifference curves implies that households would not voluntarily choose to operate above the lower envelope QT'N'. There must be an indifference curve to which a family operating at R' could move and increase



<u>Fig. 8.6</u>

<u>The Effect of Variations in the Subsistence Allowance on the Transformation Curve</u>

its utility, for example. Households with preferences depicted by I_2 would choose to utilize the maximum allowance, and reach equilibrium at X. Families represented by indifference curve I_2, would not voluntarily use any of the subsistence loan and would reach equilibrium at point Y.

Where no constraints on behaviour existed, families would use all or none of the subsistence allowance. However, a family, which had decided not to use any of the allowance at the beginning of the period, might suddenly need cash income during the period. In this case it may be forced to operate somewhere between the two transformation curves of Fig. 8.6, and to draw part of the available subsistence loan.

e. Variations in the Marginal Value Product of labour could alter the slope of the curve. Labour's MVP could vary due to differences in either prices (p_s, p_f, i of h) or the Marginal Physical Product of labour (F'_{L_s} or G'_{L_f}).

The MPP of labour would have been higher in fertile than in infertile soil. Alternatively, it would have differed between Indians and Fijians because families of the two racial groups traditionally have cultivated and consumed different staple crops. Indians predominantly grew rice while Fijians mainly cultivated cassava. Assuming the price per unit of output is the same for each crop, if the MPP of labour to rice differs from the MPP of labour to cassava, the transformation curves facing the two groups differ. In Fig. 8.7 QN is the transformation curve for a family cultivating the crop in which the MPP of labour is greater, and QN' that of the other group. The possible terminal debt, if a family's entire labour input is allocated to either cane or food, is the same for both households (OD_1 and OD_2 respectively), but in the latter case, consumption differs by C_2C_1. Differences in the price

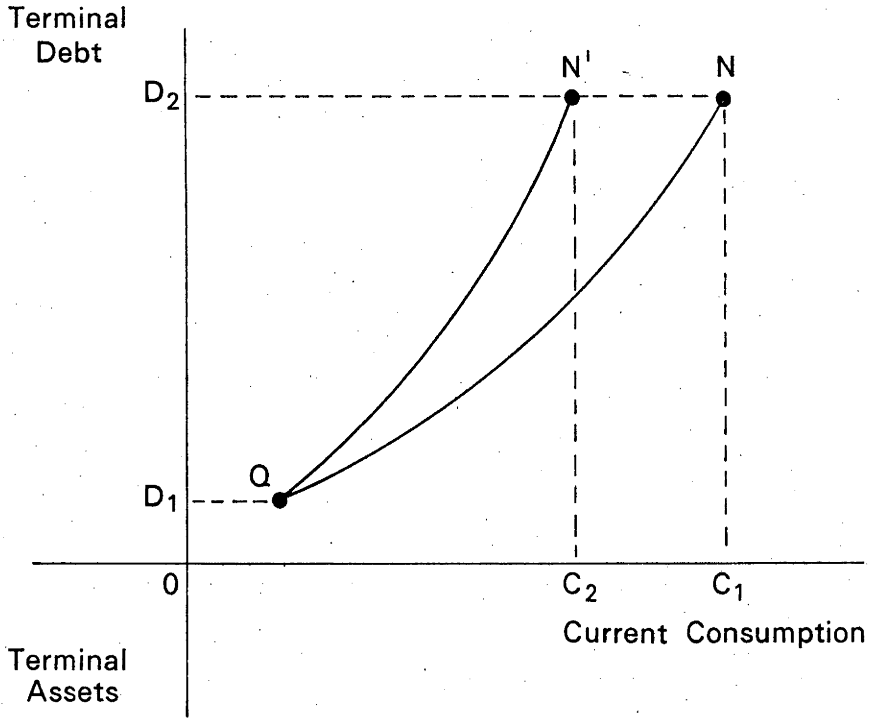


Fig. 8.7

The Effect of Variations in the Marginal Value Product of Subsistence Labour on the Transformation Curve

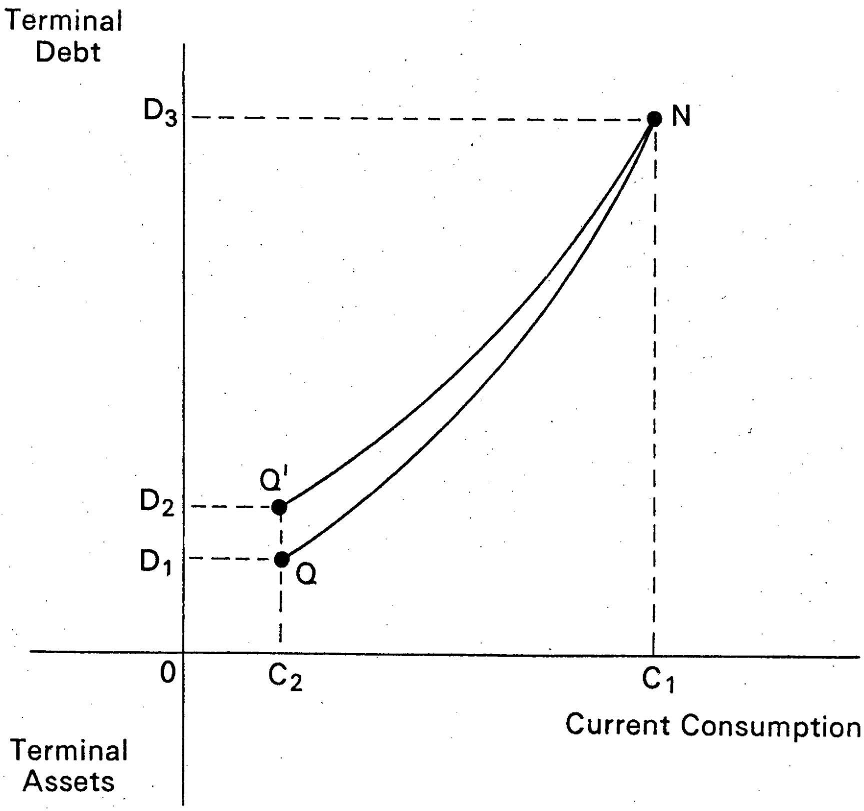


Fig. 8.8

The Effect of Variations in the Marginal Value Product of Labour to cane on the transformation curve (or the subjective valuation) of these crops would affect the transformation curve in a similar manner.

Other prices in the model could also vary. Harvesting and transport costs (h), which depended on the distance from the farm to the market, will be used to illustrate the impact of differences in prices affecting the semi-perennial crop. In Fig. 8.8, QN is the transformation curve for a family with relatively low transport and harvesting costs, while Q'N describes the production possibilities of a household facing higher charges. In this case, it is assumed that the MPP of labour in cane and food production is the same for both families.

If no labour were allocated to cane, both families would face the same terminal debt D_3. If no labour were allocated to food production, the terminal debt of the family with the lower harvesting and transport charges would be D_1, less than that of the other family which would have faced debts of D_2. Consumption would be the same for both.

Thus the observed allocation of labour between cane and food production could vary between families because of differences in any of the factors influencing the transformation curve. To this extent the model is very similar to that outlined in Chapter 6. Theoretically the transformation curve facing each family could be constructed, given its choice of total labour input, as information on debts, prices, and production is usually available. This is discussed further in Section 8.9.

8.8 Policy Implications

To illustrate how the model can be used to analyse the impact of official policy decisions on behaviour, the change in the debt repayment scheme that was introduced after the period of fieldwork will be considered.[6] Before

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6 These implications could be derived algebraically, but to maintain consistency with Chapter 6, a graphical exposition is employed.

the beginning of the 1979 growing season, the FDB announced that it would return a proportion of the proceeds of the next cane harvest to all families, instead of retaining 100% for debt retirement.

The shift in the transformation curve is illustrated in Fig. 8.9, where D_2F and EF are the old and new transformation curves respectively.[7] The numbers on the curves represent hypothetical equal labour inputs to cane. If the household initially is operating to the right of point 3 on curve D_2F, its labour input to cane would increase under the new system - the household would not operate on the backward bending part of EF. However, if the initial point of subjective equilibrium was to the left of point 3, no conclusions can be made without knowledge of the utility function.

In general the impact of policy changes on the short term allocation of labour cannot be estimated precisely without knowledge of utility functions, and these cannot be derived from observed behaviour. The advantage of the model is that it allows an indicator of the subjective rate of time preference to be calculated for each household without the need to specify utility in functional form. Details are provided in the next section.

8.9 The Rate of Time Discount

The slope of an indifference curve represents the rate at which a household is willing to increase its terminal debt at the margin to obtain an extra unit of current consumption. Because families used terminal debt as an indicator of their future consumption prospects, the slope of the indifference curve also reveals the rate at which the family is willing to trade future for current consumption. This rate of time preference cannot be estimated directly without knowledge of utility functions.

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[7] Reasons why the new transformation curve bends backwards are found in Appendix 5.

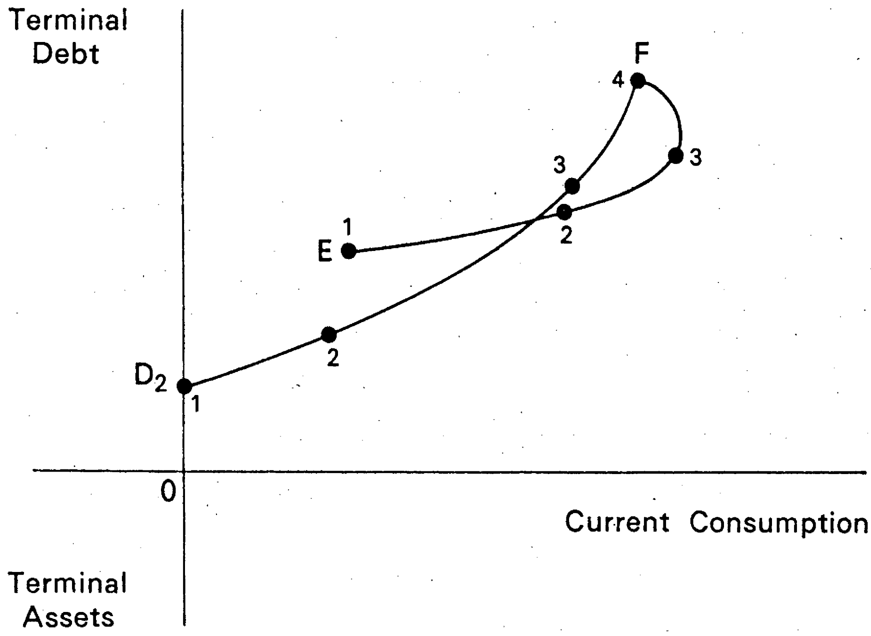

Fig. 8.9

The Impact of a Change in the Debt Repayment System on the Transformation Curve

However, the actual division of labour between cane and and food crops, and the levels of current consumption and terminal debt that this labour provided, were observed for each household during the period of fieldwork. If the transformation curve could be constructed, it would be possible to calculate its slope at the point where the family was observed to operate. Provided it can be assumed that the family operated at this point from choice, i.e. that they saw this to be their preferred position, this slope equals the slope of the indifference curve at what they see to be the optimal point. A rate of time preference is therefore revealed.

The slope of the transformation curve depends crucially on the MPP of current labour inputs to cane, and it was shown in Chapter 7 that the lack of certain time series data on cane production in Fiji prevented this from being estimated. Hence it was not possible to calculate the revealed rate of time preference for the Seaqaqa settlers on this occasion. The technique is, however, applicable to many situations where there is a choice between a semi-perennial and an annual crop, provided only that the production functions can be specified. Although debt proved to be a proxy for future consumption possibilities in this study, the model could be generalised to include future consumption directly in the utility function in the manner, perhaps, of Chapter 6. The technique therefore warrants further investigation.

8.10 Conclusions

The model developed in this chapter incorporated the same farmer objectives as those assumed in Chapter 6, but introduced a simpler method of estimating future consumption possibilities. The model was considered in some detail to illustrate that it was (a) of similar application to, and (b) could be manipulated in a similar manner to the model of Chapter 6.

It was not the purpose of this chapter to consider the impact of the official incentive scheme that was discussed earlier, and no attempt was made to incorporate the data of Chapter 5. The model was designed to illustrate how an indicator of the subjective rate of time discount could be constructed from observed behaviour, something which had not previously been done. Although insufficient data were available to derive a production function for cane cultivation in Fiji, and this prevented the calculations from being completed, the technique is worthy of further attention.

CHAPTER 9

CONCLUSIONS

In this thesis an attempt was made to identify factors influencing the response of traditional farmers to economic incentive, using the Seaqaqa Sugar Development Project as a case study. Summaries were included at the end of each chapter and will not be repeated here. Only conclusions which are thought to be particularly important are considered in this chapter.

A majority of Seaqaqa settlers were clearly in stage 2 before the scheme began, but by the period of fieldwork, they were more commercially oriented. Some of this development could have been due to the official set of incentives and disincentives introduced to encourage participation in cane farming.

The impact of these incentives on family labour inputs to cane was considered using a neo-classical model of family behaviour developed in Chapter 6. Some, including the extra length of the leases, the concessional interest rates, the FSC extension services, and the minimum cane farming criteria imposed by the Administration, were likely to have increased labour inputs to the monetary enterprise. However, some could have discouraged commitment to the cash crop. Examples were the debt repayment system, which prevented families from obtaining any cash income from cane until after their fourth harvest, and the subsistence allowance. It was suggested that a system of wage payments would have been superior to the subsistence loan - it would have provided households with a cash allowance and encouraged the application of labour to cane. It is too late to implement this recommendation in Seaqaqa as the subsistence allowance was to be phased out by the fourth harvest. However, in other schemes, wage payments for certain recommended family work should be considered as a possible alternative to a subsistence allowance.

The impact of the FSC's recommended farming practices on behaviour was difficult to analyse in the absence of data allowing the multi-period production function for cane to be estimated. The model of Chapter 6 showed that if families perceived these farming practices to be ineffective, they would allocate little labour to cane, regardless of how important the recommendations actually were. The data that were collected suggested that, after only a few years, there were wide variations in the extent to which the recommendations were followed. It therefore is important that a study be undertaken to test the efficacy of these farming practices.

This conclusion can be highlighted using the recommendation that trash should not be burned as an example. Extension officers believed that trash should be left on the ground to improve moisture retention in the soil and to prevent excessive weed growth. Data in Chapter 7 suggested that there could have been a strong negative correlation between burning and yields, which supported this recommendation. One official in fact believed that if cane had been planted correctly, and if the trash were retained, inter-row ploughing could be abandoned. He had conducted experiments on a very limited scale which supported his hypothesis. This evidence is not conclusive, but it illustrates the importance of a thorough study of the recommended farming practices. If burning can have such a strong effect on yield, it is important that steps be taken to arrest the apparently increasing tendency for farmers to burn trash. The impact of these recommendations could be tested to a limited extent at the FSC Experimental Station at Seaqaqa. However, variations in their impact under a wide range of conditions could best be examined with the aid of the multi-period production function study. The type of data which are required in addition to those collected for this thesis, were outlined in Chapter 7.

However, it was particularly surprising that no consistent correlation between yields and fertiliser inputs was found, even though an indicator of past fertiliser applications was available. It was suggested that perhaps the official fertiliser recommendation was too general for the range of conditions facing farmers in Seaqaqa. It might therefore be useful to analyse leaf samples from Seaqaqa farms, and to derive a set of farm-specific, or at last area-specific, fertiliser recommendations. The FSC Research Station in Lautoka is well equipped to undertake this task.

Even though the evidence suggested that the official system of incentives could have influenced families in Seaqaqa to become more committed to the cash sector, a striking feature to emerge from the study was that observed labour inputs were extremely low. If these data are correct, there clearly is room for increased labour inputs to productive activity, including cane production.

Variations in the response to economic incentives between households with different socio-economic characteristics were noted. Attention will be focussed on the Indian-Fijian dichotomy, which has long been a major source of contention in Fiji. Perhaps due to the system of land tenure, Indians proved more eager than Fijians to obtain blocks in the project in the early years. When Fijians began to apply for blocks, they appeared willing to accumulate larger debts for farm development than Indians. During the period of fieldwork, the average total labour input to the farm showed no significant differences between the two races, but Indians allocated a greater proportion of this labour to cane cultivation. Despite this, Indians did not achieve a significantly higher yield, something which could have been due to the greater tendency of Indians to burn trash, or to the fact that Indians applied this additional labour to activities which would not affect yields until sometime in the future.

Fijian families also expected higher terminal debts than Indians. This could have been influenced by three factors. Firstly, Fijians on average had been cultivating cane in Seaqaqa for less time than Indians, and had therefore completed fewer harvests. The average Indian family had been able to repay its loan with the proceeds of of more harvests than the average Fijian family. This trend was re-enforced by the second factor, the higher labour inputs Indians applied to the cash sector. Finally, Fijians in general had been granted larger loans than Indians in the first place.

It was shown that these differences in performance were consistent with the hypothesis that Indians discounted the future less heavily than Fijians. A method of testing this hypothesis was developed in Chapter 8, but the indicator of time preference could not be constructed for the Seaqaqa households - a reliable production function for cane in Seaqaqa could not be estimated with the data that could be collected in only one year of fieldwork. However, a method of calculating this indicator from observed behaviour has not previously been developed and the technique derived in Chapter 8 should be useful in many applications in the future.

The responses of households who had migrated specifically to become involved in the project were found to be different, in certain important respects, from those households who had been living in the Seaqaqa area before the project started. The average local resident household planted less land, and spent less time in all "productive" pursuits than the average migrant household. Some of the former appeared to be less highly motivated than migrant households. This possibly was because it was politically more difficult to evict local residents who had performed poorly than migrants.

Low levels of motivation could also have been associated with limited aspirations for market goods. If this were the case, some of the incentives designed to increase family labour inputs to cane could have had a perverse effect. For example, a rise in the MPP of labour used in cane production could have caused those families that had limited desires for market goods to reduce their labour inputs to the cash sector. Other illustrations were provided in Chapter 6. An important conclusion is that all families do not necessarily react to a given policy in the same manner. It might therefore be helpful to design a set of incentives specifically for the local residents who were performing poorly. The form these incentives should take might be identified if a separate study of these families is undertaken.

Some of the findings have implications for the criteria used in the selection of settlers for later schemes. If the major aim of a project is to increase output, the evidence from Seaqaqa suggests that the proportion of local residents should not be high. However, as the Seaqaqa experience showed, it is difficult to impose selection criteria on traditional land owners in Fiji, and this recommendation might be politically infeasible. This would be particularly so in areas where the man-land ratio was higher than in Seaqaqa.

Another implication for settler selection emerged from Chapter 4 where it was shown that absentee leaseholders, and those in full time wage employment, were more likely to be classified unsatisfactory by the Project Administration. For practical reasons these households had to be omitted from the sample, and the results of a small separate study of these families could not be reported in this thesis. However, a tentative conclusion is that many of these people would have been better excluded from the scheme.

There are however, opposing views. Some of this special group of leaseholders were highly educated and operated model farms. They claimed that they provided an example which less well educated families, less able to assimilate the knowledge provided by the Administration, could follow. Whether these benefits were real, and if so, whether they outweighed the costs imposed by the higher proportion of unsatisfactory farmers, is not clear. In any assessment, however, it must be remembered that allocating blocks to employed people violated the aim of helping the poorer members of the community. Other implications to emerge from the study, of relevance to Seaqaqa and to other schemes, were discussed in Chapter 6.

The study has had numerous shortcomings, many of which were discussed in the individual chapter summaries. Two of the most important will be restated. Firstly, the models that were used fell short of the ideal specification outlined in Chapter 3. They did however, appear to be appropriate both to the stage of commercialisation observed in Seaqaqa, and to the limited ability of families to predict the future. Secondly, the lack of time series data on certain inputs to cane cultivation in Fiji, prevented the MPP of labour in cane from being estimated, the data that could be collected being inadequate for this purpose. This in itself had an advantage. It identified an important area in which agricultural research in Fiji, and into sugar cane, had been deficient.

Despite these problems, four main contributions, over and above the policy conclusions outlined earlier were made in this study. The method of constructing the indicator of time preference has been mentioned already. The second concerned the effectiveness of the survey design described in Chapter 4. It aimed to collect the maximum amount of information from the largest possible sample with the minimum disruption to the informants' lives. The checks that were available indicated that the survey method produced reliable information on the whole. Certainly the quality of the information improved as rapport with families increased. This emphasized the fact that much of the information collected in short interviews where there is no "follow-up" process, such as those typically conducted by some government departments in Fiji, must be inaccurate. This type of survey design is worth considering in other areas where there are resource limitations on data collection.

Thirdly a means of estimating easily interpreted forms of the production function in the presence of zero inputs was suggested in Chapter 7. An attempt was made to illustrate the technique using Seaqaqa data, but in keeping with the estimates of the single period production function, the results were poor. This was attributed to the lack of information about inputs applied to cane in previous years.

Finally much of the data that were collected had not been available previously. Much has been said about the variations in the economic behaviour of Fijians and Indians, for example, but before this research few facts about their responses in Seaqaqa were known. Average outputs and yields were known to have differed little between the groups in 1977 and 1978, but differences in labour inputs, and in their compliance with FSC recommendations, had not been documented.[1] The data collected for this thesis therefore provide a useful basis for future work.

Many avenues for possible further research suggest themselves. Most importantly for Seaqaqa, and perhaps Fiji, is the estimation of a production function for cane along the lines suggested in Chapter 7. This would enable the efficacy of the recommended farming practices away from the research stations to be tested. Of a more general nature, both the modification to multiplicative production functions, and the indicator of time preference, warrant further consideration.

1

	Output (Tonnes)		Yield (Tonne per Hectare)	
	1977	1978	1977	1978
Fijians	219.9	255.6	54.98	58.62
Indians	198.5	259.6	53.94	61.23

Source: Project Manager's Annual Report, 1978.

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APPENDIX 1

QUESTIONNAIRES

Part A - Questionnaire used at the Preliminary Visit

Note: This interview was conducted by the author in all cases. The questions, therefore, were open ended, serving as notes rather than as a formal statement of the required information.

Obtain details of the following:-

1. Name, age, sex and educational experience of all people who slept at the farm last night. Identify household head/leaseholder. What is the relationship between all people and head?
2. People who do not usually live on the farm? How long have they stayed there?
3. People who usually live on the farm, but who were absent last night (same details as question 1).
4. Wage labour experience of adults normally resident on the farm.
5. Commercial farming experience of adults normally resident on farm - how long, crop/animal, where, lease conditions etc.
6. Children normally resident on farm still at school, including which school, boarding or not, school fees paid this year.
7. People normally resident on farm who are members of cutting gangs presently, including whether they are sirdars, and how much cane each is contracted to cut.
8. Place of residence immediately before they obtained this farm. Where is their "home" if applicable?
9. Cane planted on the farm, including area, variety, age, and whether it will be/has been cut this year.
10. Cane that has been cut this year.
11. Preparations for the next harvest that have begun on cane that has been cut this year, including fertiliser applications, interrow ploughing, and spraying.

12. Other crops that are growing - measure or count.

13. Animals owned, including age, when purchased, approximate cost.

14. Equipment owned (same details as question 13).

15. Price per tonne they expect to receive for this and the subsequent cane harvests.

16. For Indians, the 1977 rice harvest, including area transplanted, drilled or hand planted; number of bags harvested; quantity sold, retained for seed, given away and held in stock; fertiliser applied at all stages; and general details of how cultivation was carried out.

17. General information which may be relevant - e.g. number and type of buildings, obvious consumer durables, English speaking ability, farmers subjective evaluation of the scheme, any obvious hostility or suspicion.

Part B - Questionnaire asked over the first four days of each intensive visit

Note: On the first visit, the phrase "since the last visit" was replaced by "since the cane harvest began". This questionnaire was administered sometimes by the author and sometimes by the helpers.

1. Since the last visit, has anyone normally resident on the farm been too sick to work? YES/NO

   If YES, list the following for each person who was too sick to work:

   a. Name
   b. How many days was this person too sick to work?
   c. On how many days did this person visit outpatients?
   d. For how many days was this person in hospital?

2. Since the last visit, has anyone normally resident on the farm stopped working for any other reason? YES/NO

   If YES, for each person who did not work list:

   a. Name
   b. On how many days did this person not work?
   c. Why did this person not work?

3. Since the last visit, has anyone who does not normally live on the farm helped with the work on the farm? Do <u>not</u> include a cutting gang.
YES/NO

If YES, <u>for each person</u> list:

a. What jobs did this person do?
b. How many hours did <u>each job</u> take?
c. How much money was this person paid, if any?
d. What other gifts was this person given?
e. Will this person be given any more money or gifts?

4. Has the household begun to plough its rice fields in preparation for the next harvest? YES/NO

If YES, list:

a. How many acres have been ploughed <u>once</u> -
   with bulls
   with horse
   with tractor?
b. How many acres have been ploughed twice?
c. For about how many hours have the rice fields been ploughed -
   with bulls
   with horse
   with tractor?
d. How many acres did the family hire a tractor to plough?
e. How much money was paid to the tractor owner?

5. a. How many acres of cane has been cut this harvest?
b. In how many acres was the trash burned?

<u>Cultivation</u>

c. How many acres of ratoon have been cultivated since the last visit?
d. What equipment was used for this cultivation?
e. How many acres were cultivated by a hired tractor?
f. How much <u>cash</u> was paid to the tractor owner, if any?

<u>Fertiliser</u>

g. How many applications of fertiliser have been made to ratoon cane since the last visit?
h. For <u>each application</u> list:
   - how many bags of superphosphate were applied this application?
   - how many bags of sulphate of ammonia were applied this application?
   - how many bags of potash were applied this application?
   - how many acres were fertilised this application?

6. Has the family sprayed any ratoon cane since the last visit? YES/NO

   If YES, how much spray was applied - Ansulox 40
   - Actril D
   - Gramoxone
   - Other?

7. Has the family done any work on their plant cane since the last visit? YES/NO

   If YES, list:

   a. How much land was cleared for planting?
   b. How much land was planted?
   c. How much fertiliser was applied to plant cane -
      super
      S.A.
      potash?
   d. How many times was the plant cane cultivated -
      with bulls
      horse
      tractor?
   e. How much weedicide was applied to plant cane -
      Asulox 40
      Actril D
      Gramoxone
      Other?

8. Has the family planted any crops since the last visit? YES/NO

   If YES, for each crop that was planted, list:

   a. What crop was planted?
   b. What area/how many of this crop was planted?

9. Since the last visit, has the family applied any fertiliser or weedicide to crops other than cane? YES/NO

   If YES, for each crop list:

   a. What area/how many of this crop was fertilised?
   b. How much fertiliser was applied to this crop -
      super
      S.A.
      potash?
   c. What area/how many of this crop was sprayed?
   d. How much weedicide was applied to this crop -
      Ansulox 40
      Actril D
      Gramoxone
      Other?

10. Since the last visit, has the family hired or borrowed any equipment? YES/NO

    If YES,

    a. What was hired or borrowed?

    For each item list:

10. Since the last visit, has the family hired or borrowed any equipment? YES/NO

If YES,

a. What was hired or borrowed?

For <u>each item</u> list:

b. What was this equipment used for?
c. For how many hours was this equipment used?
d. How much money was paid for this equipment?
e. What other gifts were made in exchange for this equipment?

11. Since the last visit, has the family tried to hire or borrow any equipment, but found that it was not available? YES/NO

If YES, list:

a. What did he try to hire or borrow?
b. For <u>each item</u>, what did they wish to use it for?

12. Has any of the family's farm equipment broken down since the last visit? YES/NO

If YES, list:

a. What equipment broke down?
b. For <u>each item</u>, how many days was it broken?
c. For <u>each item</u>, has it been repaired?
d. For <u>each item</u>, how much did it cost to repair?

13. Since the last visit, has the family purchased any fertiliser or weedicide? YES/NO

If YES, for <u>each purchase</u> list:

a. What was bought?
b. From whom was it purchased?
c. If it was not purchased from the FSC, how much did it cost?

14. Since the last visit, has the family been able to obtain as much fertiliser and weedicide as it wished? YES/NO

If <u>NO</u>, list:

a. What was unavailable?
b. Has it been obtained yet?

15. How many times have Extension Officers visited the farm since the last time we visited
- FSC Farm Advisors
- MAFF Extension Officers?

16. How many times has the farmer gone to seek advice about the farm since the last visit
- to the FSC Depot
- to the MAFF?

17. Has the family sold any goods or crops since the last visit? YES/NO

    If YES, for each sale list:

    a. What goods or crops were sold?
    b. Where was this sale made?
    c. How much money was received for this sale?

18. Has the family given away any goods or crops since the last visit? YES/NO

    If YES, list:

    a. What was given away?
    b. Why was this given away?

19. Did anyone who usually lives on the farm attend any ceremonies or festivals since the last visit? YES/NO

    If YES, for each ceremoney or festival list:

    a. What ceremony or festival?
    b. Which family members attended this ceremony or festival?
    c. Where did it take place?
    d. For how long did it last?
    e. What gifts (money, goods or crops) did the family make?

20. Has anyone who usually lives on the farm looked for a wage job since the last visit? YES/NO

    If YES, for each person list:

    a. Who looked for a job?
    b. Did they find one?

Part C - Questionnaire asked on each of days 5 to 11 of intensive visits

Note: If the questionnaire was administered in the morning, questions were asked about the previous day's activity. If it was administered in the evening, they were asked about activity undertaken during the current day.

1. For everyone who did any work on the farm, list:

   a. Name
   b. What jobs did this person do?
   c. How long did each job take?

2. Did anyone who usually lives on the farm do any work off the farm? YES/NO

If YES, for <u>each person</u> list:

a. Name
b. What work did they do?
c. Where was this work done?
d. How long did it take?
e. What money, goods or crops were they paid for this work?
f. How much more money, goods or crops will they be paid for this work?

3. How many women helped to prepare food, wash clothes and clean the compound?

   b. How long did these jobs take?

4. Did any men or boys help collect firewood, haul water, clean the compound or any other household tasks? YES/NO

   If YES, for <u>each person</u> list:

   a. Name
   b. What tasks did this person do?
   c. How long did <u>each job</u> take?

5. Was any of the family's equipment, machinery or animals used? YES/NO

   If YES, for <u>each item</u> that was used list:

   a. What equipment, machinery or animals were used?
   b. What was this item used for?
   c. Where was this item used?
   d. For how many hours was this item used?

6. Were any crops harvested (<u>not</u> cane)? YES/NO

   If YES, for <u>each crop</u> that was harvested list:

   a. What crop was harvested?
   b. How much was harvested?
   c. How much was given away?
   d. How much was sold?

7. Were any animals killed? YES/NO

   If YES, list:

   a. What animals were killed?
   b. How much was given away?
   c. How much was sold?

8. Did anyone who usually lives on the farm buy anything today (with cash or on credit)? YES/NO

   If YES, list:

   a. What items were bought?
   b. What was the total cost of these goods?
   c. Which of these goods were purchased on credit?

9. Did anyone who usually lives on the farm pay any money for any other reason (tax, rent, gift, fares, repayment of loan, paying shop debts, hiring animals or equipment, religious offerings, festivals, etc.)? YES/NO

If YES, for each amount of money list:

a. How much money was paid?
b. Why was this money paid?

10. Did anyone who usually lives on the farm give away any goods or crops for any reason? YES/NO

If YES, for each gift list:

a. What goods or crops were given away?
b. Why were these gifts made?

11. Did anyone who usually lives on the farm sell anything? YES/NO

If YES, for each sale list:

a. What was sold?
b. How much money was received for this sale?
c. How much money will be received for this sale?

12. Did anyone who usually lives on the farm receive any money for any other reason (including wages)? YES/NO

If YES, for each amount of money list:

a. How much money was received?
b. Why was this money received?

13. Did anyone who usually lives on the farm receive any gifts? YES/NO

If YES, for each gift list:

a. What gifts were received?
b. Why was this gift made?

14. Did anyone who does not usually live at the farm spend last night at the farm? YES/NO

If YES, list:

a. How many visitors, what were their sexes and approximate ages?

15. Did anyone who usually lives on the farm spend last night away from the farm? YES/NO

If YES, list:

a. Names
b. Where did these people spend the night?

16. How many meals were provided for people who do not usually live on the farm
    - for people over the age of 13 years?
    - for people younger than 13 years?

17. Was anyone who usually lives on the farm given a meal by people who do not live on the farm? YES/NO

    If YES, list:

    a. Who was given a meal?
    b. How many meals was each person given?

18. Did anyone who usually lives on the farm go on a journey (to the depot, health centre, Labasa, visiting etc.)? YES/NO

    If YES, for each person who went on a journey list:

    a. Name
    b. Where did this person go?
    c. For how long were they away from the farm?
    d. Why was this journey made?

Part D - Questionnaire administered on the final day of each intensive interview

1. If the family has planted any crops during the last week, list the following details for each crop:

    a. What crop was planted?
    b. What area/how much of this crop was planted during the week?
    c. How much more of this crop does the family intend to plant?

2. If the family has been preparing for planting during the last week, but has not yet planted, list:

    a. How much land was prepared for planting during the last week?
    b. What type of preparation (drilling, disc ploughing, bull ploughing, rotovating etc.)?
    c. What crop(s) will be planted?
    d. When will the land be planted?

3. If the family has applied any fertiliser or weedicide during the past week, list: (Take note of question 1)

    a. To what crops was fertiliser or weedicide applied?
    b. For each crop, how much was applied?
        - super
        - s.a.
        - potash
        - Asulox 40
        - Actril D
        - Gramoxone
        - Other

c. To what area/how much of this crop was the fertiliser applied?
d. To what area/how much of this crop was the weedicide applied?

4. If any seed cane has been cut on the farm <u>during the last week</u>, list:

a. How many tonnes were cut?
b. How many more tonnes will be cut?
c. How much of this seed cane was planted on this farm?
d. How much of this seed cane was sold?

5. Has anyone who does not usually live on the farm helped in the work on the farm <u>during the last week</u>? YES/NO

If YES, list:

a. How much money have they received for this work?
b. What other gifts of goods or crops have they received for this work?
c. What other gifts (goods, crops or money) will these people be paid for this work?

6. If anyone who usually lives on the farm has worked off the farm <u>during the last week</u>, for each person list:

a. Name
b. How much money was this person paid for this work?
c. What gifts of goods or money was the person paid for this work?
d. What other payment (goods, crops, or money) will be received for this work?

7. How many times did Extension Officers visit the farm <u>during the last week</u>?
- FSC Extension Officers?
- MAFF Extension Officers?

8. How many times did the farmer visit the Depot to seek advice <u>during the last week</u>?
- the FSC depot?
- the MAFF?

9. If anyone who usually lives on the farm went on a journey <u>during the last week</u>, list:

a. How much money was spent or given away on the journey?
b. What other gifts were made on the journey?
c. What gifts (goods, crops or money) were received on the journey?

10. Did the farmer have any problems with the farm during the last week? YES/NO

    If YES, obtain details.

11. Does anyone who usually lives on the farm expect to be involved in any ceremonies or festivals during the next 8 weeks? YES/NO

    If YES, list:

    a. What ceremonies or festivals?
    b. When will these be held?

12. Does anyone who usually lives on the farm expect to pay out any large sums of money over the next 8 weeks? YES/NO

    If YES, list:

    a. Why will money be paid out?
    b. How much money will be paid in each case?

13. Does anyone who usually lives on the farm expect to receive any large sum of money over the next 8 weeks? YES/NO

    If YES, list:

    a. Why will money be received?
    b. How much money will be received in each case?

14. What stocks of the following goods are stored on the farm today?
    super
    s.a.
    potash
    asulox 40
    actril D
    gramoxone
    other spray
    insecticide (what sort?)
    diesel fuel
    benzine
    engine oil
    kerosene
    rice
    flour
    sharps
    sugar

Part E - Questionnaire asked after the last round of intensive visits

Note: This questionnaire was designed to test the family's knowledge of cane farming, and to obtain an idea of subjective perceptions about the scheme.

1. a. How quickly does the family think that it will repay its debt?
   b. How quickly would it like to?

2. a. If they plant more cane, would they plant mali or ragnar? Why?
   b. How many times would they be able to ratoon both varieties?

3. When the farm is fully established, how many tons per acre do they think they will get, on average?*

4. Is the land on this farm better, the same as, or worse than other land in Seaqaqa?

5. a. How much per tonne was paid to transport cane from the farm to the shunt?
   b. How much did it cost to transport cane from the shunt to Tabia?

6. How much does it cost to transport cane from this farm directly to the mill at Labasa by flat-top lorry?

7. Do they think that the fertiliser applications recommended by the FSC will produce the best results?

Note: During the discussion of this question, ask questions 8 and 9.

8. What are the fertiliser inputs the FSC recommends to apply when planting cane?

9. What subsequent applications of fertiliser should be made, how much each time, and how long between applications?

10. How much are they charged for each bag of super, s.a., and potash they buy from the FSC?

11. How much are they charged for each gallon of Asulox 40, Actril D and Gramoxone?*

12. How much does it cost to hire a tractor to cotton-king between the rows of one acre of cane?*

13. How much land do they, or the mataqali own/lease elsewhere?

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* Although metric units were introduced for the 1977 harvest officially, families still deal in terms of imperial measures.

APPENDIX 2

PART A EQUILIBRIUM CONDITIONS WHEN SUBSISTENCE PRODUCE IS MARKETED

The family is assumed to seek to maximise

$$U = U(F,C,L_e)$$

Where $U_F' > o$, $U_F'' < o$,

$U_C' > o$, $U_C'' < o$,

$U_{L_e}' > o$, $U_{L_e}'' < 0$.

The farm outputs Q and S are produced according to the following production functions

$$Q = g(L_q)$$

and $S = f(L_s)$.

The family purchases F and C in the market at prices p_s and p_c by selling S and Q at prices p_s and p_q.

It therefore has to maximize utility, subject to a budget constraint

$$p_s F + p_c C = p_s\ f(L_s) + p_q\ g(L_q) \ ,$$

and a time constraint

$$\bar{L} = L_e + L_s + L_q \ .$$

The meanings of all the symbols were given in the text.

The <u>Lagrangian</u> is

$$L = U(F,C,L_e) - \lambda_1(\bar{L}-L_e-L_s-L_q) - \lambda_2(p_sF+p_cC-p_sf(L_s)-p_qg(L_q)).$$

First order conditions

$$\frac{\partial U}{\partial F} = U_F - p_s \lambda_2 = 0 \quad (1)$$

$$\frac{\partial U}{\partial C} = U_C - p_c \lambda_2 = 0 \quad (2)$$

$$\frac{\partial U}{\partial L_e} = U_{L_e} + h_1 = 0 \quad (3)$$

$$\frac{\partial U}{\partial L_s} = \lambda_1 + \lambda_2 \, p_s \, f'(L_s) = 0 \quad (4)$$

$$\frac{\partial U}{\partial L_q} = \lambda_1 + \lambda_2 \, p_q \, g'(L_q) = 0 \quad (5)$$

$\frac{\partial U}{\partial \lambda_1}$ and $\frac{\partial U}{\partial \lambda_2}$ are omitted because they are not relevant at this stage.

Equilibrium conditions:

(A) from 1 and 2, $\frac{U_F}{U_C} = \frac{p_s}{p_c}$.

(B) from 3, 4 and 5, $p_s f'(L_s) = p_q g'(L_q)$.

(C) from 1 and 4, $\frac{U_{Le}}{U_F} = f'(L_s)$.

(D) from 2 and 5, $\frac{U_{Le}}{U_C} = \frac{p_q g'(L_q)}{p_c}$.

PART B EQUILIBRIUM CONDITIONS WHEN THERE IS NO MARKET FOR THE OUTPUT OF THE SUBSISTENCE SECTOR

Maximise $U = U(F,C,L_e)$

Subject to $\bar{L} = L_e + L_s + L_q$.

Now $Q = g(L_q)$

and $S = f(L_s)$.

But when there is no market for S,

$$F = S = f(L_s)$$

and $$p_cC = p_qQ = p_qg(L_q) \; .$$

The Lagrangian therefore is

$$\begin{aligned} L = U(F,C,L_e) &- \lambda_1(\bar{L}-L_e-L_s-L_q) \\ &- \lambda_2(p_cC-p_qg(L_q)) \\ &- \lambda_3(F-f(L_s)) \end{aligned}$$

First order Conditions:

$$\frac{\partial U}{\partial F} = U_F' - \lambda_3 = 0 \qquad \text{i.e. } \lambda_3 = U_F' \qquad (1)$$

$$\frac{\partial U}{\partial C} = U_C' - \lambda_2 p_c = 0 \qquad \text{i.e. } \lambda_2 = U_C'/p_c \qquad (2)$$

$$\frac{\partial U}{\partial L_e} = U_{L_e}' + \lambda_1 = 0 \qquad \text{i.e. } \lambda_1 = -U_{L_e}' \qquad (3)$$

$$\frac{\partial U}{\partial L_s} = \lambda_1 + \lambda_3 f'(L_s) = 0 \qquad \text{i.e. } \lambda_3 = \frac{-\lambda_1}{f'(L_s)} ,$$

and from (3)

$$\lambda_3 = \frac{-\lambda_1}{f'(L_s)} = \frac{U_{L_e}'}{f'(L_s)} \qquad (4)$$

$$\frac{\partial U}{\partial L_q} = \lambda_1 + \lambda_2 p_q g'(L_q) = 0 \qquad \text{i.e. } \lambda_2 = \frac{-\lambda_1}{p_q g'(L_q)} ,$$

and from (3),

$$\lambda_2 = \frac{-\lambda_1}{p_q g'(L_q)} = \frac{U'_{L_e}}{p_q g'(L_q)} \tag{5}$$

Equilibrium Conditions:

(A) from 1 and 2, $\frac{U'_F}{U'_C} = \frac{p_q g'(L_q)}{p_c f'(L_s)}$

(B) from 1 and 4, $\frac{U'_{L_e}}{U'_F} = f'(L_s)$

(C) from 2 and 5, $\frac{U'_{L_e}}{U'_C} = \frac{p_q g'(L_q)}{p_c}$

APPENDIX 3

ASSUMPTIONS REQUIRED FOR THE CONSTRAINTS OF CHAPTER 8.3

1. Food production can be described by a single production function.
2. No labour market exists (see Chapter 2).
3. Rent is fixed for cane land and non-cane land, regardless of how much is actually used (see Chapter 2).

These assumptions can be relaxed without altering the essence of the model, but its complications would be increased.

APPENDIX 4

EQUILIBRIUM CONDITIONS - CHAPTER 8

A. Slope of the Transformation Curve

From equations 8.2 and 8.3

$$\frac{\partial C}{\partial L_s} = \frac{-\partial C}{\partial L_f} = -p_f \, G'_{L_f} \qquad (A.1)$$

From 8.4 $$\frac{\partial D}{\partial L_s} = -(1+i)(p_s-h) \, F'_{L_s} \qquad (A.2)$$

Therefore $$\frac{\partial D}{\partial C} = \frac{\overset{>o}{(1+i)}\,\overset{>o}{(p_s-h)}\,\overset{>o}{F'_{L_s}}}{\underset{>o}{p \, G'_{L_f}}} \qquad (A.3)$$

Thus, the slope of the transformation curve is positive, if the marginal productivity of labour in both cane and food production is positive. An incremental increase in labour input to cane at the expense of food therefore reduces debt by the numerator $(1+i)(p_s-h) \, F'_{Ls}$ and reduces consumption by the denominator $p_f \, G'_{L_f}$

B. Equilibrium from First Order Conditions

Alternatively, selected first order conditions assuming total labour input is fixed, and

$U''_L < o$, $U''_C < o$, $U''_L > o$, $U''_C > o$, $U'_D < o$, $U''_D > o$:

$$\frac{\partial U}{\partial L_s} = U'_L - U'_D \, (1+i)(P_s-h) \, F'_{L_s} = o \qquad (A.4)$$

$$\frac{\partial U}{\partial L_f} = U'_L + U'_C \, p_f \, G'_{L_f} = o \qquad (A.5)$$

From (A.4), $$U'_L = U'_D \, (1+i)(p_s-h) \, F'_{L_s} \qquad (A.4.a)$$

From (A.5), $U_L' = -U_C' \, p_f \, G_f'$ (A.5.a)

so, $U_D' \, (1+i)(p_s - h) \, F_{L_s}' = -U_C' \, p_f \, G_{L_f}'$ (A.6)

i.e. $\dfrac{-U_C'}{U_D'} = \dfrac{(1+i)(p_s - h) \, F_{L_s}'}{p_f \, G_{L_s}'}$ (A.7)

The slope of the indifference curve equals the slope of the transformation curve.

APPENDIX 5

DERIVATION OF THE TRANSFORMATION CURVE UNDER PARTLY DEFERRED PAYMENT

$U = U(C,D,L)$

where $C = p_f G(L_f, K_f, B_f) - p_K K_f - R_f + SA + E_o + \alpha(p_s F(L_s, K_s, B_s) - hF(L_s, K_s, B_s) - p_K K_s - R_s)$

α = the proportion of proceeds returned to the farmer.

$o < \alpha < 1$

$D = (1+i)[D_o - (1-\alpha)(p_s F(L_s, K_s, B_s) - hF(L_s, K_s, B_s) - p_K K_s - R_s + SA]$

$$\frac{\partial C}{\partial L_s} = -p_f G'_{L_f} + \alpha(p_s F'_{L_s} - hF'_{L_s}) = -p_f G'_{L_f} + \alpha(p_s - h)F'_{L_s}$$

$$\frac{\partial D}{\partial L_s} = -(1+i)(1-\alpha)(p_s F'_{L_s} - hF'_{L_s}) = -(1+i)(1-\alpha)(p_s - h)F'_{L_s}$$

$$\frac{\partial D}{\partial C} = \text{slope of the transformation curve} = \frac{-\overset{>o}{(1+i)}\,\overset{>o}{(1-\alpha)}\,\overset{>o}{(p_s-h)}\,\overset{>o}{F'_{L_s}}}{-\underset{>o}{(p_f G'_{L_f})} + \alpha\underset{>o}{(p_s-h)}\underset{>o}{F'_{L_s}}}$$

Assuming that the marginal product of labour in cane production is positive, the numerator is negative. The denominator can be positive or negative.

when $p_f G'_{L_f} > \alpha(p_s - h)F'_{L_s}$, then $\frac{\partial D}{\partial C} > o$.

when $p_f G'_{L_f} < \alpha(p_s - h)F'_{L_s}$, then $\frac{\partial D}{\partial C} < o$.

The slope of the transformation curve changes sign at the point where the marginal value product of labour in cane production equals the marginal value product of labour to food production.